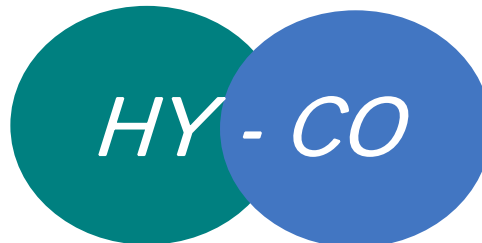**SIXTH FRAMEWORK PROGRAMME**
**PRIORITY "ERA-NET"**

**Co-ordination of Research Activities**

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## HY - CO

**Co-ordination Action to Establish a Hydrogen and Fuel Cell ERA-Net, Hydrogen Co-ordination**

*Work Package 3*

*Task 3.3, Deliverable D3.2*

A study on Identification of Legal and Other Barriers that Hinder Transnational RD&D Cooperation on the Program level in Hydrogen and Fuel-Cells

## List of Abbreviations

| | |
|---|---|
| **EC** | European Community |
| **ERA** | European Research Area |
| **ESTO** | The European Science and Technology Observatory |
| **EU** | European Union |
| **FP** | Framework Programme |
| **HFP** | The European Hydrogen and Fuel Cell Technology Platform |
| **H2** | Hydrogen |
| **IEA** | International Energy Agency |
| **OECD** | Organisation for Economic Cooperation and Development |
| **R&D** | Research and Development |
| **RD&D** | Research, Development and Demonstration |
| **SWOT** | Strengths, Weaknesses, Opportunities and Threats |
| **TAFTIE** | The Association for Technology Implementation in Europe |
| **TIC** | Techno-Institutional Complex |
| **WP** | Work Package |

# Executive summary

Lack of trans-national coordination and collaboration of R&D programs outside the EU-framework, has been identified as an important barrier to the competitiveness of the European innovation system. To meet such challenges the European Commission has financed the HY-CO Era-net. The goal of the HY-CO Era-net is to network and integrate the national R&D activities by establishing a durable European Research Area (ERA-NET) in the area of hydrogen and fuel cells.

As part of the HY-CO WP3 Common strategic issues, this report (Deliverable 3.2) of Task 3.3 continues the analyses done in Task 3.2 that identified complementarities and gaps between national H2 and Fuel Cell research programs and analyzed new opportunities in H2/FC-research, including a SWOT-analysis of the current state of affairs. This Task 3.3 examines in more detail legal and other barriers that hinder trans-national cooperation and looks for the respective good practices by looking at the common program preparations conducted in other ERA-NETs. In addition to the extensive theoretical and empirically based literature review semi-structure interviews were conducted in two iterative phases. In total, the coordinators of 10 different ERA-NETs were interviewed and respective website and online materials were examined for detailed analysis. In addition, ERA-NET materials were obtained from the HY-CO activities and the website; relevant materials were provided also by the Nordic Energy Research. The study was carried out by VTT Technical Research Centre of Finland during the year 2006. Also Risø National Laboratory participated in the project by conducting part of the interviews and providing inputs and comments to the report.

## European RD&D coordination challenges

The 'Europeanization' of national science, technology and innovation policies has been promoted through the 'open method of co-ordination' (OMC) which is an inter-governmental mechanism of voluntary cooperation of European innovation policies, of which ERA-NET activities are but one example. Despite diverse trans-national activities, ERA-NET activities are conducted in context in which around 80 % of the RD&D activities are funded nationally. The funding organizations participating in ERA-NET activities have a truly challenging task to develop European cooperation that responds also to national interests. Here, the development of ERA-NET activities is likely to benefit from experiences from the vertical coordination of multi-layered innovation systems and also from the horizontal coordination between innovation and other policy areas.

Furthermore, the interest in including also demonstration activities in the HY-CO scope create particular importance to the societal and market conditions in which hydrogen based energy systems are implemented. Both horizontal and vertical coordination of H2 RD&D cooperation is constrained by the conditions named techno-institutional complex that consists of the existing energy production, distribution and consumption infrastructures and institutions, which create barriers for the deployment and commercialization of alternative energy solutions. Institutional barriers in the form of routines, practices and organizational hierarchies create path dependencies that constrain the horizontal and vertical coordination of trans-national RD&D cooperation.

**Barriers and enablers in the institutional formation of trans-national programs within ERA-NET scheme**

In this report, institutional barriers and respective enablers to overcome the barriers are explored in the context of the formation of common trans-national RD&D program activities in the three specific areas:
- Legal and institutional restrictions to co-operation
- The format and timescales of calls
- Running the program.

These institutional aspects are explored with regard to the ten different ERA-NETs interviewed:
- ACENET Applied Catalysis European NETwork
- ERA-NET Bioenergy
- BONUS for the Baltic Sea science - network of funding agencies
- ERABUILD Strategic cooperation between national programs promoting sustainable construction and operation of buildings
- ERASME ERA-NET on National and Regional Programs to Promote Innovation Networking and Co-operation between SMEs and Research Organizations
- INNER Innovative Energy Research
- MATERA MATERA - ERA-NET Materials
- NORFACE New Opportunities for Research Funding Co-operation in Europe
- VISION A collaborative network of nationally leading innovation policy agencies
- WoodWisdom-Net Networking and integration of national programs in the area of wood material science and engineering.

Legal and institutional restrictions to co-operation are related to the different forms of funding, eligible costs and contributions, required contracts and IPR issues.

- Based on the interviews of ERA-NET coordinators, it seems that the ERA-NETS are initiating common RD&D activities at least in three different levels of intensity of common funding: i) exchange of information and simultaneous national calls, ii) virtual common pots and iii) common pots based funding. Within the HY-CO activities, the interest in promoting not only R&D but also demonstration of hydrogen based energy systems creates challenges related to the competitiveness issues such as IPR and possible difficulties in funding foreign industries. Therefore, it seems that exchange of information, simultaneous national calls and the exploration of the possibilities for the use of virtual common pot are the most feasible options.

- The preparations of the trans-national RD&D programs face diverse barriers how to agree upon the costs and contributions. It is likely that partners have different national policies in view of costs and contributions. Hence, it is recommendable that joint activities are designed in view of national differences and providing the possibility for each partner to define its role in accordance with its national policies.

- The preparations may face barriers how to agree on the needed contracts for the RD&D cooperation. Typically contracts exist at different levels. It is common that

the national ERA-NET partners sign a contract with the organization that they fund. Often they also require or recommend project consortia to sign a contract. In addition to these two levels, at the ERA-NET level, the partners sign the memorandum of understanding on the participation to the ERA-NETs. Some of the ERA-NETs preparing common calls sign also additional agreements on the call. In case of article 169 application it is necessary to establish a legal entity to manage the program. It is likely that partners have different national policies in view of contracts that need to be considered. However, there are no explicit obstacles to develop contract guidelines and explore the possibilities for synchronization of contract practices.

- IPR issues may create some barriers for trans-national RD&D cooperation especially when deployment and commercialization aspects are included in the scope of the ERA-NET, for example in the ACENET and the ERABUILD. Even though when the focus is on the basic research, the IPR issues need to be dealt with, for instance, in the INNER, the specific guidelines are developed. Different national IPR policies need to be taken into account. The easiest way to initiate common activities may be to leave the IPR issues to be agreed between the project partners. However, the ERA-NET level support may be required especially when demonstration projects enclose various stakeholders. Toward this end, in addition to taken into account national policies it is relevant to explore how IPR issues have been dealt with for instance within HFP and hydrogen light house projects.

The funding organizations have diverse routines and practices how to organize the format and timescales of calls including the form of the call, form of response to call, evaluation of proposals, informing applicants of decision, and different timescales.

- Organizational barriers concerning the organization of the calls can create some obstacles in the preparations of joint programs. The ERA-NETs seem to overcome barriers, related for instance to the form and focus of calls and the type of further guidance, with different kinds of learning processes. Depending on the chosen approach, the ERA-NETs utilize open or restricted calls for proposals or specified tenders to receive applications for the programs and improve the understanding of possible obstacles. Both the different phases of calls and the use of intermediaries provide further opportunities for learning and networking that may improve the quality of joints calls and the formation of common program activities. This also supports the compilation of explicit guidance of calls for applicants. However, such activities need to be balanced with the possible time constrains.

- The ERA-NETs seem to have different approaches for the participants to respond to the call, for instance responding directly to the ERA-NET office, to national funding organizations or in some cases to both of them. The barriers may emerge partly because of the different national practices among the funding organizations but also partly because of different levels of expertise among the participants to work with (online) application forms. Despite national differences, opportunities exist to avoid extra work by requiring applicants to compile many applications. Such opportunities need to be carefully studied before launching the calls. Especially, the use of electronic solicitation of applications is recommendable when suitable.

- The practices of how the proposals are evaluated vary among the ERA-NETs. Sometimes the evaluation starts within the ERA-NET level and after that the recommended projects are evaluated at the national level (e.g. the ERASME); other times the national level evaluation is followed by the ERA-NET level evaluation (e.g. the MATERA). The evaluation approaches vary depending on the ERA-NET, there seems to be tendency toward further coordination and the creation of ERA-NET level expert groups for the evaluation of proposals. This needs to be evaluated also within HY-CO activities. The evaluation work and the criteria for evaluation will be however difficult to agree upon, especially because of the interests also in demonstration activities that are complicated to evaluate with objective criteria, for instance, expected societal impacts related to different national interests.

- In forming the applicants of the decision has not created any major discussions among the interviewed ERA-NETs, the applicants are informed either directly by the ERA-NET office or the national funding organization. Among the interviewed ERA-NETs it seemed to be common that the applicants are informed also informally to provide the news in a good time. There seems to be no barriers to coordinate informing of applicants at the ERA-NET level. However, still the partners may find it attempting to inform their national researchers also informally.

- The preparations of ERA-NETs face considerable barriers with regard to timing. The ERA-NET partners seem to have three major difficulties related to timescales. First, they need to agree on the timing for joint calls in line with the national schedules. Second, the preparations of the proposals among the participants from many countries may require extra time. Third, the evaluation processes of the proposals are often dependent on the different national evaluation practices that may require considerable time. Timing of different national activities is likely to be complicated. Therefore, feasible approach may be organizing several phases of calls that create required flexibility. In the timing of responses and evaluations it is recommendable to include some lag time in different actions.

Furthermore, funding organizations need to balance also the differences in the practice of running the programs, such as monitoring of projects, dissemination of project results and project and program evaluation.

- There is little experience how to monitor the ERA-NET project activities, because most of the ERA-NETs have not yet the projects running. It seems that ERA-NETs are still largely discussing on the issue and the agreements on how the monitoring will be organized will be discussed after dealing with the calls. However, there appears to be a common view that the national funding organizations monitor the projects that they are funding. Furthermore, there are different forms how the ERA-NETs tend to organize the monitoring at the ERA-NET level. Among ERA-NETs, there exists little experience on the monitoring of projects at the moment. However, some plans exist already, as discussed above, that may provide further guidance for planning also HY-CO monitoring activities.

- In view of the dissemination of project results, some barriers may emerge because of the possible IPR issues. However, most of the ERA-NETs have not discussed these issues. The expectations are mainly positive trusting on the usual national level dissemination and additional ERA-net level dissemination activities. For

example, in the ERABUILD, there seems to be no major problems related to publication and dissemination of results, because the participants are primarily public research institutions in the fields of construction. IPR issues are not expected to create major barriers for the dissemination. However, because of the HY-CO focus also on demonstration activities, this needs to be discussed thoroughly to avoid conflicts later on during the project implementation and reporting.

Within the ERA-NETs, there exist different kinds of general expectations on the purpose, results and collaboration that make the initial collaboration challenging and it may take considerable time to create a common working agenda, for instance:

- In the management and preparations of common ERA-NET activities, the partners need to deal with the possible language differences. Especially among the new member states the level of English creates further barriers in the communication. However, the language skill is considered rather as a prerequisite for the participation rather than a barrier.

- Funding organizations have also different kinds of institutional cultures, routines and expectations how the processes are implemented. Such differences create difficulties among the ERA-NET coordination if particular attention is not given to the communication of the expectations of all the partners.

- To initiate trans-national RD&D programs, it is not necessary to harmonize a lot of regulations, even though some of the ERA-NETs have worked intensively with the adjustment of regulations, especially the SAFEFOOD-ERANET. Much of the national differences can be overcome with the novel interpretations of the existing regulations and with the changes in national procedures and practices.

- In several ERA-NETs it is recognized that different procedures and practices create contradictions leading to excessive extra work and time.

- The ERANET scheme is considered as a European politically sensitive instrument of which continuity may not be as certain as of national activities. For a successful ERA-NET it is considered relevant that the European Commission ensures financial support for the secretariat functions and also secures an acceptable standard of quality within the ERA-NETs.

