A European RD4SD Platform – an ad hoc study

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1. Introduction

A recommendation of the VISION RD4SD project is to develop activities for building and strengthening European RD4SD capacities on a continuing basis and for developing a consistent reference framework for the practice of RD4SD. An initial sketch of the key targets and orientations for a capacity-building facility or process has been developed. Discussions within the VISION RD4SD project and supporting research make clear that the integrating, interfacing and transformative aspects of RD4SD pose challenges for researchers and that gaps (quantitative and qualitative) exist in existing scientific capacities to fulfil these functions efficiently and effectively. Capacity-building and community strengthening activities are needed; however, the organisational form for these activities is still to be decided. A European Competence Centre for RD4SD was initially proposed. Latest project thinking has raised suggestions of a European RD4SD Platform.

A targeted outcome of the VISION RD4SD project is a plan that specifies the details of an initiative for building and strengthening RD4SD capacities. The purpose of this ad hoc study is to provide information relevant to further specifying this idea, establishing its viability, and determining how to carry it forward. The study: sets out the need and the idea as these are seen currently (section 2); outlines the general science policy context within which any such facility or process for capacity building would have to be placed and made operational (section 3); indicates which communities, networks, centres, platforms and resources already exist (section 4); describes the features of existing 'models' of competence centres, networks, and platforms in the science and science policy domains and experience with these to date (section 5); and concludes with an initial reflection on the venture and a mapping of potential stakeholders in it (section 6). This is a short (10-day) study. It is intended to contribute information useful to the discussion. The study is therefore indicative, not exhaustive.

2. The identified need and the idea

The VISION RD4SD project workshops and discussions so far have made clear that, as a complement to usual forms of disciplinary science, a different kind of science is needed to meet the aims of the Europe 2020 Strategy and to address the grand societal challenges: a science that responds to

societal needs, is sensitive to context, is impact oriented and is transformative. The needed science[1] is different from disciplinary science and it makes special demands. It requires specific skills (and associated methods, tools and processes) for engaging with stakeholders, integrating knowledge, and achieving transformative change. It also requires enabling framing conditions, including new science funding and evaluation criteria, training and support for practitioners, enhanced career paths, and greater recognition and rewards for its practitioners.

The need for up-scaling and improving the effectiveness and efficiency of this new science is made more urgent by the economic and financial downturn. The downturn also requires that the new science is practised efficiently as well as effectively. For this, efforts are needed to learn from past and current RD4SD practice, to identify good and successful practice and factors that contribute to success, and to exchange examples and experiences.

There is opportunity for this. Some of the needed skills are already practised and are being tested and honed by pioneering RD4SD practitioners and related researchers in a variety of organisational and project contexts, supported, in some instances, by more innovative science policy makers and foundations. Different approaches to RD4SD are being developed and deployed in many different contexts, using different reference frameworks for developing or choosing methods, tools and processes. So far, however, albeit there have been some small-scale studies to evaluate particular experiences, there has been no large-scale systematic effort to compare, consolidate and integrate different approaches or to adopt a more strategic experimental design to the overall RD4SD effort to enable learning from these real-life 'experiments'.

A systematic effort will involve deployment of a consistent evaluation methodology to undertake comparative and meta-analysis of a wide range of case studies that represent different contexts, methods and outcomes. Such an effort is needed in order to establish a reliable evidence base for the design, management and evaluation of future RD4SD programmes and projects, as a basis for learning and capacity building, and as a basis for building, recognising and rewarding RD4SD practitioners. This would contribute to delivering a validated conceptual and methodological framework for RD4SD. Ideally this effort should be on a continuing basis to provide for on-going experimentation, evaluation, learning, standard-setting and improvement. Continuity also provides opportunity to develop a permanent basis for the performance of associated tasks and activities, such as validation and accreditation, which are important for quality control and establishing credibility and reputation for RD4SD and its practitioners.

Some of these tasks and activities are set out in earlier workshop discussions and in documents developed from these. The recent note prepared by Jill Jäger lists six candidate functions:

- A stimulus for innovation and creativity
- Maintaining an accessible, interactive (web-based) structured repository of RD4SD resources (a one stop-shop or clearing house function)
- Facilitating open conferences, dialogue, reflection, learning, exchanges (of experiences, personnel and resources from around Europe and around the world), transfer of good

[1] The needed science is referred to variously by different groups and communities as Sustainability Science, RD4SD, and Interdisciplinary and Integrative Science, among others, but it has, as a common theme the reconciliation of societies' development goals with planetary limits over the long term and the harnessing of science and technology in the quest for sustainability (see: Jäger, 2009).

practices (and adaptation-to-context) and the development and consolidation of a community of good practice
- Provision of a pool of expertise and practical and policy advice for effective cooperation
- Training and capacity building in key skills and qualities required for RD4SD
- A focal point for international cooperation and exchange

The development and implementation of such a facility will involve actors from the RD4SD practitioner communities, science policy makers and funders, business, and civil society. It could perform many different tasks and fulfil different roles. It could also take on any of several different organisational forms, including as a physical or virtual competence centre, a network of excellence, a platform or a programme. There is also the possibility of establishing a network of excellence involving national/regional centres (perhaps thematic) that has the goal of establishing permanency through a joint programme of activities. The needed functions could be performed by creating a new organisation or network, or by integration into existing organisations or networks. The initiative could be progressed using established instruments (e.g. through a Network of Excellence, an ERA-NET, or a KIC for RD4SD) or via a more customised route. A European facility is suggested, but there is the possibility, also, that a European facility could be part of a broader international or global initiative; e.g. as a regional hub in a global network. A European facility could, conceivably, also initiate and/or coordinate a global initiative.

3. The wider science and science policy context

It is important to assess the wider policy and science context into which any initiative will be launched and must be made operational. Is the initiative in line with the main directions in policy, science policy and science? Is it timely? Are the needs it addresses recognised to be important and investment worthy? Are there other such initiatives and how will our initiative relate to these (compete, cooperate, complement, duplicate, etc.)?

3.1 Trends and directions

The wider policy, science policy and science context is increasingly characterised by recognition of the growing number and urgency of major systemic challenges societies across the globe are facing. These challenges are manifest in different ways in different contexts and at different scales, but they share common features, especially a systemic aspect that makes them largely immune to traditional approaches to finding solutions. There is clearly emerging recognition among policy makers and scientists that new approaches are needed to address these challenges and that, to be effective and efficient, solutions will need to be more holistic, systemic, and integrated and to be developed in context together with the concerned stakeholders. This is indicated in the emergence of new styles of goal setting, policy making and scientific support to decision makers and stakeholders.

Increasingly, policy goals are being set with reference to cross-cutting challenges. The focus within Europe on implementing the Europe 2020 Strategy, which aims at smart, sustainable, and inclusive growth and the focus on addressing the grand societal challenges are in line with this general trend. So too at global level is the current development of the post Rio+20 sustainable development goals [Box 1]. There are moves toward more coherent approaches to policy making based on developing

integrated policies that cut across hitherto separately-addressed policy areas, such as poverty alleviation and habitat conservation. In order to support more coherent policy making, efforts are being made to provide more integrated scientific support. At the global scale, the new Future Earth project is in this direction [Box 2].

Box 1: Rio+20: Sustainable Development Goals

At the Rio+20 United Nations' conference in June 2012, the world's governments agreed to produce over the next 2 years a set of Sustainable Development Goals (SDGs), which should be integrated into the United Nations development agenda beyond 2015. The Rio+20 outcome document proposes that the SDGs must be "action-oriented, concise and easy to communicate, limited in number, aspirational, global in nature and universally applicable to all countries while taking into account different national realities, capacities and levels of development and respecting national policies and priorities". An intergovernmental Open Working Group on SDGs is charged with producing the SDGs. In its capacity as a Co-organising Partner for the Scientific and Technological Community Major Group for Rio + 20 and follow-up at the United Nations, the International Council for Science (ICSU) is seeking to convince governments of the need to utilise the best possible interdisciplinary scientific knowledge in this process.

A major challenge ICSU foresees in producing the SDGs is the interdisciplinary nature of sustainable development, which cuts across economic, environmental and social dimensions in ways that are not well understood, requiring "the best available knowledge to analyse these linkages, possible synergies and trade-offs". In a comment in Nature (Glaser, 2012) argues ICSU's position that "the SDGs must be based on science and on cross-disciplinary themes rather than separate pillars of economy, environment and social development". Themes proposed to date include: integrated water management; energy for sustainable development; sustainable and resilient cities; healthy and productive oceans; enhanced capacity of natural systems to support human welfare; improved efficiency and sustainability in resource use; and, enhanced employment and livelihood security. The United Nations Department of Social and Economic Affairs (UN-DESA), ICSU and the International Social Science Council (ISSC) organised an Expert Group Meeting on "Science and Sustainable Development Goals" in March 2013 to provide an entry point for the scientific community to inform the Working Group on SDGs and as a first step in opening a dialogue between scientific experts, government representatives and members of the Open Working Group.

Box 2: Future Earth

'Future Earth' is currently being planned as a ten-year international research initiative for global sustainability (www.icsu.org/future-earth) that will build on decades of scientific excellence of the four GEC research programmes (See: Appendix 1). The development of Future Earth has been at the request of the Science and Technology Alliance for Global Sustainability, which brings together organisations that represent the international science community, funders and users of environmental research, and environmental information providers. Today, these include ICSU, ISSC, the Belmont Forum, IGFA, UNEP, UNESCO, UNU and WMO as an observer. Future Earth builds on and will bring together the research and capacity developed through the current Global Environmental Change programmes – IGBP, DIVERSITAS, IHDP, WCRP –, their projects, and their partnership ESSP – and seeks to introduce a more integrated scientific and organisational approach to the sustainability challenges faced by society. The 'Alliance' has charged a team composed of scientists, sponsors and users, under the leadership of Professor Johan Rockstrom and Professor Diana Liverman, to develop the initial design of Future Earth. The initial design report will be completed by early 2013, and the focus is now moving to the implementation of Future Earth. The Earth System Science Partnership (ESSP) will close and transition into 'Future Earth' as it develops over the next few years.

3.2 The status of sustainability science

Already more than a decade has passed since 'sustainability science' was identified and established as a recognised research domain. The foundational work in the US and Europe (e.g. Kates et al 2001; Clark, 2003; Weaver and Jansen, 2004) involved defining sustainability science in terms of main dimensions, characteristics, challenges and distinctive features, and classifying it. Sustainability science is considered to lie in the category of 'use-inspired basic research', the so-called Pasteur's Quadrant in Stokes' typology of science and is regarded as 'critical' science, since it challenges the status quo of prevailing development, policy and scientific paradigms. Definitions emphasise its normative, systems-based, forward looking and transformative aspects and that uncertainty is an intrinsic feature of its subject matter.

Although sustainability science is now recognised as a research domain, its practices have developed through many disparate initiatives, carried forward by different scientists and scientific groups in many different contexts, often emphasising different methodological approaches, reference frameworks, themes and perspectives. While the diversity and innovativeness of the scientists involved has led to experimentation with a wide range of tools, methods and practices, the development has not been strategically coordinated or systematically and comprehensively studied and evaluated. Efforts among various small groups of practitioners reflect different topical interests. There is no overarching umbrella organisation bringing these strands together. The field is still characterised by fragmentation. There is therefore a lack of coherent evidence relating either to effective practices or to enabling conditions for effective practice.

The VISION RD4SD Project has identified specific skills that scientists in the RD4SD domain need if they are to contribute most effectively to more sustainable development.

However, our project is not alone in setting out these core competences or in recognising that there is a competence gap in the RD4SD domain that needs to be filled.

A study organised by Arizona State University[2] has sought to define the knowledge and skill profile of sustainability scientists as "future problem solvers, change agents and transition managers" (Wiek et al, 2011). Wiek defines competencies in sustainability in general as "complexes of knowledge, skills and attitudes that enable successful task performance and problem-solving with respect to real-world sustainability problems, challenges and opportunities". Five core competences are identified: systems-thinking, strategic, normative, anticipatory and interpersonal. The study describes how the different core competencies relate to each other and emphasises that a comprehensive approach to sustainability research and problem solving requires their integration.