**Discussion and conclusions**

Within the ERA-NETs, the general objectives for the formation of common RD&D activities can be defined as i) *vision-building* for clarifying shared interests and joint benefits of international collaboration, ii) *networking* for mobilizing the RD&D communities in different countries and iii) *priority setting* for formulating promising research themes and corresponding resource allocations. However, despite its strategic vision in initiating coordination tools such as ERA-NETs, the Commission has taken few proactive efforts to assist and provide process support for their management.

In the WoodWisdom-Net, such objectives were attained through the extensive bottom-up consultation process, presumably applicable also within other ERA-NETs. Tentative

interests in prospective collaboration were probed by inviting stakeholders from different countries to explore what research themes should be pursued through international joint RD&D activities, in view of expected S&T developments, industrial needs and societal demands. The resulting information helped funding organizations in the formulation of their own research agendas, clarified linkages between national and European agendas, and prepared the broader RD&D community for later calls for proposals and other actions. At best, such a process can overcome some of the institutional barriers in the preparation of trans-national programs; it can also contribute to the development of complementary value networks based on different technological competencies.

Within the HY-CO activities, the interest in promoting not only R&D but also demonstration of hydrogen based energy systems creates challenges related to the competitiveness issues such as IPR and possible difficulties in funding foreign industries. Furthermore, especially demonstration activities are complicated to evaluate with objective criteria, for instance, expected societal impacts related to different national interests. Therefore, the suitable approach may be a virtual common pot that keeps much of the control at the national level. The programs based on the virtual common pot need be designed in accordance with national and European interests keeping in mind the regulatory, institutional and organizational barriers identified in Chapter 3. While this HY-CO report D3.2 has identified existing institutional barriers to the formation of common programs within other ERA-NETs, there was only a few information how to run, monitor and evaluate such programs. Therefore, it is recommendable to communicate actively with other ERA-NETs for further learning and exchange of ideas on the management of common RD&D programs in the future. Furthermore, it is relevant to consider the particular conditions of trans-national H2 RD&D activities that are conditioned not only by the horizontal and vertical coordination challenges but also by the rigid techno-institutional conditions that create particular constrains to the market entry of H2 based energy systems. Therefore, linkages to HFP and integrated projects dealing with the demonstration issues need to be explored with scrutiny.

# 1 Introduction

Research into the area of hydrogen and fuel cell technology has, in recent years, become an increasingly important priority on the European research and development (R&D) agenda. Like in other fields of science and technology Europe also face competition from the USA and Japan and to a lesser extent Canada within the field of hydrogen and fuel cell technology (ESTO, 2005a). These countries are making significant progress in all areas of hydrogen and fuel cell technology. The European Commission been noticed, that although Europe has the skills and the potential to become a key player in the development of fuel cell and hydrogen technology, RD&D programs are fragmented within and across the different countries (European Commission, 2003). Lack of trans-national coordination and collaboration of R&D programs outside the EU-framework, has been identified as an important barrier to the competitiveness of the European innovation system. To meet such challenges the European Commission has financed the project HY-CO. The goal of the project "HY-CO" is to network and integrate the national R&D activities by establishing a durable European Research Area (ERA-NET) in the area of hydrogen and fuel cells. Among the projects main objectives is to promote and develop a strong and coherent RTD policy on hydrogen and fuel cells in Europe, and stimulate the "*co-operation and co-ordination of national and regional research and innovation activities*". The vision behind it is to create an internal market in research and development. HY-CO started in October 2004 and is running for four years. The project is financed by the European Commission and has 21 participants from 16 countries. The HY-CO project consists of five work packages (WP). See figure 1.
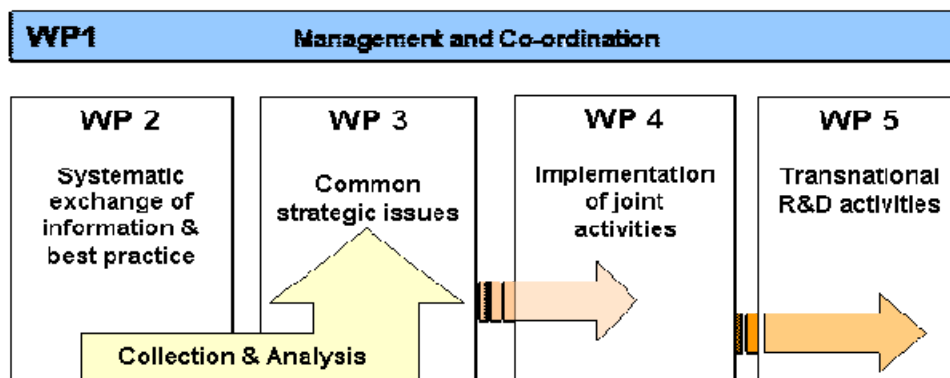


**Figure 1:**     Overview of the HY-CO project.

As part of the WP3 Common strategic issues, this report (Deliverable 3.2) of Task 3.3 continues the analyses done in Task 3.2 that identified complementarities and gaps between national H2 and Fuel Cell research programs and analyzed new opportunities in H2/FC-research, including a SWOT-analysis of the current state of affairs.

This Task 3.3 examines in more detail legal and other barriers that hinder trans-national cooperation and looks for the respective good practices by looking at the common program preparations conducted in other ERA-NETs. The SWOT report identified the different phases in setting up trans-national cooperation in H2 RD&D (see Figure 2).

**Figure 2:** Phases in facilitating trans-national cooperation and the focus of Task 3.3.

First two phases, the identification of potential areas of RD&D activities and the matching of trans-national project partners, have been examined in the SWOT report and elsewhere in the HY-CO project. The institutional evolution of national institutions with their particular practices and political conditions may create path dependence that inhibits the full exploitation of the opportunities related to trans-national cooperation. This study ide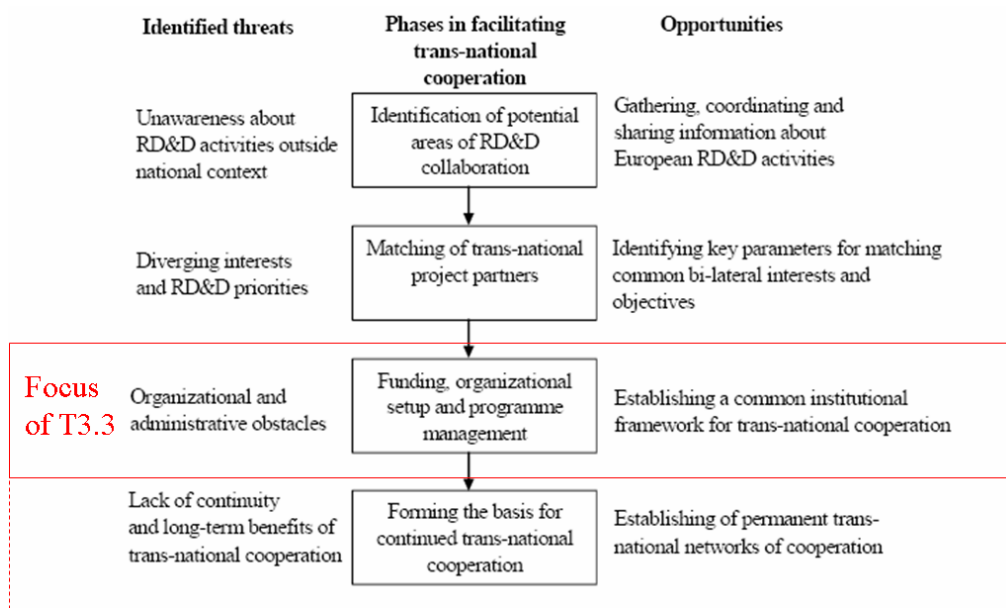ntifies the obstacles and some recent approaches to overcome them to develop a common institutional framework for the management of trans-national H2 RD&D research programs within the ERA-NET scheme. Hence, this report focuses particularly on the institutional and regulatory barriers in funding, organizational setup and program management as well as in forming the basis for continued trans-national cooperation. In addition to the examination of diverse barriers also relevant enablers to overcome the barriers and respective recommendations for the HY-CO activities are identified.

In addition to the extensive theoretical and empirically based literature review (see references) semi-structured interviews were conducted in two iterative phases.

- **The first phase** of the interviews were designed based mainly on the SWOT report, the materials of the HY-CO Oslo meeting in February 2006 and the correspondence with the Nordic Energy Research. During the spring and summer 2006, VTT interviewed Finnish coordinators of six ERA-NETs and one IPR specialists. Based on the experiences of the conducted interviews and the materials and feedback collected based on the presentation in the HY-CO Workshop on Implementation and 4th Network Committee Meeting (Prague, June 19-20, 2006), the detailed interview protocol was designed (see, Attachment I).

- **In the second phase** during the fall 2006, the interview protocol was applied in six ERA-NET interviews conducted by Risø National Laboratory.

In total, the coordinators of 10 different ERA-NETs were interviewed (see, Attachment II) and respective website and online materials were examined for detailed analysis (see, the list of interviewees in Attachment II). In addition, ERA-NET materials were obtained from the other HY-CO activities and the website; relevant materials were provided also by the

Nordic Energy Research. The study was carried out by VTT Technical Research Centre of Finland during the year 2006. Also Risø National Laboratory participated in the project by conducting the interviews and providing inputs and comments to the report.

Chapter 2 describes theoretical bases for the analyses of the challenges in the European H2 RD&D coordination. Chapter 3 describes the results of the empirical part of the study. Chapter 4 discusses further the different dimensions of the formation of European H2 RD&D cooperation. Chapter 5 is for the conclusion.

# 2 European RD&D coordination challenges

The SWOT report concluded that within the hydrogen and fuel cell area trans-national cooperation takes place through a number of different organizations and schemes. All countries tend to use EU programs for trans-national cooperation. The majority of the countries use other schemes simultaneously, for example bi- and multilateral agreements. Most countries are to some extent involved in a number of specific $H_2/FC$ programs that entail trans-national cooperation, primarily in the context of EU programs (under the FP5 & FP6 programs) (see e.g., European Commission, 2004; ESTO, 2005b). Furthermore, countries are involved in trans-national cooperation through programs offered by International Energy Agency (ex. IEA Hydrogen Program or IEA Advanced Fuel Cells) or through regional cooperation schemes (ex. in the Nordic region). Indeed, trans-national RD&D cooperation offers relevant opportunities to harmonize energy and innovation policies and exploit synergies (Haug, 2004) that may facilitate the emergence of increasing returns mechanisms (Arthur, 1994) within the hydrogen based energy systems. Despite diverse trans-national activities, ERA-NET activities are conducted in context in which around 80 % of the RD&D activities are funded nationally. Furthermore, there are diverse barriers for trans-national cooperation – according to the SWOT report (D3.2), especially, funding bureaucracy and coordination problems, differences between RD&D programs and standard procedures, human resources, and intellectual property rights / legal problems. Optimat report (2005) identifies further barriers for trans-national RD&D cooperation.

Policy level barriers:
- Policy to achieve national priorities through internal capacity building
- The legal constitution forbids payments to non-residents
- Another organization deals with international activities
- No significant policy changes to encourage trans-national activities
- Inequality of investment makes it impractical to design joint programs

Program level barriers:
- Sufficient volume of high quality applications from internal capacity
- No explicit criteria that encourage trans-national activities
- Source of funding does not allow use of funds for trans-national activities
- Program owner has limited experience of pan-European collaboration
- Different national rules and cycles make it impractical to collaborate
- The program is designed to address country-specific issues
- Financial administration systems are not designed to cope with non-national contracts
- Insufficient knowledge of similar national programs

Project level barriers:
- National researchers not keen to see more budget used for trans-national activities
- No demand from national applicants for inclusion of foreign partners
- Administration costs of trans-national projects outweigh the benefits

To overcome diverse barriers, the Commission has initiated the **ERA-NET Scheme** (European Research Area), which is about the coordination and cooperation of national and regional programs and as such, it aims at the national and regional (in the EU Member States and the Associated States) program makers and managers. These are, in most

countries, either working in the Ministries or working in national funding agencies, which implement programs on behalf of their governments. The ERA-NET Scheme is implemented via open call for proposals. The Commission pays all additional costs related to the coordination up to 100%. One of the benefits of the ERA-NETs is that the cooperation, coordination and a free movement of knowledge and scientists enable the different national systems to take on RD&D tasks collectively that they would not have been able to tackle independently. HY-CO is one of these different ERA-NET programs.