A recent report to the United Nations Office on Sustainable Development (UNOSD) acknowledges that: "the nature of knowledge and, with it, sustainable development knowledge is changing" and that "this has profound implications for the practice of sustainable development and for the process of building capacity to implement it". It states further that: "these changes combine with the emergence of networked governance, increasing the importance of boundary work, facilitation and mediation; and these underscore the need for UNOSD to develop its knowledge sharing, capacity building and networking activities and provide suggestive guidance for this development". The

[2] The study involved a literature review and an international survey of leading experts and practitioners in sustainability science institutions around the world (see: Wiek et al, 2011).

report recommends, inter alia, that UNOSD develop (or identify) new, specialised tools and methods for knowledge management and implementation of sustainable development, help build capacity for managing and participating in networked governance, and train people on effective boundary work, which the report defines as involving managing the interfaces between science, policy, and stakeholder groups and building strong networks among the people in these groups. While national officials (rather than scientists) are the core target group for UNOSD, the same drivers, functions, capacities and competences as we identify in VISION RD4SD as relevant to the "gap" are identified in the UNOSD report.

3.3 Learning from practice

Neither is our project alone in recognising that the current gap is not just one of a lack of appropriate training or exposure of scientists to good practices, but is also one of a lack of knowledge about what constitutes good and effective practice, such that filling the gaps depends on organising and undertaking more (and more consistent) context-sensitive research into RD4SD practices and their effectiveness.

The ESF MO Forum on Science-in-Society (SiS) has recently concluded that SiS activities need to be analysed by research.[3] "The embedding of SiS in diverse cultures is a fruitful field of research. A common European view on SiS and SiS practices needs to be elaborated with simultaneous consideration of the diversity of local and national contexts and situations… The definition and design of European science policy cannot be divided and managed only through thematic societal challenges and disciplinary actions. **There is a need for an exchange of practices as well as themes from an academic point of view at European level and this might be one of the places where exchange could be developed across the globe**" (ESF MO Forum Science in Society, 2012, pg. 26.) This last remark is also especially pertinent, since it points to the potentially greater value that could come if a European effort is part of a global effort.

The recent book *"Disciplining Interdisciplinarity: Integration and Implementation Sciences for Researching Complex Real-World Problems"* by Gabriele Bammer [available on-line at: http://epress.anu.edu.au] comes to similar conclusions about the need for a new style of science, the tasks involved in implementing this new science, the core competencies that are implied, and the need for reflexive processes so that lessons from practice can be used to inform future practice . Bammer calls this new style of science "*Integration and Implementation Science (I2S)*." She structures the competencies into three domains and, for each, reviews the state-of-the-art. The three domains she identifies are: synthesising disciplinary and stakeholder knowledge; understanding and managing diverse unknowns; and, providing integrated research support for policy and practice change. In a prospective section, "Moving Forward", Bammer considers how I2S functions as a discipline and outlines a virtuous cycle between capacity, demonstrated success, and funding. She explores the scope and feasibility of a drive to develop I2S and outlines ways of enhancing I2S by working on problems; transmitting findings; fostering widespread awareness and appreciating different levels of expertise; establishing proof-of-concept; building capacity; etc.

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3 http://www.esf.org/index.php?eID=tx_ccdamdl_file&p[file]=40454&p[dl]=1&p[pid]=3728&p[site]=European%20Science%20Foundation&p[t]=1365956193&hash=b268a9da4b533ea1891411be8b56f6c3&l=en

3.4 Evaluation

Learning from experience is essential for competence building. This requires a dynamic and continuous interplay between past, present and future practices mediated through reflexivity based on systematic evaluation, in context, of a diversity of RD4SD programmes and projects in order to highlight general principles and distinguish these from factors that are context-specific. Evaluation – to establish which practices are successful and in which contexts – is key to identifying good practices and developing the core competences, just as it is for designing and evaluating research programmes and assessing research impact. Approaches to evaluation and valuation (e.g. social valuation) of research and research outcomes have, therefore, become important topics of innovative R&D on the part of science policy makers, science funders and scientists (see, for example, the ad hoc study on evaluation).

The large number of organisations that have recently instigated work on methods and schemes for evaluating the new style of research and valuing its outcomes and impacts is an indication of strong awareness on the part of the research and research funding communities of the needs identified in the VISION RD4SD dialogue and suggests a receptive context for the initiative we now propose. These include European organisations, such as the European Foundation Centre,[4] the European Science Foundation,[5] and the European Commission, and national agencies, such as the German Federal Environmental Protection Agency and Research Councils UK. In principle, those who have engaged directly or indirectly[6] in organising, funding, or contributing to the development of methods and schemes for valuing and evaluating RD4SD and/or related activities are candidate stakeholders in an initiative to build and strengthen capacities and communities involved in RD4SD.

3.5 Leveraging returns on R&D investments

The economic and financial downturn is also a very relevant contextual factor. It has created a more challenging context for science generally and for RD4SD specifically, but this also brings opportunities. Some European countries frame R&D as a vital driver of innovation and maintain their investment in R&D even (and especially) in times of austerity, while others frame their expenditure on R&D as a cost and are cutting their R&D budgets and/or are seeking to leverage greater private investment in R&D. Everywhere, however, there is a heighted concern to achieve greater societal returns on public investment in science and to encourage closer working between science and business and societal stakeholders. There is policy recognition that a new form of development is needed. The economic downturn has achieved some policy reframing, pushing to the fore more integrative development concepts, such as 'green' growth, the 'green' economy and 'social' innovation, which stress means and ends other than only economic growth.

RD4SD is directly relevant to efforts to stimulate green growth and address societal challenges that are beyond the scope of traditional approaches. Furthermore, the core characteristics of sustainability science – interdisciplinarity, transdisciplinarity and knowledge integration/synthesis – and the methods pioneered in sustainability science to address the challenges these imply are increasingly seen by science policy makers to be important for increasing the economic and social impact of science generally. RD4SD therefore has both direct value in stimulating recovery through a

[4] http://www.efc.be/
[5] http://www.esf.org/
[6] Indirect engagement could be, for example, as a member of one of these organisations.

green economy and addressing societal challenges, and indirectly has value as a pioneer of methods that are relevant for leveraging the impact of other investments in science. This offers a strong argument that investment in capacity-building is not a cost, but rather is a potentially high-yielding investment that will help deliver greater returns across a wide range of other R&D investments, especially by supporting bottom-up initiatives that contribute to the implementation and delivery of top-down policy goals, which is needed in an innovation and implementation system with distributed agency.