The ERA-NET scheme[1] seeks to strengthen the coordination and cooperation among national and regional research programs organized by ministries and national funding agencies in the member states. To-date, a considerable number of ERA-NETs have been launched, each with a focus on a specific field of science and/or technology, for the purpose of supporting mutual learning, opening-up of national innovation systems and the development of new collaborative forms of European RTD funding. Levels of ambition of trans-national coordination can be categorized for instance as follows:
- information exchange and best practices
- common strategies issues
- joint activities
- joint/common calls
- common programs

The ERA-NETs have prepared different types of calls, such as regular calls for yearly award and major calls for trans-national research projects, both for fundamental and industrial research in various areas. Also smaller pilot calls have been launched for testing joint call mechanisms. The Commission's particular interest in ERA-NET seems to be to look for projects/programs coming up with innovative ideas (e.g. joint calls) for achieving the ERA. In the future, the Commission expects broadening (new member states) and deepening (focus) the scope of ERA-NETs. For the continuation and reinforcement of ERA-NET scheme in FP7, The ERA-NETs may apply for ERA-NET Plus or for the application of Article 169.

**Article 169** refers to the Article in the Treaty that enables the Community to participate in research programs undertaken jointly by several Member States including participation in the structures created for the execution of national programs. Even though Article has not been used before FP6 a few important lessons have already been learned. Among the lessons is that projects must have a clear political pertinence, good visibility and involve preferably a large number of Member States. Furthermore, the European added value must be clearly demonstrated. Finally, the experiences show that the time-consuming nature of the required co-decision procedure should not be underestimated.

**The funding organizations participating in ERA-NET activities** have a truly challenging task to develop European cooperation that responds also to national interests. Participating funding organizations have evolved through path-dependent processes that reflect the characteristics of their respective national innovation systems, thus they may be intent on advancing their national interests (ERA-NET TRANSPORT, 2005). The funding organizations have different priorities for research themes and resource allocation; they also operate subject to different regulatory and institutional constraints that limit what kinds of organizations and activities they can fund (e.g., availability of funding to foreign

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[1] http://cordis.europa.eu/coordination/era-net.htm

researchers). Furthermore, they have different management practices as concerns the launching, monitoring and evaluation of RTD projects, which means that ERA-NETs must operate in the presence of a multitude of governance cultures. These and yet other complexities are further amplified by the many options that can be pursued in the implementation of shared research agendas, ranging from the relatively weak coordination of national programs to the institutionalization of a new legal entity for allocating a common pot of resources through competitive calls for proposals. (Brummer et al., forthcoming.)

**The 'Europeanization'** of national science, technology and innovation policies has been promoted through the 'open method of co-ordination' (OMC) which is an inter-governmental mechanism of voluntary cooperation of European innovation policies. First applied in European employment and social policies (Arrowsmith et al., 2004; Kaiser & Prange, 2004; Schäfer, 2006), the OMC approach does not rest on regulatory enforcement but, rather, on guidelines, benchmarking and sharing of best practices. In the context of innovation policy, it has been implemented by introducing new networks, stakeholder forums and policy processes or, more generally, *coordination tools* which encourage stakeholders to co-ordinate and self-organize the formation of common research and technology development (RTD) agendas. Such coordination tools have been promoted, for example, within 'Integrated Projects', 'Networks of Excellence', 'ERA-NETs', 'European Technology Platforms' and 'Technology Initiatives', whereby the European Commission has provided general recommendations only, remaining cautious so as not to overtake stakeholder-lead processes. Thus, while the coordination tools have enjoyed considerable freedom, they have received little methodological guidance on how consultative processes to support their management activities should be designed and implemented. The apparent lack of methodological support for this kind of international coordination is striking. Expectations concerning formation of new research and technology development (RTD) networks and programs are not necessarily easy to fulfill due to the complexities that are driven by vertical and horizontal coordination challenges of national innovation systems (Könnölä, et al, in press). European coordination tools must account for major variations among national and regional innovation systems which, in turn, are influenced by various legislative and budgetary powers and shaped by national coordination mechanisms within different institutional structures (Lundvall, 1992; Edquist, 1997). In the hydrogen and other energy related activities, these conditions are particularly shaped by the different national conditions of the co-evolution of technological infrastructures and social institutions (Könnölä et al., 2007). Hence, the further development of European coordination tools is likely to benefit from experiences from the vertical coordination of multi-layered innovation systems and also from the horizontal coordination between innovation and other policy areas. (Brummer et al., forthcoming.)

## 2.1 Vertical coordination of multi-layered innovation systems[2]

Experiences from the vertical coordination between local, regional and (inter-)national levels provide insights into the challenges of managing multi-layered innovation systems. Such challenges have been attributed to the systemic nature of innovation (Smits & Kuhlmann, 2004), performance of innovation systems (Lundvall, 1992; Edquist, 1997), and even processes of regionalization (Kaiser and Prange, 2004) which have resulted in complex multi-layered policies especially in Europe. In effect, this complexity

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[2] Section 2.1 is based on the paper of Brummer et al., fortcoming.

differentiates innovation policy from other policy areas – such as social or employment policies – where the OMC has applied earlier on.

Historically, innovation policies have emerged through development paths that reflect the societal contexts of their path-dependent techno-institutional co-evolution. They have also evolved over a long period of time and are thus extraordinarily stable. At present, innovation policies are challenged by the global market conditions where Member States, regions or even industrial or local clusters compete for critical resources, such as knowledge, human resources, and foreign RTD investments (Kaiser & Prange, 2004).

## 2.2 Horizontal coordination between innovation and other policy areas[3]

Successful innovation processes can be facilitated by horizontal coordination between innovation and other policy areas (such as competition, regional, financial, employment and education policies). In effect, the adoption of innovation as a cross-cutting policy objective – which is prominent even in sectorally oriented policies – holds promise for the closer integration of innovation and other policies: for example, eco-innovations can contribute towards the realization of the Lisbon Strategy which recognizes economic, social and environmental aspects as key drivers of growth (European Commission, 2003, 2004b).

This notwithstanding, coordination-oriented innovation policy differs from other policy areas, because it has to account for context- and sector-specific differences that are caused by the dynamics of evolutionary processes with different phases of competing technological alternatives and emerging dominant designs (e.g. Smits and Kuhlmann, 2004). In such settings, horizontal coordination efforts must seek opportunities for collaborative policy formation while recognizing the relevance of multiple perspectives in relation to the goals of different policies. Methodologically, these efforts call for carefully organized multi-stakeholder processes, lest they be taken over by short-term policy agendas that foster position-based bargaining and claiming of value.

## 2.3 Techno-institutional path dependencies and the creation of European hydrogen-based energy systems

Furthermore, the interest in including also demonstration activities in the HY-CO scope create particular importance to the societal and market conditions in which hydrogen based energy systems are implemented. Thus, it is relevant to consider the particularly challenging techno-institutional context in which the alternative energy systems are developed and deployed. Both horizontal and vertical coordination of H2 RD&D cooperation is influenced by the existing energy production, distribution and consumption infrastructures and institutions that create barriers for the deployment and commercialization of alternative energy solutions. Indeed, several authors have argued that techno-institutional changes[4] are difficult to achieve, because the prevailing system acts as

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[3] Section 2.2 is based on the paper of Brummer et al., fortcoming.

[4] Also terms 'socio-technological transformation' (Geels, 2002), 'system innovation' (Edqvist, 1997) and 'transition' (Rotmans et al., 2001) have been used to describe similar kind of fundamental transformation processes of the co-evolution of technological and institutional systems.

a barrier to the creation of a new system (e.g. Kemp and Soete 1992; Jacobsson and Johnson 2000; Unruh, 2000; Kline, 2001; Geels 2002; Carlsson and Jacobsson, 2004; Frenken et al., 2004; Foxon, T. J., R. Gross, et al., to appear). The need for a system-level change is apparent in case of hydrogen technologies; for components like fuel cells to be useful they will have to be integrated into a new larger energy system that includes hydrogen production, transportation, storage, transformation, generation and end uses (Clark and Rifkin, 2006; IEA, 2006; Könnölä et al., 2007).

The introduction of hydrogen technologies faces significant barriers, not the least of which is the existence of a well developed and ubiquitous energy system that already produce services comparable to those offered by proposed hydrogen infrastructures. These pre-existing energy systems, including electricity generation and distribution as well as liquid fuel systems for transportation, have been termed Techno-Institutional Complexes[5] (Unruh, 2000, 2002, see also Figure 3). Such systems include the large physical technologies themselves and the social organizations and institutions that build and manage them. TIC emerge through a path-dependent process driven by increasing returns to scale, which powers their growth and ultimately fosters numerous sources of quasi-irreversibility or lock-in. Indeed, it has been argued that these TIC systems are largely responsible for the lockout of promising energy technologies such as hydrogen technologies. (del Río and Unruh, 2006.)
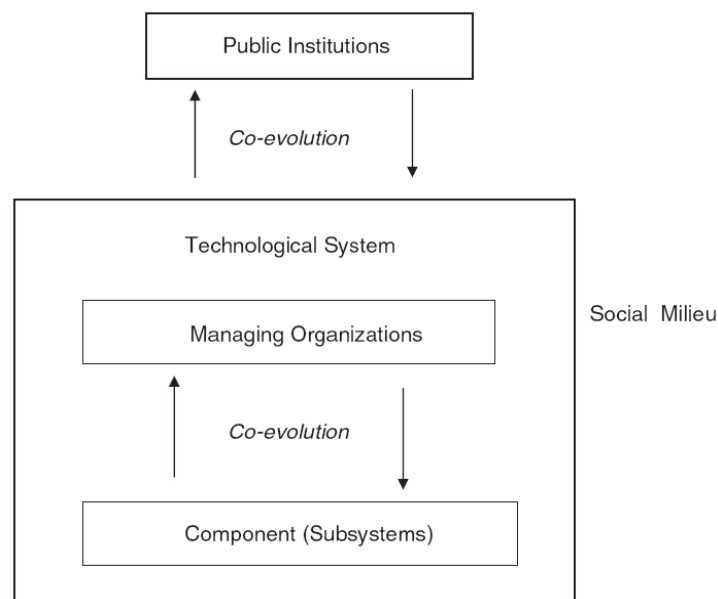


**Figure 3**:      Elements of techno-Institutional complex (del Río & Unruh, 2006)

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[5] "The Techno-Institutional Complexes (TIC) emerge through a path-dependent co-evolutionary process that begins when innovation creates several technological variants that compete in an environment of technological increasing returns to scale. Ultimately one variant emerges from the competition as a dominant design, locking-in key technological architectures. Surviving dominant design-producing firms organizationally lock-in around standardized decision routines, core competencies, distribution networks and customer–supplier relationships, which conditions their investments in non-dominant design technologies. As the system scale expands, complementary industry and interindustry networks, including financial institutions, emerge and lock-in coordination standards, relationships and capital investment patterns. If the system becomes socially pervasive, advocacy groups, voluntary associations and the media socialize the system, adapting preferences and expectations to continued system dominance. Finally, government may intervene in system growth for policy reasons (national security, universal service, anti-trust/natural monopoly, etc.) and encourage system expansion through subsidies, incentives or outright ownership. The intervention by government, which overrides market forces, signals the emergence of a techno-institutional complex." (del Río & Unruh, 2006.)

When the techno-institutional complex has become socially and economically pervasive and if there are other justifications such as national security, government may intervene and encourage system expansion through a variety of mechanisms including subsidies, incentives or out right ownership. The impact of government intervention is to override market forces as government policies lead system extension. Frequently legal regimes and government ministries are established around the system to facilitate the expansion and governance of the TIC. The ongoing role of these institutions is to create needed stability and predictability in system operation. They also dramatically intensify the barriers to change because of the created interests dependent upon system continuation.

A shift from the current fossil fuel-based energy system to one based on hydrogen will likely follow a similar evolutionary or transitional patterns, but at a more rapid rate (Clark et al., 2004). The shift to a hydrogen economy would represent a discontinuity with the current fossil fuel-based TIC. This is important because discontinuity changes tend to create greater resistance than continuity-type changes (Unruh, 2000). A discontinuous change creates winners and losers, especially among the created interests, and engenders numerous barriers and significant inertia.

Historically, policy-makers have rarely attempted to make discontinuous changes to existing technological infrastructures. More traditional policy has been of the continuity type, focusing on corrective optimization of existing systems (Kline, 2001). These corrective policies that seek to minimize pollution from existing technologies can even reinforce lock-in conditions by escalating the commitment to existing systems. Transitions to new systems, on the other hand, are rare and require different actions on the part of policy makers. Such perspectives have created pressures to some paradigm shifts among European funding organizations and RD&D program owners, namely i) from the funding and control and to the facilitation and enabling of the innovation processes and ii) from the centralized national top-down policy making to the European multi-level governance. Overcoming the national level techno-institutional barriers will require coordinated actions by both the public and private sectors and will most likely require the creation of a new techno-institutional complex based on hydrogen as the economy's energy carrier. Facilitating such a transition will be highly complex and full of uncertainties and with few policy tools that exist for decision makers wishing to initiate such a complex transition process.

## 2.4 Institutional barriers for trans-national RD&D coordination

As discussed above, trans-national H2 RD&D cooperation is constrained not only by the barriers related to the advances of physical technologies but also by those of social technologies. Technological systems are best understood as being composed of both *physical technologies* -in the form of components and infrastructure, and *social technologies* – in the form of organizational hierarchies and managing institutions. Nelson and Sampat (2001) associate the term "institutions" with "social technologies" that have come to be regarded by the relevant social group as standard in the context. They regard it in terms of how knowledgeable people act and interact where the effective coordination of interaction is key to accomplishment. Not all social technologies are institutions, but rather only those that have become a standard and expected thing to do, given the objectives and the setting. Institutions are "the rules of the game" when these are regarded as defining relatively closely, but with discretionary room, what people do when they play the game. It is not biased towards seeing these factors as "the rules of the game" (interpreted as broad

constraints) or "governing structures" (embodied in particular organizational forms) or "cultural beliefs and norms". In addition to being embodied in and molded by particular organizational and governance structures, standardized social technologies are formed, and held in place, in the context of the broad system of norms, beliefs, and rules of the game, that prevail in a society. Routines, practices and organizational hierarchies characterize social technologies. A routine involves a collection of procedures which, taken together, result in a predictable and specifiable outcome. Complex routines, of the sort associated with the production of goods and services, almost always can be analytically broken down into a collection of subroutines. (Nelson and Sampat, 2001.)

Institutional barriers have been discussed in the organizational level for example by Van de Ven (1986) and Tushman and O'Reilly (1997). Van de Ven (1986) discusses three universal limitations that lead to organizational inertia, including focus on short-term demonstrable progress, inadequate problem definitions and the tendency of human behavior to protect existing practices. Tushman and O'Reilly (1997) extend these ideas by distinguishing between structural and cultural inertia: the former rooted in the size, complexity and interdependence in the organization's physical structures, systems, and processes while the latter is embedded in the organizations social structure including shared expectations, norms, values and social networks. As organizations grow, structural and cultural inertia intensify, hindering proposed changes and innovations, especially if they demand radical or discontinuous modifications to currently successful activities. These evolutionary perspectives can be further supplemented by noting that an individual's behavior is guided by "bounded" or "procedural" rationality and satisficing behavior (i.e., rules of behavior are changed only when these no longer lead to satisfactory outcomes. (Könnölä, Brummer et al., in press.)

Institutional barriers create path dependencies that constrain the horizontal and vertical coordination of trans-national RD&D cooperation. The trans-national RD&D cooperation creates diverse RD&D opportunities as defined in the SWOT report. Furthermore, the trans-national cooperation opens up opportunities for overcoming national-level constrains both in view of physical and social technologies. Hence, the trans-national RD&D cooperation also challenges the program owners to re-evaluate their role within the national systems.

# 3 Barriers and enablers in the institutional formation of trans-national programs within ERA-NET scheme

In this report, institutional barriers and respective enablers to overcome the barriers are explored in the context of the formation of common trans-national RD&D program activities in the three specific areas:

- Legal and institutional restrictions to co-operation
- The format and timescales of calls
- Running the program.

Legal and institutional restrictions to co-operation are related to the different forms of funding, eligible costs and contributions, required contracts and IPR issues. The funding organizations have diverse routines and practices how to organize the format and timescales of calls including the form of the call, form of response to call, evaluation of proposals, informing applicants of decision, and different timescales. Furthermore, funding organizations need to balance also the differences in the practice of running the programs, such as monitoring of projects, dissemination of project results and project and program evaluation. These institutional conditions are explored in the subsequent sections with regard to the ten different ERA-NETs that are listed in the Table 1. For the summary table of the ERA-NET responses, see Attachment III).

| Accronym | full name or description | Participating countries | RD&D Scope | Website |
|---|---|---|---|---|
| **ACENET** | Applied Catalysis European NETwork | France, Germany, Greece, Italy, Poland, Portugal, Spain, The Netherlands, United Kingdom | R&D | http://www.acenet.net/ |
| **BIOENERGY** | ERA-NET Bioenergy | The Netherlands, Germany, United Kingdom, Sweden, Austria and Finland. | R&D | http://www.eranetbioenergy.net/ |
| **BONUS** | BONUS for the Baltic Sea science - network of funding agencies | Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden | R | http://www.bonusportal.org |
| **ERABUILD** | Strategic cooperation between national programs promoting sustainable construction and operation of buildings | Finland, Austria, Denmark, France, Germany, Netherlands, Sweden, United Kingdom | RD&D | http://www.erabuild.net/ |
| **ERASME** | ERA-NET on National and Regional Programs to Promote Innovation Networking and Co-operation between SMEs and Research Organizations | Austria, Belgium, Czech Republic, Denmark, Estonia Finland, France, Germany, Greece Hungary, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Slovenia | R&D | http://www.era-sme.net/public/ |
| **INNER** | Innovative Energy Research | France, Germany, The Netherlands, Nordic Countries, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, UK | R&D | http://www.inner-era.net/ |
| **MATERA** | MATERA - ERA-NET Materials | Belgium, Finland, Germany, Iceland, Ireland, Italy, Latvia, Luxemburg, Norway, Poland, Slovenia, Switzerland, UK, | RD&D | http://www.matera.fi |

| | | Israel | | |
|---|---|---|---|---|
| **NORFACE** | New Opportunities for Research Funding Co-operation in Europe | Estonia, Denmark, Finland, Germany, Iceland, Ireland, Netherlands, Norway, Portugal, Slovenia, Sweden and the United (Associate partner: Canada) | R | http://www.norface.org |
| **VISION** | A collaborative network of nationally leading innovation policy agencies | Austria, Denmark, Estonia, Finland, Belgium, Ireland, Latvia, The Netherlands, Norway, Sweden (Observer: IPTS) | R | http://www.visioneranet.org/ |
| **WoodWisdom-Net** | Networking and integration of national programs in the area of wood material science and engineering | Denmark, Finland, France, Germany, Norway, Sweden, United Kingdom, | R&D | http://www.woodwisdom.net/ http://www.woodwisdom.tkk.fi/ |

**Table 1:**      The set of ERA-NETs selected for the semi-structured interviews.


## *3.1 Legal and institutional restriction to co-operation*

Legal and institutional restrictions to co-operation are related to the different forms of funding, eligible costs and contributions, required contracts and IPR issues.

### 3.1.1 Funding

In view of funding trans-national RD&D programs, there are different kinds of barriers. The SWOT analyses identified general difficulties related to funding in Europe:

- A number of the SWOT project interviewees mentioned problems with <u>aligning financial resources and budget disputes over co-funding as frequent problems when engaging in trans-national cooperation</u>.

- In the national level, it is not only lack of funding that causes problems; <u>a lack of budgetary flexibility</u> can also be a serious hindrance in trans-national RD&D programs. It is often difficult to change or alter the program plan while the program is still taking place. This can be a major problem, since research programs and priorities can change during time.

- On the other hand, the importance of <u>ensuring the continuity</u> of a RD&D program should not be underestimated. According to the SWOT interviewees, long-term financial stability and a genuine commitment are important parts of a RD&D program, because it takes time to establish trust and commitment.

- In addition, <u>different public financing mechanisms</u> (vertical vs. horizontal grants, loans, tax reductions etc.) and different <u>obligations with respect to auditing</u> are also important problems that impede trans-national cooperation.

The SWOT report discusses also a number of financial models used in collaboration schemes between national programs existing today. In Table 2, different models are described. While the centralized common pot financing model is mainly suitable for collaboration activities in basic research and continuous schemes, it is less suited for time-limited RD&D projects, which includes the majority of trans-national cooperation projects. Instead, *decentralized common pot financing methods* appears to be best suited for industry-related strategic research, technological development and innovation collaboration schemes. It is particularly well-suited for financing of time-limited collaborative RD&D actions, which is often the category most trans-national cooperation agreements fall under. However, the widely used funding model in national RD&D programs, the preferential access financing model, is actually not well-suited for collaborations between national programs.

| Models for financing trans-national cooperation in RD&D | Examples |
|---|---|
| **a) Centralized Common Pot**<br><br>Requires a central organization with a legal basis. Funds gathered by means of taxes, fees, etc. according to, for example, participants GNP or RTDI investment. | |
| **aa) Centralized Common Pot - without guaranteed fair return ("juste retour")** | • European RTD Framework Programs<br>• Research programs of European Science Foundation (ESF)<br>• RTDI programs of Nordic Innovation Centre |
| **ab) Centralized Common Pot - with adjustment of return** | • Space science programs ESA |
| **b) Decentralized Common Pot - with mutual follow-up of separate national financings** | • RTDI funding procedures of the French-Norwegian Foundation<br>• The German–French program Deufrako on land transport.<br>• The EDCTP program according to Art.169 of European Treaty |
| **c) Simultaneous National Funding**<br>National authorities handle applications and make decisions according to commonly decided plans and schedules. | • The Finnish – Swedish – Norwegian collaborative ICT program NORDITE<br>• The Swedish-Israeli joint program on telecom applications SIBED |
| **d) Preferential Access Financing**<br>Not well suited for collaboration between national programs. | • Used widely in national programs |

**Table 2:**     Models for financing trans-national cooperation in RD&D. Source TAFTIE (2005).

Based on the interviews of ERA-NET coordinators, it seems that the ERA-NETS are initiating common RD&D activities at least in three different levels of intensity of common funding: i) exchange of information and simultaneous national calls, ii) virtual common pots and iii) common pots based funding.

**Exchange of information and simultaneous national calls**

At the moment, some of the ERA-Nets are not conducting common calls but focus on the exchange of information and the identification of areas for future collaboration. Typical reasons for not conducting the common calls emerge from the need of learning first the differences among the participating funding agencies. Main barriers learned, in the case of INNER, for instance, have been differences in the approach of national programs. Firstly, the experience was that national programs are based on different ways in funding, respectively a top-down and a bottom-up approach. Secondly, due to the broad definition of "Innovative Energy Research" questions have caused some problems. For instance, the term "innovation" is defined and used differently by different program agencies. The differences appear even stronger if the aim is to include the whole innovation chain: companies, universities and R&D-institutions. Some funding organizations fund only basic research, others only industrial, or mixtures of basic and industrial research. Some countries are not allowed to inform what industrial projects they are funding. Furthermore some programs fund only projects that include PhD work while other programs can fund even a single PhD not part of any larger project. Often the funding is limited to national activities, which is considered a restriction to participate in trans-national programs. Hence, in some occasions the calls and funding are taken care nationally. Every agency will organize the calls and finance its national applicants. In such cases, opportunities for common actions are explored in smaller groups, for instance in INNER there are five large categories called joint actions for these purposes.

**Virtual common pots**

Often ERA-NETs, as the most of the ERA-NETs interviewed in this study, apply in the common calls a funding model baptized as "virtual common pots". Depending on the way the model is applied it is close to decentralized common pots or simultaneous funding models. *Virtual common pots* mean that the participating funding organizations earmark the amount for a common call, and once the commonly evaluated projects are chosen the funding organizations choose projects they want to fund according to their national funding policies. In practice, the funding organizations often fund projects that benefit and include activities within their country. Often there are no cross-border transfers needed. For example within BIOENERGY, they have a joint project with Sweden and the UK. The Swedish program pays the Swedish part and the UK program pays the UK part. It's one project and it comes together out of the joint call. In the ERABUILD, proposals are invited from universities, research institutes and other public research organizations following national eligibility criteria. Private companies also have the opportunity to send their own proposals or take part in a consortium, but it is advised by the ERABUILD to study the national funding conditions. Proposals should include partners from at least two of the countries involved in the call and a plan of work that distributes work evenly among all parties involved is of great importance. Research is funded from national sources.

Before the common calls, the funding agencies earmark the amounts they participate in the virtual common pot. Therefore, it is important to agree on the common rules and practices on the call, evaluation and the management of the projects. For that purposes it is common to organize limited pilot calls before launching the extensive call. For instance, ACENET has had positive experiences funding R&D institutions but identified problems with funding of industrial research.