3.6 Other initiatives

Comparable initiatives are being organised or are already underway in other world regions.

The UNOSD report states that: "UNOSD can add value to existing SD processes by building the capacity of …lead actors to communicate effectively and to create a climate of reciprocal, responsive engagement through an explicit focus on boundary work. The concrete skills should include the use of practical tools such as participatory modelling, serious games, dialogue processes, the use of whatever communication channels are the most effective (currently social media) and decision support processes such as decision theatres and scenario exercises" (UNOSD, 2012).

The authors of the I2S initiative, based at the Australian National University, are planning to host the First Global Conference on Research Integration and Implementation in Canberra, Australia, September 2013 [http://www.i2sconference.org/]. The conference has the objectives of: linking networks by bringing together researchers and educators who use systems-based, action-oriented, multidisciplinary, interdisciplinary, or transdisciplinary approaches; taking stock by learning from case studies that tackle complex real-world problems and compiling effective concepts and methods for synthesising knowledge, managing risk and other unknowns, and supporting policy and practice change; and planning for the future by identifying common ground, establishing synergies, and joining forces. The I2S Conference will be complemented by co-conferences bringing together participants in locations other than Canberra, Australia. They will follow the plenary presentations (some live, some recorded, depending on the time difference), will organise their own discussions and their own networking events. The outcomes of their activities and deliberations will be presented to the whole conference. To date two co-conferences are planned in Europe: one is being arranged by Leuphana University, Germany[7]; the other (subject to funding) will be held in the Netherlands.[8] Importantly, while I2S is an Australian initiative, it is international and global in its outlook.

The International Society for Sustainability Science (ISSS) was founded in 2012 by Arizona State University (USA), La Sapienza University of Rome (Italy), The University of Tokyo (Japan), and the United Nations University [http://sussci.org/]. Its creation followed two earlier initiatives by these four universities: the development of an annual international conference on sustainability science (ICSS) and the launching of an academic journal, *Sustainability Science*. The ISSS website states that: "its over-arching goal is to overcome the limitations of traditional fragmented academic disciplines in building sustainable society. ISSS will promote integration and cooperation among diverse academic fields and across geographic and national borders with a particular focus on developing

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and enhancing top-flight academic programs in sustainability science." To meet these goals, ISSS plans to:

- Strengthen academia's reception of and commitment to education in sustainability science through the sharing of experiences and celebration of institutional success;
- Create, enhance, and promote a scientifically-based vision of a sustainable future for the world and its inhabitants through the society's focus on education;
- Provide expanded opportunities for international and interdisciplinary collaborations among faculty and students engaged in sustainability science research and education;
- Expand opportunities for universities and research institutions located in developing countries to participate in these collaborations;
- Promote development of a new base of scientific knowledge that is specifically aimed at societal transformation for sustainability;
- Strive to enhance synergies and reduce duplication of effort within the community of sustainability science scholars.

The 2013 ISSS International Conference on Sustainability Science is scheduled to take place at Aix-Marseille Université , France, 16-17 September [http://icss2013.univ-amu.fr/].

The International Network for Interdisciplinarity & Transdisciplinarity (INIT) [http://www.inidtd.org/] has been formed recently by representatives from the US-based Association for Integrative Studies (AIS), the European-based Transdisciplinarity-Net (td-net), and the Center for the Study of Interdisciplinarity (CSID) at the University of North Texas in the US. INIT seeks to provide an international platform for discussion and promotion of interdisciplinary and transdisciplinary research, teaching, and policy. INIT will inventory existing understandings, facilitate and enhance communication, and stimulate new research. INIT has been launched because the field of interdisciplinarity (ID) and transdisciplinarity (TD) is quite diversified, consisting of different subgroups with different strengths, emphases, applications, and perspectives. INIT is envisioned as facilitating communication and collaborative work among organizations, institutions, and individuals that view ID and TD as a vibrant way to respond to the challenges of 21st century society. To further its mission, INIT plans to hold seminars, workshops, and conferences to inaugurate this community and to develop a common agenda.

3.7 International aspect

Given that several similar initiatives are currently underway or are in process of being launched from bases in the US, the Asia-Pacific region (Japan, Australia) and Europe, it will likely be needed to coordinate and consolidate the international efforts in order to capture synergies and avoid duplication. This has implications, which include a need to identify a possible umbrella organisation to establish relationships among the initiatives. Importantly, the initiatives with US or Asia-Pacific based leadership are not regional initiatives as such. They are global initiatives led by organisations from these regions. Indeed, the globalisation of science means that most of the most significant communities and networks in the domain of sustainability science and many facilities are international rather than regional and it is difficult to identify specifically or uniquely regional communities and networks, albeit some have been initiated from a specific region and have a majority of members from one region.

The International Council for Science (ICSU) is potentially relevant as an umbrella organisation. Capacity building is integral to all aspects of its mission. Elements of ICSU's current strategic plan

include ensuring that capacity building is given due attention in all the activities of the ICSU family and in relevant policy fora. Relevant ICSU executives and personnel include its Executive Director, Steven Wilson, and the Senior Advisor on science for sustainable development Gisbert Glaser. Steven Wilson was previously at Natural Environment Research Council (NERC), as Director, Strategy & Partnerships, in which role he helped found the Belmont Forum of international environmental research funders, later becoming its co-chair and securing a number of national and international partnerships.

Another possibility to which this study returns later is to consider whether there is a role here that the International Institute for Applied Systems Analysis (IIASA) might usefully play.

3.8 Organisational form for any European initiative

The European science policy landscape is currently in some state of flux with the move from the Framework Programmes to Horizon2020, with less clarity yet over future programmes and over the future availability of specific funding instruments. The uncertainty may, in part, explain why other advocates of European initiatives have not yet been explicit about preferred organisational form. In recommending further research on SiS, its importance and impact, the ESF MO Forum on SiS notes that: "a common European view on SiS and SiS practices needs to be elaborated… [which] would also mean the animation of a network of researchers" and that "ESF and Science Europe could be the place to launch a proposal to members to initiate common SiS research programmes in cooperation with the European Commission", but states explicitly that "it does not want to propose exactly what form should be adopted" (ESF, 2012, pg. 26).

4. Existing communities, networks and resources

4.1 Development of the domains of sustainability research and sustainability science

The field of sustainable development research has expanded markedly since the 1992 UNCED (Rio) Conference on Environment and Development. Databases provided on the website of the journal, *Sustainability: Science, Practice and Policy* give some indication of the scales of the practitioner and student communities now involved in sustainability research and of currently available capacity- and capacity-building opportunities in different regions. It lists more than 100 worldwide educational institutions offering over 200 degree-awarding sustainability programmes. It also provides a searchable list from COS Scholar Universe™ with profiles of over 350,000 sustainability researchers. These listings – albeit extensive – are far from comprehensive.

The broad nature of sustainable development and approaches to its study means that many disciplines may engage in sustainability research, including: economics; engineering; geography and physical/spatial planning; ecology; development studies; management science; politics, political and policy science; health; law; ethics; etc.

New interdisciplinary fields have also emerged to address the interactions between the bio-physical and the socio-economic elements of social-ecological systems. Examples include: environmental economics, ecological economics, and industrial ecology; sustainability governance and public engagement; sustainable design and green design; corporate social responsibility, business ethics and ethical finance; etc.

Concerns for sustainable development and the inter-disciplinary, trans-disciplinary, and integrative aspects of sustainability have also been a stimulus for researchers in systems science, complexity science, modelling and simulation, integrated assessment, impact evaluation, systems dynamics, and transitions.

However, only a subset of the total volume of research related to sustainable development could actually be considered to be RD4SD in the sense meant in the VISION RD4SD project.

4.2 International or Global Societies, Communities and Networks

Some of the most active communities and networks in sustainability science have been mentioned already in section 3. These include:

- The International Society for Sustainability Science (ISSS) [http://sussci.org/]
- The I2S initiative [http://www.i2sconference.org/], which is led by the Australian National University.
- The International Network for Interdisciplinarity & Transdisciplinarity (INIT) [http://www.inidtd.org/]

Other important communities include:

- The European Sustainability Science Group [www.essg.eu]

- The Integrated Research System for Sustainability Science (IR3S) [http://www.ir3s.u-tokyo.ac.jp/index_e.html] – a collaboration of Japanese Universities (the University of Tokyo, Osaka University, Ibaraki University, Hokkaido University, and Kyoto University), which aims to be a global research and educational platform for sustainability science. It develops and promotes sustainability science *inter alia* through collaboration with other leading groups around the world and by (jointly) establishing leading international research platforms in this field. One such platform is the International Sustainability Science Society (see earlier in this report).

- The Resilience Alliance [http://www.resalliance.org] – aims help bridge three gaps its members perceive in understanding and resolving complex issues involving people and nature: the conceptual gap created by partial theories and concepts inherent in scientific disciplines; the knowledge gap between science and policy or between understanding and action; and the communication gap, created by limitations of existing media for scientific discourse. Member include: Aga Khan University, Faculty of Arts and Sciences (East Africa), ARC Centre of Excellence for Coral Reef Studies, Arizona State University, Global Institute of Sustainability, Beijer International Institute for Ecological Economics, Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), CSIRO Sustainable Ecosystems, Emory University, Indiana University, Duke University, McGill School of the Environment and Department of Geography, McGill University, School of Resource and Environmental Management, Simon Fraser University, South Africa National Research Foundation, Stockholm Environmental Insititute (SEI), Stockholm Resilience Center, The Dutch Node, University of Alaska Fairbanks, University of Exeter , and the University of Nebraska. An official vehicle for its members is the journal *Ecology and Society* [See: Box 3].

- The Network for Transdisciplinary Research (td-net) [http://www.transdisciplinarity.ch/] is an initiative of the Swiss Academies of Arts and Sciences. In 2000 the Swiss Academic Society for Environmental Research and Ecology (SAGUF) launched the network. In 2003 it was taken over by the Swiss Academy of Sciences (SCNAT), with support of the three further Swiss Academies. The network was initiated to advance transdisciplinary research in all thematic fields. Its origins are, however, the experiences made in the fields of environmental and sustainability research. As a platform, td-net advances the mutual learning between inter- and transdisciplinary researchers and lecturers across thematic fields, languages and countries and thereby supports community building. As a centre of competences td-net disposes of expertise, methods and tool for coproducing knowledge, which it deploys in inter- and transdisciplinary projects. The network also assists the Swiss Academies of Arts and Sciences in facilitating exchange and collaboration between disciplines and between science and society.

- The Association for Integrative Studies [http://www.units.muohio.edu/aisorg/index.shtml] is based in Ohio but has an international membership. It is the professional association devoted to interdisciplinarity. The Association promotes the interchange of ideas among scholars, teachers, administrators, and the public regarding interdisciplinarity and integration; advances the exploration of key terms and seeks out new theoretical models essential to interdisciplinarity and integration; sustains the development of real-world applications of interdisciplinarity and integration; and, encourages high quality interdisciplinary curriculum development at both the undergraduate and graduate levels.

- The Sustainability Transitions Research Network (STRN) [http://www.transitionsnetwork.org/] was created in 2009 following a conference that confirmed the existence of a critical mass of researchers in Europe and beyond who are actively working on various aspects of the governance and scientific analysis of sustainability transitions. Membership of the STRN is open to researchers from any field who are actively engaged in researching sustainability. The network offers, *inter alia*: a conference series; a forum for discussion and debate at the leading-edge of transitions research; an online seminar series; and email updates about the network and its members' activities, relevant events, etc. The society has a dedicated journal, the *Journal of Environmental Innovation and Societal Transitions* [See: Box 3].

- The Integrated Assessment Society (TIAS) [http://www.tias-web.info/] supports and promotes the community of scientists and practitioners who develop and use Integrated Assessment (IA).[9] TIAS defines IA as "the interdisciplinary process of integrating knowledge from science and stakeholder groups in order to evaluate a problem situation from a variety

[9] IA builds on two major methodological pillars: approaches to integrating knowledge about a problem domain, and understanding policy and decision-making processes. IA is applied to the analysis and management of complex human-environment interactions at various scales. It has been developed for addressing issues such as climate change, land degradation, water and air quality management, forest and fisheries management, and public health.

of perspectives and contribute to its solution." The goals of TIAS are to nurture this community, to promote the development of IA, and to encourage its wise application, including in the management of the environment and natural resources and in supporting transitions to sustainability. A key role of the society is to provide fora for the promotion of IA, exchange of experiences, and development of new activities. TIAS has therefore organised conference sessions and workshops on topical interdisciplinary themes. It hosts 'webinars' or online seminars in order to engage its members in IA dialogues. It hosts or co-sponsors an international summer school and runs shorter training courses on IA methods, such as uncertainty analysis and stakeholder collaboration. TIAS maintains and makes available a compendium of relevant literature, data sources and models, as well as training and education materials, and job openings. IA news is published in the TIAS newsletter and interim updates.