In case of WoodWisdom-Net pilot calls were not considered necessary partly because of the opportunity to build on the earlier experiences on trans-national program cooperation but also because of the extensive bottom-up consultation process that created improved understanding of the issues necessary for the preparation of the common calls.[6]


**Common pots**

Among the interviewed ERA-NETs, the NORFACE and the BONUS applied common pot funding. Both of them are focused on the basic or applied research and coordinated by research councils. The basic idea of the *common pot* is that the national funding is not earmarked to national purposes but to collected to common pot and allocated to best European projects. Therefore, the national partners can not assure that their contributions will necessary benefit the national RD&D activities. In the NORFACE, the application of common pot was facilitated by earlier Nordic collaboration and the collaboration between the Nordic countries and the UK in the 90's when research councils organized common seminars on social sciences, discussed program management and evaluation issues. The participation of each funding agency is based on the algorithm that considers the population and GDP factors. The algorithm has been used over 20 years in Nordic countries. It appeared to be suitable especially for small countries because their shares are small and thus also the risks. Only Ireland had some difficulties with the budget, because of the high GDP and respective higher proportional share of the common pot. Respectively Germany had some difficulties to participate, because of the interpretations of regulatory constrains which would mean that the funding should be allocated first to national researchers and only if some extra funding is available it could be allocated to trans-national purposes. Building on the common pot approach, the NORFACE may later on apply for ERA-NET Plus.

The BONUS is among the four candidate ERA-NETs (AAL Ambient assisted living, SME Eurostar, IMERA and BONUS) for the article 169 application. The BONUS builds on the Nordic cooperation on Baltic Sea research. The article 169 requires the establishment of a legal entity to manage the program, the participating funding organizations allocate the resources and the commission adds within FP7 another 50 percentage for the program. The preparation process for the BONUS 169 has been fairly extensive consisting of the expert compilation of the background paper and national workshops engaging over 800 persons in total. In case the BONUS will not be chosen for the 169 application, it is likely to continue as an ERA-NET Plus.

**Recommendations for HY-CO activities**

Within the HY-CO activities, the interest in promoting not only R&D but also demonstration of hydrogen based energy systems creates challenges related to the competitiveness issues such as IPR and possible difficulties in funding foreign industries. Therefore, it seems that exchange of information, simultaneous national calls and the exploration of the possibilities for the use of virtual common pot are the most feasible options.

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[6] See, www.woodwisdom.tkk.fi

## 3.1.2 Costs and Contributions

The preparations of the trans-national RD&D programs face diverse barriers how to agree upon the costs and contributions. What personal, overhead, material or travelling costs can be covered? What organizations can be funded and how much funding they can receive?

**The type of costs**

Because of different funding organizations involved there are typically also different national rules applied. In general, it's salary, overheads, material and equipment, and also some costs for travelling and subcontracting. This is in most cases equal between research institutes, universities and private sector. However, the conditions depend very much on the each participating national funding organizations.

**Co-funding rules**

ERA-Nets participants tend to apply with the EU funding rules that leads to 50-100 % funding for research institutes and universities research and when applicable 25-50 % funding for companies. According to the SWOT report, in the US, public co-funding of industrial research can be up to 80%, whereas in Europe it cannot be more than 40 %. In Canada the limits to public funding are lower – usually 33-50% (with an absolute axe of 75%) (ESTO, 2005a). This makes it harder to attract, motivate and involve companies in the EU, which otherwise is seen as an important way to bridge the gap between research and commercialization on the market.

In practice, the type of proponents that can be funded varies between the different participating funding organizations involved in the ERA-NET. For instance, in the ERA-BUILD, program agencies in Austria and Finland did not seem to have a problem with funding of private companies whereas regulations in Denmark, Sweden and France complicated funding of private companies. Indeed, private sector participation may be severely constrained by the European co-funding rules. On the other hand, for example, the WoodWisdom-Net has no allocated funds specified for researcher exchange. This is one of the issues that can de discussed possibly in the ERA-NET Plus scheme.

**Contributions**

In some cases the national regulations constrain the funding to national activities. The constrains can be also within the organizational practices or routines. In the most severe cases, this means that foreign RD&D activities can not be funded. National funding organizations need to ensure the national benefits. In most of the examined ERA-NETs, overcoming these constrains seems to depend on the efforts done to communicate the differences and to search for common ground. Still, the national resources for the trans-national RD&D cooperation can be difficult to obtain nationally, because they can be seen taken away from some national uses. According to interviewed this seemed to be the case both in some smaller countries, e.g. Denmark, and larger countries, e.g. Germany. In the INNER, the big countries, especially Germany, have had difficulties to participate in trans-national RD&D programs because of the organizational challenges how to get the funding approvals from the higher levels of the administration.

Especially when the common pot model is not used in the ERA-NETs, the covered costs and contributions vary between the different national program owners. For instance, in the ERABUILD that uses the virtual common pot approach, the Swedish part of a project shall be co-financed with at least 50%, Finland fund between 15% and 70% of the eligible costs depending on types of organizations involved and Austria is funding up to 100% of eligible costs.

**Recommendations for HY-CO activities**

It is likely that partners have different national policies in view of costs and contributions. Hence, it is recommendable that joint activities are designed in view of national differences and providing the possibility for each partner to define its role in accordance with its national policies.

## 3.1.3 Contracts

The preparations may face barriers how to agree on the needed contracts for the RD&D cooperation. Typically contracts exist at different levels. It is common that the national ERA-NET partners sign a contract with the organization that they fund. Often they also require or recommend project consortia to sign a contract. In addition to these two levels, at the ERA-NET level, the partners sign the memorandum of understanding on the participation to the ERA-NETs. Some of the ERA-NETs preparing common calls sign also additional agreements on the call. In case of article 169 application it is necessary to establish legal entity to manage the program.

**The national level contracts**

Often each national ERA-NET partner (national funding organization, either program owner or manager) require the organization receiving project funding to sign a contract in accordance to national conditions with their national ERA-NET partner. Such contracts vary according to the country but often cover the grant, loan or subsidy and all the reporting requirements - and that all the receiving parties fulfill these requirements.

**Project level contracts**

Participants from different countries are required or recommended to sign a common consortia contract to define the rights and obligations of the program partners, for instance, issues related to IPR and the distribution of work. In the INNER in Germany, a form is used that defines how often participants need to report and how often they receive funding. In the case where many projects are involved in a network, like a compound project, each project has its own contract. In general, the projects with subcontractors are more complicated and difficult to control by the funding organizations.

**ERA-NET level agreements**

At the ERA-NET level, the partners sign the memorandum of understanding on the participation to the ERA-NETs. Some of the ERA-NETs preparing common calls sign also additional agreements on the call. For example, the ERABUILD is considering the need for a contract to cover obligations and rights at an ERA-NET level. However, this is not

always considered necessary because the national contracts may cover all the relevant matters. In case of article 169 application it is necessary to establish legal entity to manage the program.

**Recommendations for HY-CO activities**

It is likely that partners have different national policies in view of contracts that need to be respected. However, there are no explicit obstacles to develop contract guidelines and explore the possibilities for synchronization of contract practices.

## 3.1.4 Intellectual Property Rights (IPR) Arising from Projects

IPR issues may create some barriers for trans-national RD&D cooperation especially when deployment and commercialization aspects are included in the scope of the ERA-NET, for example in the ACENET and the ERABUILD. Even though when the focus is on the basic research, the IPR issues need to be dealt with, for instance in the INNER the specific guidelines are developed. However, in general, it is difficult to develop a guideline for IPR because these context-dependent issues differ significantly among projects.

IPR issues are commonly dealt with at the project level in the consortium agreement. In the consortium agreement the industry and the R&D performers need to come up with a common denominator of the IPR. Consortia are typically free to organize these issues as they see best for them but within the limits of the rules of the funding organizations. However, the ERA-NETs also recommend participants on this issue. For instance, in the MATERA it was recommended that the industry should be in a position to benefit from that research and basically the rights should be granted to them and not be left with the R&D organizations. Alternative view was provided in the ERABUILD in which the participants were advised to share the IPR among them. In the MATERA, the INNER and in several other ERA-NETs, outlines or guidelines for consortium agreements including IPR issues have been drafted.

It will be very difficult for other agencies to give funding to a project where a company from another country receives all the IPR. In the ERABUILD, there have been extensive discussions on IPR issues probably largely because it is meant to cover also demonstration, in addition to R&D activities. In the case where a company claims the rights to IPR due to a possible future product development there may arouse complications between the legislation systems of the different countries. For instance, Danish rules do not allow a company to develop and maintain IPR for public tax money. If a project, consisting of an Austrian company and one or two Danish research institutions, results in patentable knowledge, and the Austrian company obtains the IPR, it is hard to get acceptance for this way of spending Danish taxpayers' money. If the Austrian company does get the IPR the basic research results need to get published straight away.

**Recommendations for HY-CO activities**

Different national IPR policies need to be taken into account. The easiest may be to leave the IPR issues to be agreed between the project partners. However, the ERA-NET level

support may be required especially when demonstration projects enclose various stakeholders. Toward this end, in addition to taken into account national policies it is relevant to explore how IPR issues have been dealt with for instance within HFP and hydrogen light house projects (HFP, 2006a, 200b).

## 3.2 Format and Timescales of Calls

The Trans-national RD&D program preparations need deal with the details on the format and timescales of calls. Each country has its specific practices and routines how the programs calls are defined and organized, in more specifically, what is the form of the calls and the form of response to call; and the evaluation of proposals and informing applicants of decision. How to deal with different timescales and expectations of the ERA-NET partners and agree on the common approach to organize the call?

### 3.2.1 The Form of the Call

Organizational barriers concerning the organization of the calls can create some obstacles in the preparations of joint programs. The ERA-NETs seem to overcome barriers, related for instance to the form and focus of calls and the type of further guidance, with different kinds of learning processes. Depending on the chosen approach, the ERA-NETs utilize open or restricted calls for proposals or specified tenders to receive applications for the programs and improve the understanding of possible obstacles.

**Various phases of calls**

Usually, the ERA-NETs have two or more calls that enable learning first with the pilot calls before launching the major call. In some other cases, for instance in the WoodWisdom-Net the extensive bottom-up queries and participatory preparation work were conducted that made it possible to prepare directly the joint calls for the program with no preceding pilot calls.

For instance, the ERABUILD has 3 different calls: The first call for proposals created general understanding of the RD&D interests. It was necessary that all the countries participate. The second call was for specified tenders. Four countries agreed to make a common pot with rather limited contributions (total 20.000 Euro). Each country invited two organizations to participate in the ERA-NET tender (i.e. 8 in total). The participating countries made a draft of the joint call material and exchanged information on legal documents that would influence the call. The third call for proposals was the most wide-ranging call the ERABUILD has carried out. All participating countries dedicated 500,000 Euro (total of 3 million Euros).

The ERA-NET partners tend to have also different practices how to select the themes for the programs. For instance, in Germany basic research programs are often initiated by researchers, whereas in Nordic countries the programs tend to be prepared through the open top-down process. In the NORFACE, the preparations of the pilot call themes built on the extensive questionnaires and more experience was collected through the seminar and pilot calls before the major call. In the NORFACE, it is also estimated that the preparations of the major call will take considerable time and the initial schedule may need some adjustment.

In the ERASME, the partners were not forced to participate. They were rather given an opportunity to participate in different phases of the calls. The ERASME has 21 partners and they started the first common call with five of them and the second call with 6 of them. And the third one comprised of 10-12 of these partners.

**Use of intermediaries**

In the ERASME, intermediaries in the second call of thematic proposals were used to promote the calls and to initiate new projects. The intermediaries were regional agencies or institutions or freelances in the specific field. They were explained the project format and they were asked to see if their existing networks could be taking up for larger projects. Intermediaries knew sufficient numbers of stakeholders within the specific field and they had an interest to collaborate trans-nationally. Hence, they had a quite a significant impact on the number of proposals received.

**Guidance of calls**
In connection to the calls for proposals, the ERA-NETs tend to provide some specific guidance for the applicants. In the MATERA, diverse guidance is provided, including the forms for pre-proposal and full proposals as well as guidelines and instructions for applicants, criteria for eligibility checking and the evaluation form for the full proposal. Also in the ERABUILD, the participating countries made an exhaustive joint call text of 15 pages defining for example subject areas within it was possible to get funded and criteria by which projects are evaluated. Typical eligibility criteria cover the suitability of the project in view of the chosen themes and the participation from different countries, often at least from three countries.

**Recommendations for HY-CO activities**

Both the different phases of calls and the use of intermediaries provide further opportunities for learning and networking that may improve the quality of joints calls and the formation of common program activities. This also supports the compilation of explicit guidance of calls for applicants. However, such activities need to be balanced with the possible time constrains.

## 3.2.2 Form of Response to Call

The ERA-NETs seem to have different approaches for the participants to respond to the call, for instance responding directly to the ERA-NET office, to national funding organizations or in some cases to both of them. The barriers may emerge partly because of the different national practices among the funding organizations but also partly because of different levels of expertise among the participants to work with (online) application forms.