- The Alliance for Global Sustainability (AGS) is an international partnership created in 1997 involving four science and technology universities: the Swiss Federal Institute of Technology (ETH), Zurich; Massachusetts Institute of Technology; University of Tokyo; and Chalmers University of Technology [http://globalsustainability.org/content.cfm?uNav=27&uLang=1]. AGS seeks to improve scientific understanding of global environmental challenges, develop technology and policy tools to help societies reconcile ecological and economic concerns, and educate a new generation of leaders committed to meeting the challenges of sustainable development.

- The University Network for Climate and Ecosystems Change Adaptation Research **(**UN-CECAR) was established in 2009 by leading universities in the Asia Pacific region to strengthen the higher education sector to respond effectively to climate and ecosystems change [http://cecar.unu.edu/]. Its members include: Indian Institute of Technology, Delhi, Bangladesh University of Engineering and Technology, Institute of Engineering (Nepal),University of Peradeniya (Sri Lanka),Chinese Academy of Forestry, Ibaraki University, Institute for Global Change Adaptation Science, Integrated Research Systems for Sustainability Science, Keio University, Kyoto University, Ritsumeikan Asia Pacific University, Tsinghua University, The University of Tokyo, UNU Institute for Sustainability and Peace, Waseda University, Yeungnam University, Asian Institute of Technology, Gadjah Mada University, National University of Malaysia, University of Philippines, Viet Nam National University, The Australian National University.

Although not strictly involved in sustainability science, important work is being done within the some communities of economists and engineers to integrate sustainability into these disciplines and to apply hybrid research to societal concerns. Important communities in these respects include:

- International Society for Ecological Economics (ISEE) [http://www.isecoeco.org/about/regional-societies/] was founded in 1987 to help bring economic, social and natural science analyses together in new perspectives to respond to the concerns for sustainability. It is the umbrella society for several regional societies, including the European Society for Ecological Economics (ESEE) [http://www.euroecolecon.org/]. ESEE was inaugurated in 1996, during the International

Conference Ecology Society Economy hosted by the Université de Versailles St Quentin en Yvelines, France.

- The Engineering Education in Sustainable Development (EESD) network [https://www.upc.edu/eesd-observatory/] has been active for more than a decade, organising biennial conferences since 2002 and producing books and special issues of journals devoted to developing and sharing educational materials and experiences relating to integrating sustainability awareness into the undergraduate and postgraduate engineering curriculum. EESD began as a European initiative of three European Universities and has a predominantly European orientation (especially in the membership of its Scientific Committee), but it also has an International Advisory Panel and it is linked both to parallel initiatives in other world regions, such as the New Zealand Sustainability Society, NZSS, (formerly the New Zealand Society for Sustainability Engineering) and to several global initiatives, including the Global University Network for Innovation (GUNi), and the Global University Partnership for Environment and Sustainability (GUPES). The background to the establishment and mission of the EESD is set out in its 2004 Barcelona Declaration [Full text available at: http://www-eesd13.eng.cam.ac.uk/conference/barcelona]. The network has three partner journals: The Journal of Cleaner Production, The International Journal of Sustainability in Higher Education, and Engineering Sustainability.

- The New Zealand Sustainability Society (NZSS) [http://www.thesustainabilitysociety.org.nz/] is a Learned Society established to foster sustainability engineering. It provides training and fosters dialogue on sustainability through workshops, seminars, forums and international conferences. It was known formerly as the New Zealand Society for Sustainability Engineering and Science (NZSSES). NZSSES/NZSS has hosted a biennial international conference series since 2004 with sessions and papers devoted, inter alia, to sustainability science and its practice.

4.2 Sustainability science resources

There has been a rapid development over the past decade of internet-based platforms providing resources relevant to the needs of RD4SD researchers and practitioners. Notable platforms include:

- The American Association for the Advancement of Science (AAAS) hosts the Forum on Science and Innovation for Sustainable Development [http://sustainabilityscience.org/]. The forum provides an online list and survey of sustainability science programmes from across the globe that approach sustainability from the perspective of science, technology, and innovation. It highlights people and programmes that are studying nature-society interactions and applying the resulting knowledge to create sustainability transitions. Forum content is organized and cross-referenced within a Framework comprised of Critical Sectors, Development Goals, Geographic Region, Geographic Scale, and Research Themes.

- Network of Networks [http://nns-u.org/index.html]: a website mapping the communities and networks involved in sustainable development, including sustainability science.

- Sustainable Development (SD) Gateway [http://sdgateway.net]: a website hosted by the International Institute for Sustainable Development that integrates the online information developed by members of the Sustainable Development Communications Network. It provides access to over 1,200 documents available on sustainability-related topics and hosts services such as a calendar of events, a job bank, a roster of mailing lists (listservs), and news sites dealing with sustainable development.

- The Sustainable Communities Capacity Center [http://www2.uwsuper.edu/sustainability/index]: an online resource that aims to build capacity of the local governments, the businesses and the public to engage in sustainable community development.

- Learning for Sustainability [http://learningforsustainability.net/]: a guide to on-line resources about participation, engagement, and inter- and trans- disciplinary working that is designed for government and agency staff, NGOs, researchers and other community leaders working in community development, public health and natural resource management sectors. It acts as a gathering point for resources developed in these separate sectors and supports the sharing of ideas across sectors. The site structure highlights activity areas considered to be prerequisites for social learning, including: networking, dialogue, adaptive management, knowledge management, and evaluation. The site provides a short introduction to each section and links to key manuals and guides. A separate section is devoted to integrated and interdisciplinary research approaches. This section is also developing links on research methods, links to interdisciplinary journals, and tips for writing and communication.

- The Sustainable Cities Network [http://www.sustainablecitiesnet.com/] : an on-line resource to showcase and inventory international environmental initiatives, models, and resources that contribute to creating sustainable cities. The site also acts as a portal of communication and support to members of Sustainable Cities throughout the world.

- World Sustainability Forum [www.sciforum.net]: MDPI, an international publishing house for scientific journals, based in Basel, Switzerland sponsors a platform for electronic, scientific conferences (sciforum)and also publishes scientific open access journals, including *Sustainability* [See: Box 3]. The platform hosts a sustainability-related conference: the World Sustainability Forum. The 3rd World Sustainability Forum is scheduled for November 2013.[10] The Forum is an electronic conference, which is designed to provide a platform for rapid, direct and accessible exchanges about research findings and experiences, offering a possibility for global meetings with no limitations related to traveling. Participation is free of charge.

[10] Areas covered include: environmental sustainability; corporate sustainability strategy; social values for a sustainable economy; energy efficiency and renewable energy sources; sustainable urban development; sustainable development policy and practice; sustainability entrepreneurship and sustainability innovation; and, remote sensing for sustainable management of land and biodiversity.

Some of the key journals that are outlets for sustainability science are listed in Box 3. Some of these journals are dedicated to sustainability science, while others are science journals that address sustainability issues more generally, but sometimes publish papers on sustainability science topics.

Box 3: Journals in Sustainability Science and Sustainability

Sustainability Science: Proceedings of the National Academies:
http://www.pnas.org/misc/sustainability.shtml

Sustainability Science:
http://link.springer.com/journal/11625

Sustainability: Science, Practice and Policy:
http://sspp.proquest.com/

Sustainable Development:
http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291099-1719

Sustainability:
http://www.mdpi.com/journal/sustainability/

Ecology and Society:
http://www.ecologyandsociety.org/index.php

Journal of Environmental Innovation and Societal Transitions: http://www.journals.elsevier.com/environmental-innovation-and-societal-transitions/

The Journal of Transdisciplinary Environmental Studies (TES):
http://www.journal-tes.dk/

Environment, Development and Sustainability:
http://www.springer.com/environment/sustainable+development/journal/10668

Environment: Science and Policy for Sustainable Development:
http://www.environmentmagazine.org/

International Journal of Innovation and Sustainable Development (IJISD):
http://www.inderscience.com/browse/index.php?journalCODE=ijisd

International Journal of Sustainable Development (IJSD):
http://www.environmental-expert.com/magazines/international-journal-of-sustainable-development-ijsd-3472

International Journal of Environment and Development:
http://www.inderscience.com/browse/index.php?journalCODE=ijesd

The International Journal of Sustainability in Higher Education
http://www.emeraldinsight.com/products/journals/journals.htm?id=ijshe

Engineering Sustainability
http://www.icevirtuallibrary.com/content/serial/ensu

Current Opinion in Environmental Sustainability
http://www.journals.elsevier.com/current-opinion-in-environmental-sustainability/

5. Organisational forms

Several different groups around the world, as well as within Europe, identify the need to build RD4SD capacities and recognise this must be based on establishing mechanisms for both developing new knowledge and knowledge sharing. However, there is generally less clarity over what organisational form these mechanisms should take.[11] Candidates forms include: networks, centres of excellence, competence centres, platforms and programmes. This section describes 'models' of different organisational forms, some instruments in the science and science policy domains that have been used for creating these, and experience with these forms and instruments to date. It provides a basis for assessing their relative strengths and weaknesses and degree of 'fit' with the intention of building relevant RD4SD capacities, establishing a reference framework for RD4SD, and strengthening and serving the RD4SD community on a continuing basis.

5.1 Networks

Scientific and thematic networks are particular types of social network.[12] Networks are defined by the properties of relations between and within constituent units, instead of the properties of these units themselves. In general, social networks are self-organizing, emergent, and complex.

A mapping and review of the SD-network landscape covering 70 knowledge, capacity building and sustainable development (SD) networks has recently been made by Alan AtKisson on behalf of the United Nations Office for Sustainable Development (UNOSD, 2012). Networks were analysed in this review in relation to the purposes served, geographical scope, theme or sector, vitality, lifespan, and governance. Some of the more important networks in the survey include: ICLEI,[13] Balaton Group,[14] Earth Charter Initiative,[15] and LEAD International.[16] Six purposes identified in an earlier study of SD-related networks (Waddel, 2010) were used. These include: accelerating the spread of knowledge; realising benefits of scale; innovating; enhancing coherence; improving coordination; and integrating the (complementary) resources, knowledge and skills of network members.

[11] In recommending further research on SiS, its importance and impact, the ESF MO Forum on SiS notes that: "a common European view on SiS and SiS practices needs to be elaborated… [which] would also mean the animation of a network of researchers" and that "ESF and Science Europe could be the place to launch a proposal to members to initiate common SiS research programmes in cooperation with the European Commission"… however, Forum Members state explicitly that they do not want to propose exactly what form should be adopted, (ESF, 2012, pg. 26).

[12] A social network is a theoretical construct useful in studying relationships between individuals, groups, organizations, or even entire societies and for defining social structures determined by such interactions.

[13] International Council for Local Environmental Initiatives, established 1990 as a clearinghouse on sustainable development and environmental protection policies, programs, and techniques being implemented at the local level.

[14] The Balaton Group was founded in 1982 by the authors of the 1972 book *The Limits to Growth* to review the state of the art of natural resource modelling and to identify ways to advance the theory and the practice of natural and environmental resource management. It promotes long-term, systems-based perspectives on sustainable development.

[15] The Earth Charter is a civil society initiative with a mission to promote the transition to sustainable ways of living and a global society founded on a shared ethical framework, which are set out in the Charter. A goal is to promote recognition and use of the Earth Charter as a soft law document that includes respect and care for the community of life, ecological integrity, universal human rights, respect for diversity, economic justice, democracy, and a culture of peace.

[16] LEAD is the world's largest international non-profit organisation focused on leadership and sustainable development.

Findings of potential relevance for the VISION RD4SD project include that most networks in the SD domain exist to accelerate the spread of knowledge; few networks are very long-established and/or have maintained high-levels of activity on a consistent and continuous basis; and, many networks have experienced one or more periods of low- or zero- activity. The longest-lived network among those surveyed is the Balaton Group, which has lasted more than 30 years and, in this regard, is an exception. Important factors contributing to network success were found to include "clarity over the shared outcomes and mutual benefits that the network aims to produce for all its members." Networks were found more likely to succeed when they first "focus on meaningful work" and on "building an atmosphere of mutual trust" (UNOSD, 2012).