Several ERA-NETs, collect and coordinate the responses to the ERA-NET office. For example the MATERA and ACENET are running a solution at the web; the proposals have to be submitted online through the communication platform. So, there is one central point where all proposals arrive. Participants are often required to send application to their

national funding organization. Still, the way how the proposals are sent vary among the ERA-NETs:

- In case of the MATERA, after receiving the proposal at the MATERA call office, the project coordinator gets an email that says that the application has been received. And then each project participant was requested the national application using the existing forms they usually use. In case of the Finnish applicants, they did not need to write another full proposal but they could use the MATERA full proposal.

- In the ACENET, the forms will be electronic and there'll be a web-reporting. The electronic system can be used also to send information between the project participants and for instance for eligibility check. The ACENET will use the central point of handling the proposals but for checking the national eligibility of proposals all partners will be asked to do that for their countries.

- In case of the BIOENERGY, applicants send their response to the national funding organization. After that the applications are collected together to one point.

- In case of the ERABUILD, all partners in a project consortium agree on a joint application and they all send the same application to their respective Research Councils for assessment. To keep the projects anonymous all partners refer to one common telephone number though with different country codes.

**Recommendations for HY-CO activities**

Despite national differences, opportunities exist to avoid extra work by requiring applicants to compile many applications. Such opportunities need to be carefully studied before launching the calls. Especially, the use of electronic solicitation of applications is recommendable when suitable.

## 3.2.3 Evaluation of Proposals

The practices of how the proposals are evaluated vary among the ERA-NETs. Sometimes the evaluation starts within the ERA-NET level and after that the recommended projects are evaluated at the national level (e.g. the ERASME); other times the national level evaluation is followed by the ERA-NET level evaluation (e.g. the MATERA):

- In the ERASME, first a group of the ERA-NET project partners evaluate the proposals mainly in view of win-win situations to be seen in the trans-national cooperation. Second, a ranking or shortlist is created and the recommended projects are forwarded to the national evaluation.

- In the MATERA, first, the national funding organizations have their evaluation process. Second, the ERA-NET level ranking on the proposals is made for further recommendations for funding. And this information will be send again to the national funding organizations for the final decisions. Hence, the national eligibility check was made by each national funding organization. In case of the ERABUILD, the similar process was used, except that the ERA-Net level ranking of projects

were made by a United Kingdom judge. The ranking consist of 3 levels (A, B, C) and the allocation of money works after a basic principle that A should obtain funding first, then B-projects and at last C-projects. However, the some problems emerged already before the ERA-NET level ranking. The national research councils who carry out the scientific assessment of a proposed project do work on different sets of criteria. Therefore, it turned out that the same proposals got evaluated differently by their respective national research councils and hence out of 7 projects the Danish Research Council rejected 3 projects that had already obtained acceptance by all other involved research councils. In next call the ERABUILD committee intends in corporation with the National Research Councils to appoint experts to assess proposals. With this initiative they hope to avoid approval of projects in some countries and disproval in others. In view of avoiding excessive influence of national interests to the evaluation process also the experiences from ERABUILD in securing anonymity by partners referring to one common phone number could be a solution.

- In case of the ACENET, a program committee will be established that will be responsible for assessing the proposals. There are two stages, first a pre-proposal and second a full proposal so the program committee will check if it fits in the themes and will select a certain amount of proposals to be worked out in a full proposal. National funding organizations are not involved themselves. The program committee makes advice on which proposals to fund and the partners decide in the end who should receive funding. But in the memorandum of understanding, the ERA-NET partners promise to do everything to follow the ranking of the committee.

- In the WoodWisdom-Net, for the Second-Step Proposal evaluation, there will be a panel of internationally recognized experts from the fields of the call themes. Depending on the nature of the proposals invited to the second step, the most suitable evaluators will be selected to participate in the evaluation. Each participating organization will suggest a few evaluators, but there will be no country representation in the evaluator panel in the sense that each partner will be represented; the scientific expertise will be a priority. The Steering Committee appoints the members of the panel and the WoodWisdom-Net secretariat officially invites each of the experts to be an evaluator, explains the rules and sends a set of evaluation documents and any other useful documents. If evaluators accept the invitation, they send a signed confidentiality disclosure agreement to the WoodWisdom-Net Secretariat. As soon as the Steering Committee has decided from whom the full proposals will be requested, participating organizations will start searching for suitable evaluators.

**Criteria**

In general the ERA-NETs seem to require participation from several countries and the projects should have sustainable added value for all the participating countries. In the ERASME the following set of criteria is used:
- scientific excellence
- impact on the national innovation system
- European impact
- suitability for the product development in those areas.

The ACENET use the following criteria for the evaluation:
- innovation and excellence of the ideas and feasibility of the project
- added-value for partner countries and the EU industrial system
- relevance to the theme of the call
- competences of the partners and boosting of trans-national collaboration and
- industry participation and expectations of results.

In the ERABUILD, the evaluation criteria are:
- competence of proposers and quality of collaboration
- scientific quality of the project
- the quality of the proposal
- objective(s) and prospects of the project
- relevance of the project
- strategic importance of the project.

**Recommendations for HY-CO activities**

The evaluation approaches vary depending on the ERA-NET, there seems to be tendency toward further coordination and the creation of ERA-NET level expert groups for the evaluation of proposals. This needs to be evaluated also within HY-CO activities. The evaluation work and the criteria for evaluation will be however difficult to agree upon, especially because of the interests also in demonstration activities that are complicated to evaluate with objective criteria, for instance, expected societal impacts related to different national interests.

## 3.2.4 Informing Applicants of Decision

Informing the applicants of the decision has not created any major discussions among the interviewed ERA-NETs, the applicants are informed either directly by the ERA-NET office or the national funding organization. Among the interviewed ERA-NETs it seemed to be common that the applicants are informed also informally to provide the news in a good time. There seems to be some differences how the applicants are informed:

- In the ERASME, once the international ranking has taken place, the applicants are given indication that their project has been considered to get funded. This is a kind of pre-conditional confirmation but it has to be pre-conditional to the national evaluation and national decision.

- In the MATERA, the official information will be given by the national funding organizations after the funding decision is made. But before that the MATERA partners may communicate informally with national applicants.

- In the BIOENERGY, the information is put on the ERA-NET website and the applicants are also informed by the national funding organizations.

**Recommendations for HY-CO activities**

There seems to be no barriers to coordinate the informing of applicants at the ERA-NET level. However, still the partners may find it attempting to inform their national researchers also informally.

## 3.2.5 Timescales

The preparations of ERA-NETs seem to face considerable barriers with regard to timing. The ERA-NET partners seem to have three major difficulties related to timescales. First, they need to agree on the timing for joint calls in line with the national schedules. Second, the preparations of the proposals among the participants from many countries may require extra time. Third, the evaluation processes of the proposals are often dependent on the different national evaluation practices that may require considerable time.

**Timing of common calls**

The national RD&D programs tend to start and last different times, which make it challenging for the ERA-NET partners to define the suitable timing for the calls. In the INNER, the timescales has been considered a major barrier, because countries have different timescales. For example, the German Ministry there have been some organizational changes that has affected also the ERA-NET, the Ministry decided to do only one call instead of two calls for ERA-NET and with fairly a short notice. Because of obvious difficulties, other partners have been looking ways forward. For instance, Nordic Energy Research is planning a trans-national call.

**Timing of responses to common calls**

The preparations of the proposals among the participants from many countries may require extra time. It takes time to get the participants from different countries sufficiently informed about the format of the proposal and what they are asked to do exactly. It seems that often there is a need to leave considerable time for proposal preparation because it can be a bit more complicated to respond the proposals and use the project format on a trans-national level than on the national level.

- In the ERASME, it was experienced that there is <u>a need for making more lengthy time scale</u> for the participants to make their proposals. They asked the responses to the first call of pre-proposals within a time period of three months and for the full proposals time period of up to 6 month. They closed the call 6 months after announcement. This appeared to be a bit short, especially because it coincided with the summertime. Furthermore, it was experienced that it takes time for the partners to finalize their consortium agreements. This was after they received funding decision, when they needed to come up with a signed agreement on how to proceed in the project.

- In the MATERA, it was recognized that it may have been good to have had more time when the call opened. There was only 1 month time to respond. And also to

make the full proposal applicants only had 2-3 month, which coincided with the <u>summer holidays.</u>

**Timing of evaluations**

The evaluation of proposals often engages also national funding organizations to conduct also national level evaluation of the proposals. While this assures the eligibility of the proposals from the national perspectives it also seems to take considerable time, because the timescales of national evaluation processes vary. The timing issues related to the evaluation of proposals have been experienced in the ERA-Nets with diverse forms:

- In the ERABUILD, it was experienced that <u>national funding organizations that carry out the evaluation</u> of scientific excellence tend to have only a few meetings through out a year and therefore it may be difficult to gather all the evaluations within a short timeframe. Furthermore, the evaluation period was running over the summer that prolonged the process even further.

- In the INNER, the <u>evaluation process is aimed to be a flexible process</u>. While the commission requires specific deadlines, the actual management can adjust the plans in a flexible way when necessary to take advantage of possible new good ideas that may come up during the evaluation process.

- In the ACENET, the pilot calls have been considered to be fairly easy to organize with little timing difficulties. However, for <u>regular calls in the future</u>, the timing issues are expected to by a major challenge.

**Recommendations for HY-CO activities**

Timing of different national activities is likely to be complicated. Therefore, feasible approach may be organizing several phases of calls that create required flexibility. In the timing of responses and evaluations it is recommendable to include some lag time in different actions.

## *3.3 Running the program*

The national funding organizations tend have their specific practices how to run RD&D programs. Hence, while running the trans-national RD&D program need to be designed to be as effective and efficient as possible they also need to be adjusted to the national differences in view of how to deal with the monitoring of projects and dissemination of project results, and how to evaluate the project and the whole program.

## 3.3.1 Monitoring of Projects

There is little experience how to monitor the ERA-NET project activities, because most of the ERA-NETs have not yet the projects running. It seems that ERA-NETs are still largely discussing the issues, and the agreements on how the monitoring will be organized will be discussed after dealing with the calls. However, there appears to be a common view that the national funding organizations monitor the projects that they are funding. Furthermore,

there are different forms how the ERA-NETs tend to organize the monitoring at the ERA-NET level.

**National monitoring activities**

National funding organizations may have at least two approaches how to monitor the projects: i) the project consortium coordinators and ii) the national participants in different projects:

- In the ERASME, the project consortium coordinators report to their national funding organization. In the Consortia projects, there is a dedicated coordinator. Hence, the basic monitoring and coordination activity lies within the funding organization in the country of the coordinator of the project. Each funding organization is planned to monitor the projects a period of half a year or year. So there is a monitoring foreseen but it has not taken place so far. And the program agency of the respected country is doing the monitoring. Basically it is the person involved in the project funding. The funding organizations participate in project meetings to get a good understanding of the project.

- In the ERABUILD, the national funding organizations will carry out monitoring of the respective national project participants.

**ERA-NET level monitoring**

At the ERA-Net level, the monitoring seems to have at least two different approaches: i) the coordination and comparison of national monitoring activities and ii) additional direct monitoring activities of the projects.

- In the BIOENERGY, the plans are that, in addition to the national evaluation procedures, there will be joint responsibility at the ERA-NET level to look at the international context.

- In addition to national monitoring, the ERABUILD is planning to carry out monitoring of the work of project consortia. However, in practice, the monitoring is likely to be carried out by the countries involved in a project. For instance the French partners in the ERABUILD may have little interest in monitoring a project with Finnish, Danish and Austrian partners.

**Recommendations for HY-CO activities**

Among ERA-NETs, there exists little experience on the monitoring of projects at the moment. However, some plans exist already, as discussed above, that may provide further guidance for planning also HY-CO monitoring activities.

## 3.3.2 Dissemination of Projects Results

In view of the dissemination of project results, some barriers may emerge because of the possible IPR issues. However, most of the ERA-NETs have not discussed these issues. The expectations are mainly positive trusting on the usual national level dissemination and additional ERA-net level dissemination activities. For example, in the ERABUILD, there seems to be no major problems related to publication and dissemination of results, because the participants are primarily public research institutions in the fields of construction.

**Recommendations for HY-CO activities**

It seems that IPR issues are not expected to create major barriers for the dissemination. However, because of the HY-CO focus also on demonstration activities, this needs to be discussed thoroughly to avoid conflicts later on during the project implementation and reporting.

### 3.3.3 Project and Program Evaluation

ERA-Net activities often include some level of evaluation of the ERA-NET activities. The evaluation issues have not been discussed extensively so far, but it is likely that the evaluations will be conducted in view of the calls of the programs, the programs and the individual projects:

- ERA-NETs plan to evaluate the conducted <u>calls</u>. For instance, in the MATERA the process of calls is planned to be evaluated. They have evaluated some of the practices internally and collected feedback from the applicants.

- At the national level, the <u>programs </u>tend to be evaluated. In case of the MATERA, also the ERA-NET activities are foreseen to be evaluated as part of the national evaluations.

- In the ERASME, the plan is to have <u>project </u>evaluations in the end of the ERA-NET as part of the general evaluation of the ERA-NET. In case of MATERA, some of the projects have a longer duration that the ERA-NET, which may create difficulties in the evaluation phase.

**Recommendations for the HY-CO activities**

This is one of the areas that HY-CO project needs to exchange ideas and experiences with other ERA-NETs.

### 3.4 Other issues and barriers

Within the ERA-NETs, there exist different kinds of general expectations on the purpose, results and collaboration that make the initial collaboration challenging and it may take considerable time to create a common working agenda. Furthermore, in the management and preparations of common ERA-NET activities, the partners need to deal with the possible <u>language differences</u>. Especially among the new member states the level of

English creates further barriers in the communication. However, the language skill is considered rather as a prerequisite for the participation rather than a barrier.

Funding organizations have also different kinds of <u>institutional cultures</u>, routines and expectations how the processes are implemented. Such differences create difficulties among the ERA-NET coordination if particular attention is not given to the communication of the expectations of all the partners. For example the Swedish consensus type of decision making processes are sometimes seen problematic among the procedure oriented countries such as Finland or France.

To initiate trans-national RD&D programs, it is <u>not necessary to harmonize a lot of regulations</u>, even though some of the ERA-NETs have worked intensively with the adjustment of regulations, especially the SAFEFOOD-ERANET. Much of the national differences can be overcome with the novel interpretations of the existing regulations and with the changes in national procedures and practices. ERA-NETs offer opportunities for learning from different national systems and to develop important network relations. The ERA-NETs are networks that can test different collaboration forms and initiate pilots that provide opportunities for learning especially among the partners. The cyclic approach of various calls seems to create positive results, for example in case of ERASME. However, such cycles of calls are not an only way to create common understanding. For instance, in case of WoodWisdom-Net extensive bottom-up queries were conducted to collect research interests among the stakeholders, which were analyzed in the series of ERA-NET workshops. In both approaches it has appeared to be important to provide opportunities for the partners to learn about the requirements for the trans-national cooperation and about how to manage the risks of allocating resources on something that would not be in line with the national rules.

In several ERA-NETs it is recognized that different procedures and practices create contradictions leading to <u>excessive extra work and time</u>. Especially, the differences in the evaluation processes created difficult conditions of contradictory evaluation results; the national evaluation processes also may take lots of time. Therefore, the ERA-NETs are likely to look for opportunities for common European procedures, for example in the ERABUILD, there are plans together with the partners to create an expert panel for the project evaluations.

The ERANET scheme is considered as a European politically sensitive instrument of which <u>continuity</u> may not be as certain as of national activities. For a successful ERA-NET it is considered relevant that the European Commission ensures financial support for the secretariat functions and also secures an acceptable standard of quality within the ERA-NETs.


## 3.5 Conclusions on barriers

The RD&D scope of the ERA-NET and earlier cooperation among partners seem to define largely what type of funding model is applied. The ERA-NETs that apply the common pot model focus on the basic research and, therefore, are not so much affected by the barriers related to the competitiveness issues such as IPR and possible difficulties in funding foreign industries. Furthermore, basic research seems to be easier to evaluate with objective criteria, whereas with D&D there is a need to agree upon expected impacts related to

different national interests. Therefore, it seems that when common pot cannot be applied, the suitable approach is virtual common pot that keeps much of the control at the national level. The programs based on the virtual common pot can be organized in diverse manners with different levels of intensity in the centralized ERA-NET coordination. The approach offers the opportunity for the partners to engage in the mutual learning processes that may lead to the harmonization of the national practices without the enforcement of national partners.

Because most of the ERA-NETs have been fully occupied with the organization of common calls relatively little attention has been given to the issues how to run the common programs. Many respondents considered the actual common program preparations as pilots that provide opportunities for learning. Hence, the lack of clear design for running the programs can be seen to be in line with the approach of learning-by-doing that enables required flexibility in the ERA-NET process and keeps the partners actively engaged in the formation of trans-national RD&D activities.

# 4 Discussion

To-date, the ERA-NET Scheme and other OMC coordination tools have supported the greater convergence of innovation policies at different territorial levels through the active surveillance and fixing of common targets (Kaiser & Prange, 2004). Yet excessive concentration of innovation policy coordination with the Commission at its core may provoke national resistance. Conversely, loose decentralized coordination of innovation policies may lead to increased rivalry among regional actors, disintegration and widening of existing socioeconomic gaps (Kuhlmann & Edler, 2003).

Kuhlmann and Edler (2003) have identified a third and possibly more desirable scenario where 'post-national' innovation systems evolve towards centrally mediated policy-making for distributed but interrelated innovation systems. They view recent strategic efforts towards the creation of ERA as indicative of this scenario whose realization would call for the coexistence of two partly competing policy targets, i.e. (i) the socio-economic cohesion of European regions in view of dimensions such as similar working conditions and (ii) the adoption of the 'géometrie variable' concept where a varying number of Member States or sectors initiate their joint initiatives (Kuhlmann & Edler, 2003). Effective co-ordination efforts must therefore be enacted within multi-actor governance structures, assisted by transparent and accountable intermediary interfaces that can be fostered through mutual learning processes and new collaboration activities (Kuhlmann & Edler, 2003). Such approaches seem to fit fairly well with the most widely applied funding model of virtual common pot in the Era-NET Scheme to apply the 'géometrie variable' concept in the common program formation and to retain some of the control also in the national level.

## 4.1 Management of ERA-NET processes

The political momentum for the Commission's role as a facilitator is visible in several recent coordination tools. For example, the ERA-NET activities of funding agencies provide support for European coordination and mutual opening-up of national policies. Also Technology Platforms and Technology Initiatives provide new fora where companies, research organizations, funding agencies, and regulatory authorities are engaged in the definition of common research agendas and associated legal and regulatory conditions. Broadly seen, these initiatives are indications of the transformation of the EU innovation policy from the provision of financial resources to the facilitation and monitoring of stakeholder processes. There is, in effect, an ongoing shift from optimization-oriented innovation policies for the mitigation of market failures towards coordination-oriented policies (Könnölä, Brummer et al, in press) where policy-makers interact with other stakeholders in learning processes, thus creating new coalitions and institutions with distributed strategic intelligence (Smits & Kuhlmann, 2004).

While central to this transformation, coordination tools have been managed by the stakeholders largely through processes of self-organization, whereby the Commission has provided documents only on general guidelines and routinely applied governance principles (e.g., effectiveness, coherence, accountability, participation and openness; European Commission, 2001). This may be one of the reasons why the specific demands posed by the management of coordination tools have received little attention, although these tools will undoubtedly encounter challenges in coordinating European policies within

multi-layered innovation systems. Further complications are caused by the presence of different and even conflicting interests of national and industrial perspectives, to name but some examples. Despite its strategic vision in initiating coordination tools, the Commission has taken few proactive efforts to assist the managers of these multi-stakeholder processes.

Within the ERA-NETs, the general objectives for the formation of common RD&D activities can be defined as i) *vision-building* for clarifying shared interests and joint benefits of international collaboration, ii) *networking* for mobilizing the RD&D communities in different countries and iii) *priority setting* for formulating promising research themes and corresponding resource allocations. In the WoodWisdom-Net, such objectives were attained through the extensive bottom-up consultation process. Tentative interests in prospective collaboration were probed by inviting stakeholders from different countries to explore what research themes should be pursued through international joint RD&D activities, in view of expected S&T developments, industrial needs and societal demands. The resulting information helped funding organizations in the formulation of their own research agendas, clarified linkages between national and European agendas, and prepared the broader RD&D community for later calls for proposals and other actions. At best, such a process can overcome some of the barriers discussed in Chapter 3; it can also contribute to the development of complementary value networks based on different technological competencies (Könnölä et al., 2007).

Broadly seen, ERA-NETs and other European coordination tools are indicative of the transformation of the EU innovation policy from financially oriented measures to the facilitation and monitoring of stakeholder processes which do not necessarily have a central agent for controlled agenda setting and resource allocation (Könnölä, Brummer et al., in press). Overall, this transformation represents a shift from optimization-oriented innovation policies for the mitigation of market failures towards coordination-oriented policies where policy-makers interact with RTD stakeholders in learning processes and build new coalitions and institutions with the help of distributed strategic intelligence (Smits & Kuhlmann, 2004). This transformation can be assisted by coordination tools that help RD&D stakeholders recognize how the benefits of trans-national collaboration can outweigh the efforts needed to overcome the barriers related to regulatory and institutional conditions, organizing the common calls and managing common programs.

## 4.2 Toward trans-national H2 RD&D coordination[7]

In the common RD&D program formation, it is relevant to consider the particular conditions of trans-national H2 RD&D activities that are conditioned not only by the horizontal and vertical coordination challenges but also by the national rigid techno-institutional conditions that create particular constrains to the market entry of H2 based energy systems. With this respect, in HY-CO activities it may be beneficial to give particular attention to the three general policy objectives that can facilitate an escape from conditions of techno-institutional lock-out of alternative energy technologies such as H2 based energy systems (Könnölä et al., 2007). These include fostering: i) the diversity of technological options, ii) common visions for the implementation of technological alternatives, and iii) changes in the physical and social networks.

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[7] This section is based on the paper of Könnölä et al., 2007.

**Can HY-CO foster the diversity of innovative and viable solutions?**

*Diversity of technological options* is one of the first stages in the evolutionary emergence of a new technology or system. It includes both physical technologies, in the form of technological artifacts and infrastructures, and social technologies in the form of organizational designs and institutions (Nelson and Sampat, 2001). The development and diffusion of these new options, however, are often hampered by the presence of pre-existing dominant designs which can lock-out innovation and investment in alternatives (Unruh, 2000). Due to limitations of bounded rationality and imperfect information, it is impossible to identify ex ante which technologies and organizational responses will be most desirable for society (Kline, 2001). Thus rapid learning and diffusion of knowledge are important at the early stages.

For components like fuel cells to be useful they will have to be integrated into a larger energy system that includes hydrogen production, transportation, storage, transformation, generation and end uses. Hence, a mediated evolutionary process will ultimately select a dominant system design (Dosi et al, 1988) and it is possible that governments may choose the technological standards (see e.g., HySociety, 2005), as in the historic case of nuclear power generation (Clarke, 1985). However, there is a danger in any government prematurely selecting a technological winner given the uncertainties. Thus, while enhancing the diversity of technological options is fundamental for adaptive flexibility and evolutionary potential of technological systems, the challenge for decision makers is to balance between the exploration of diverse options and ultimately signaling which dominant design will be supported by policy. Along these lines, Adamson (2004) has argued the need for a long term binding commitment at the level of the EU Parliament to ensure that the emerging pathway of the hydrogen generation from natural gas does not become locked into a dominant production route. Developing transition roadmaps, or visions for the implementation of the diverse options, is a way to organize the complexity of the evolutionary process.

**Can HY-CO facilitate building European visions for the implementation of technological alternatives?**

Many technologies become commercially established without member state intervention. The personal computer, for example, was commercialized almost entirely by private companies.[8] It is therefore possible that hydrogen energy technologies can be commercialized without member state interventions. If the only element of the dominant design were the fuel cell, and not the large associated infrastructure and systems, then the competitive forces, however imperfect, would play the decisive role in the outcome. However, a hydrogen economy is composed of conjoint technological compliments which are public-private collaborations that require coordination on a very large scale, preferably European wide coordination. The financial estimates for building the infrastructure vary, but are in the billions of euros, which is well beyond the capacity of most private companies. The apparent scale and cost of the undertaking will require multiple producers of complimentary assets that will have to be coordinated.

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[8] The computer itself, however, was developed dominantly through government initiatives.

Given this situation, a likely scenario is that member states will play a key role if hydrogen systems are to become a reality. Member states can make numerous justifications for this intervention (Table 3). Just as government played a catalytic role in the creation of the Internet, automobile transportation, telecommunications, electricity and other systems, public officials and authorities will likely play an essential part in building a hydrogen economy (Dunn, 2002).  It is clear, however, that member states cannot do it alone and will need the special knowledge and resources of the private sector. In addition, financial institutions - both private and public - will also need to be engaged to supply the capital needed to finance the development and construction of viable systems. Ultimately end users will have to be drawn in as well and convinced to adopt the new technologies. Coordinating the participation of these various actors is extremely difficult and unlikely to be successful using only command and control approaches. An alternative is the creation of a common vision, or series of visions, that participants can identify with.

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|---|
| *National and economic security*. Energy infrastructure is vital to economic function. Energy is fundamental to national security. |
| *Environmental concerns*. Climate change and other environmental issues obviously play a constraining role. These are external to most private, profit maximizing decisions. |
| *Infrastructure cost and risk spreading.* The cost estimates are varying, but the general perception is that the cost will be high. No matter what, corporations and banks have said they can't do it alone. Most past systems of this scale have required some government intervention. |
| *Public Safety*. Hydrogen has a checkered past. Public safety issues will bring government into management. For example, regulating safety played a key role in legitimizing the automobile in the US. |
| *Natural Monopoly/Resource coordination*. No reason to build multiple parallel systems. Natural monopoly arguments that work in the past for other systems will apply. Codes and Standard setting is the probable way that government and municipalities will interact this time. |
| *Lock-in of pre-existing energy systems.* The existing energy techno-institutional complex can be seen as locking out investment and innovation in hydrogen technologies. Governments can make public good arguments to engage in hydrogen system development. |

**Table 3:** Government justifications for intervention in the emergence of hydrogen systems (Könnölä et al, 2007).

By initiating processes for creating the shared systemic understanding of techno-institutional co-evolution, authorities and stakeholders can begin to formulate pathways to alternative technology arrangements. Toward this end, the HY-CO activities need to be put forward in close connection with the other coordination tools, namely the European Hydrogen and Fuel Cell Technology Platform and the Technology Initiative (HFP, 2006a, 2006b) and H2 related integrated projects, for instance HyWays[9].

**Can HY-CO create changes in the physical and social hydrogen networks?**

Ultimately, the move toward the H2 economy will require the restructuring of industrial boundaries and the creation of new technological infrastructures. Only through change in existing physical and social networks can the vision of a hydrogen economy be attained. Therefore, converting visions of alternative pathways into policy for implementation requires a redefinition of stakeholder roles and institutional structures, as well as actual changes in the physical systems. Such changes can be induced by many actors, including

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[9] http://www.hyways.de/

policy-makers and other non-profit or non-government organizations along with profit making stakeholders who shape institutional context through their strategic actions of creating and claiming value. Authorities may initiate and facilitate processes that encourage corporate initiatives that break traditional industry boundaries; engage actors from outside the techno-institutional complex that provide new alternatives and motivations which form new coalitions with different value networks to develop and implement different H2 infrastructures. Within high uncertainty of future technological solutions and markets, viable pilot demonstrations can concretize different technological H2 visions.

In this context, member states may initiate actions to facilitate change to existing networks. Instead of "picking technological winners" it is more prudent to foster competition among differing coalitions and learn from the outcomes of the competition (Könnölä, Brummer et al., in press). Also within HY-CO activities, it makes sense to encourage the formation of European coalitions with different visions on H2 technologies to compete in the future for market share (ESTO, 2005c).

# 5 Conclusions

Within the HY-CO activities, the interest in promoting not only R&D but also the demonstration of hydrogen based energy systems creates some challenges related to the competitiveness issues such as IPR and possible difficulties in funding foreign industries. Furthermore, especially demonstration activities are complicated to evaluate with objective criteria, for instance, expected societal impacts related to different national interests. Therefore, it seems that whereas the common pot model is difficult to apply, the suitable approach may be a virtual common pot that keeps much of the control at the national level. The programs based on the virtual common pot need be designed in accordance with national and European interests keeping in mind the regulatory, institutional and organizational barriers identified in Chapter 3.

While this HY-CO report D3.2 has identified existing institutional barriers to the formation of common programs within other ERA-NETs, there was only limited information how to run, monitor and evaluate such programs. Therefore, it is recommendable to communicate actively with other ERA-NETs for further learning and exchange of ideas on the management of common RD&D programs in the future. Furthermore, it is relevant to consider the particular conditions of trans-national H2 RD&D activities that are conditioned not only by the horizontal and vertical coordination challenges but also by the rigid techno-institutional conditions that create particular constrains to the market entry of H2 based energy systems. Therefore, linkages to HFP and integrated projects dealing with the demonstration issues need to be explored with scrutiny.

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# Attachment I Interview protocol

The purpose with the interviews is to collect lessons learned from other ERA-NETs to better understand the barriers for initiating, managing and evaluating trans-national RD&D cooperation activities. The task is to identify barriers within three main areas:

- Legal and Institutional Restrictions to Co-operation

- Format and Timescales of Calls

- Running of Programs and Projects

## Legal and Institutional Restrictions to Co-operation

1. **Funding**

   - Who can be funded according to participating funding organisations?

   - What kind of cooperative forms of financing are considered?

       ….

2. **Costs and Contributions**

   - What kinds of costs can be covered by the different program owners??

       *(salaries and subsistence, overheads, equipment costs, Researchers -50-100% funding, Industry 25-50%, countries apply EU funding rules,)*

3. **Contract**

   - What kinds of contracts program owners tend to sign, what kinds of contracts are made in ERA-NET and between whom, why?

       *(Program owner, program manager, contractors, - consortium agreements)*

4. **Intellectual Property Rights (IPR) Arising from Projects**

   - What kinds of IPR challenges program owners face and how they are dealt with?

       *\*shared with research partners (program owner, lead contractor), suppported with general guidelines*

# Format and Timescales of Calls

**5.  The Form of the Call**

- What kinds of forms of calls are applied and why?

    *(open, restricted calls for proposals, specified tenders)*

**6.  Form of Response to Call**

- How is the response to calls organised?

    *(What is the practice of the program owner, paper/electronic forms, formal/no fixed structure,)*

**7.  Evaluation of Proposals**

- How are the proposals evaluated in national programs and in the ERA/NET?

    *(internal/external, criteria, relevance to objectives, quality or consortium, approach, work plan, dissemination)*

**8.   Informing Applicants of Decision**

- How the applicants are typically informed about the decision in national programs and in the ERA-NET?
    *(formal/informal)*

**9.  Timescales**

- What kind of timing challenges are faced and how does they affect the transnational cooperation?
    *(timing of calls and evaluation process)*

# Running Projects

**10. Monitoring of Projects**

- What kinds of monitoring practices exist and by whom? how monitoring is organised in the ERA-NET?
    *(program manager, contractor reports, meetings, steering committee - termination - in what conditions?)*

### 11. Dissemination of Projects Results

- How the dissemination issues are dealt with within national programs and in the ERA-NET?
  *(often limited set of results published, IPR issues)*

### 12. Project and Program Evaluation

- How the project and the whole program are evaluated in national programs and in the ERA-NET?
  (*different to monitoring, the impact of the project and the overall performance*
  *•often no criteria of project evaluation*
  *•mid-point program evaluation)*

## Formal and informal barriers for trans-national cooperation in RD&D

### 13. Barriers

- Do you find other barriers for trans-national cooperation in RD&D?

- Do you have any recommendations on how to remove these barriers?

# Attachment II List of interviewed ERA-NET coordinators

ACENET
NWO, Holland
Dr. Louis B.J. Vertegaal (NWO - Chemical Sciences / ACTS), Yvonne van der Meer

BIOENERGY
SenterNovem, NL
mr. Kees Kwant

BONUS
Academy of Finland
Kaisa Kononen

ERABUILD
Tekes National Technology Agency, Helsinki, Finland
Mika Lautanala (projectleader)
Gustav Christoffer Jensen

EraSME
VDI/VDE Innovation + Technik GmbH / Germany
Guenter Kuelzhammer

INNER
Forschungszentrum Jülich GmbH, Project Management Organisation Jülich
Ms Sabine Semke, Gillian Glaze

NORFACE
Finland, Academy of Finland
Eili Ervelä-Myréen

MATERA
Tekes National Technology Agency, Helsinki, Finland
Ms. Sisko Sipilä

VISION
Finland, Ministry of Trade and Industry
Hannes Toivanen

WoodWisdom-net
Tekes
Christine Hagström-Näsi, Maija Lönnqvist (IPR Issues)

# Attachment III Summary table of the ERA-NET responses

| Issues: | ACENET | BIOENER GY | BONUS | ERABUIL D | ERASME | INNER | MATERA | NORFAC E | VISION | WOODWI SDOM |
|---|---|---|---|---|---|---|---|---|---|---|
| *1 Legal and Institutional Restrictions to Co-operation* | | | | | | | | | | |
| *Funding* | Virtual common pot | Virtual common pot | Common pot, 169 candidate | Virtual common pot | Virtual common pot | National, maybe later common calls on selected issues | Simultaneo us national calls and funding | Common pot | Virtual common pot | Virtual common pot |
| *Costs and contributions* | According to national rules | According to national rules | According to common pot rules | According to national rules | According to national rules | According to national rules | According to national rules | Common algorithm used for the common pot | According to national rules | According to national rules |
| *Contracts* | At a national level. | At the ERA-NET level | Legal entity to be established within the article 169 application | At the national level, at the project level | At the national level, at the project level | At the national level | At the national level, recommend ed for the project level | At the ERA-NET level. | At the national level | At the ERA-NET level |
| *IPR* | Case-by-case within the projects | According to national rules. | not a major issue because mainly basic research | Project consortia are advised to share IPR. | Case-by-case within the projects | Guidelines for project consortia | Case-by-case within the projects | Not an issue, basic research | According to national rules. | Typically IPR for all the participants |
| *2 The format and timescales of calls* | | | | | | | | | | |
| *The form of the call* | Open calls for theme specific pre- and full proposals. | Restricted pilot call | Open call on specific themes | Joint call for proposals, selected joint call for tenders, wide joint call for proposals | The use of intermediar ies, two thematic pilot calls | Pilot calls, probably two phases. | Open pre-proposal and proposal calls | Thematic seminar and pilot calls before the main program call. | Contract research pilot in 2007 | Open call with two phases on specified themes |

| Issues: | ACENET | BIOENERGY | BONUS | ERABUILD | ERASME | INNER | MATERA | NORFACE | VISION | WOODWISDOM |
|---|---|---|---|---|---|---|---|---|---|---|
| *Form of response to call* | ERA-Net website | Each participant to national funding organization and the project coordinators to the ERA-NET office | | Each participant to national funding organization and the project coordinators to the ERA-NET office | ERA-NET website | Possibly electronic response to calls | Project coordinators to the ERA-Net office by e-mail, project participants to national funding organizations | | | To the ERA-NET office by e-mail. |
| *Evaluation of proposals* | The ERA-NET level | First, ERA-NET evaluation, second , national evaluation | Joint evaluation | First national evaluation, second ERA-NET evaluation | First, ERA-NET evaluation, second , national evaluation | | First national evaluation, second ERA-NET evaluation | | | First national evaluation, second ERA-NET evaluation |
| *Informing applicants of decision* | By the ERA-NET | Both by the ERA-NET and national funding organizations | | First by national funding organizations, second by the ERA-NET | First by the ERA-NET, second by national funding organizations | To be decided | First by national funding organizations, second by the ERA-NET | | | The ERA-Net office sends A written statement to the consortia leaders. |
| *Timescales* | Probable timing difficulties to set the regular calls in the future | Expectations to meet all the deadlines. | | Lack of time for the national evaluation procedures | Lack of time for the responses to common calls | Timing difficulties of common calls, lack of time for national evaluations | Lack of time for the responses to common calls | Lack of time in the preparation of the main call. | | Expectations to meet all the deadlines. |
| *3 Running the program* | | | | | | | | | | |
| *Monitoring of projects* | ERA-NET program committee responsible | Foreseen at the national level and the ERA-NET level | | At the national level, foreseen at the ERA- | At the national level | At the national level, foreseen also ERA- | Foreseen at the national level | | | |

| Issues: | ACENET | BIOENERGY | BONUS | ERABUILD | ERASME | INNER | MATERA | NORFACE | VISION | WOODWISDOM |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NET level monitoring of the project consortia | | NET level | | | | |
| *Dissemination of project results* | At the ERA-NET level responsibility of the program committee | To be discussed | | No major IPR issues constraining dissemination. | At the national level and the addition ERA-Net activities | | At the national level and the addition ERA-Net activities | | | |
| *Project and program evaluation* | To be discussed. | | | Foreseen At the ERA-Net level | At the ERA-NET the evaluation of the calls and projects. | | ERA-Net evaluated as part of the national program evaluations, foreseen also ERA-NET level the evaluation of calls, not projects | | | |
| *4 Key barriers and other issues* | | | | | | | | | | |
| *Key issues* | IPR issues, industry participation excludes the common pot approach | Understanding national differences, towards this end learning by doing | National procedural differences, funding commitments, previous collaboration | Contradictory national evaluation processes, networking among ERA-NET | National differences, 'geometrie variable' – principle, selective participation in calls. | Expectations of ERA-NET partners and national differences | Lack of time, look for balance between the expectations | Timing challenges, e, good bases for cooperation : earlier collaboration, many pilots for learning | Benefits of participation, national programs with the budgets of similar size | Extensive bottom-up preparation process |