In the European context important science policy instruments for establishing networks have been the Network of Excellence instrument and the ERA-NET scheme.

The Network of Excellence (NoE) instrument was an innovation under FP6 and was continued under FP7. As defined by the European Commission *"Networks of Excellence are designed to strengthen scientific and technological excellence on a particular research topic by integrating at a European level the critical mass of resources and expertise needed to provide European leadership and to be a world force in that topic."* They are considered appropriate when: research capacity in the considered thematic area is fragmented; this fragmentation prevents Europe from being competitive at international level in that area; and the proposed integration of research capacity is likely to lead to higher scientific excellence and more efficient use of resources. NoEs aim progressively to integrate the activities of the network partners and to link national centres of excellence by providing frameworks for the exchange of researchers and for sharing data and facilities.

Activities of the networks cover three components constituting a "joint programme of activities". The components are: integrating activities, such as shared usage of equipment or infrastructures staff exchange schemes and joint supervisory bodies; a joint research programme; and activities linked to the spreading of excellence, such as training programmes and dissemination activities. Participants in the Networks mostly consisted of research centres, universities, research and technology organisations with businesses represented to the least extent. Importantly, however, NoEs have the mission to share excellence beyond the project participants.

NoEs were implemented across a wide range of thematic areas, but all have the common feature of dealing with fragmentation as their main objective aiming to shape the way of European research and to achieve durable integration as main deliverable. Due to the special activities of the Networks, the Commission introduced indicators to measure the quality of integration achieved within the projects:

- The extent of mutual specialisation and mutual complementarity, particularly through the regular co-programming of the partners' activities, through the building up of strengths and the shrinking of weaknesses, and perhaps through the relocation of resources;
- The sharing and development for common use of research infrastructures, equipment, tools and platforms;
- The regular joint execution of research projects;
- Interactive working between the partners using electronic communication systems;
- The joint management of the knowledge portfolio;
- Joint programme of training for researchers and other key staff;

- A coherent management framework that encourages staff mobility, staff exchanges, the interoperability of data and other systems, common approaches to science and society issues and gender equality in research.

The instrument has been only partially successful. Evaluations have emphasised the contribution of NoEs in developing interdisciplinarity, overcoming fragmentation, and supporting young researchers, but concerns include that many networks have failed to achieve durable integration. Most have been found to lack continuation or exit strategies. For this reason, an explicit objective of using the NOE instrument to develop long-lasting communities and centres of excellence that would continue the cooperation beyond the initial funding period was built into some calls, such as that for an NoE for Impact Assessment, which was won by the LIAISE consortium. Now coming to the end of its five-year funding period the LIAISE consortium is charged with developing and implementing a business plan to secure this legacy. The intention of the Commission is that future Centres of Excellence developed through NoE should be self-financing and not reliant on further block funding from the Commission.

The ERA-NET scheme[17] and experience with it is described in detail in the VISION RD4SD EU Case Study (Jäger and Jäger, 2001). The scheme was introduced in FP6 with the intention to avoid duplication in European R&D and to strengthen the coordination and coherence of public research programmes conducted at national or regional level. The ERA-NET scheme has continued under FP7, implemented under both the Cooperation and Capacities programmes. Under FP6, owners and managers of participating programmes were largely free to choose the topic areas of networking and cooperation.[18] Under FP7, the ERA-NET scheme takes a more strategic approach for the coordination and cooperation of national and regional research programmes, which is achieved by directly linking the ERA-NETs to the Calls and Themes of the Cooperation and Capacities Programmes. At the end of 2011 there was a call for ERA-NETs with a strong emphasis on "innovation for sustainable development".

ERA-NETs activities typically follow four steps:[19]

i. Systematic exchange of information and good practices on existing programmes
ii. Definition and preparation of common strategic activities
iii. Implementation of joint activities between national or regional programmes
iv. Funding of joint transnational research

ERA-NET actions should aim to progress to the fourth step and, ideally, should lead to cooperation between national or regional research programmes that continues beyond the duration of the ERA-NET action itself. The 'good practice example' of an ERA-NET described in the EU Case Study (Jäger and Jäger, 2011)[20] has tasks that resonate with those envisaged here in respect to strengthening

[17] Two specific action lines exist: 'ERA-NET actions', which provide a framework for actors implementing public research programmes to coordinate their activities e.g. by developing joint activities or by mutually supporting joint calls for trans-national proposals, and 'ERA-NET Plus actions', which in a limited number of cases with high European added value provide additional EU financial support to facilitate joint calls for proposals between national and/or regional programmes.

[18] According to the ERAWATCH classification, the most important research fields covered by the earlier ERA-NETs are "environment", "health" and "food, agriculture and fisheries".

[19] Provisions for the preparation of ERA-NET actions and their practical implementation - An issue paper serving as background document. DG Research, Version: 30 June 2010 (http://cordis.europa.eu/fp7/coordination/library_en.html Accessed 7 Nov. 2011)

[20] CIRCLE-2

RD4SD capacities; e.g. a work package focused on assessing the transferability of knowledge and sharing knowledge to support policy development and research programming.

At the time of the FP7 interim evaluation,[21] the number of ERA-NETs approached 120, with a total public funding commitment of about € 2 billion. Formal evaluations have shown the potential of the scheme to support coordination of non-Community research programmes and to reduce the fragmentation of the European Research Area. Experience shows ERA-NETs can be good instruments for joint funding initiatives and for reframing science policy. They can be used to kick-off new actions in a flexible way (see: Jäger and Jäger, 2001). Discussions at the Annual Joint Programming Event (Brussels, 9/10 November 2011)[22] indicated that the ERA-NET scheme, with some adaptations and improvements, will continue in Horizon 2020.

5.2 Centres of Excellence and Competence Centres

In general, the terms *centre of excellence* and *competence centre* refer to an entity that provides leadership, best practices, research, support and/or training for a focus area. Within an organization, a centre of excellence may refer to a group of people, a department, or a shared facility. It may also be known as a competency center or a capability center. The term may also refer to a network of institutions collaborating with each other to pursue excellence in a particular area. In academic institutions, a center of excellence often refers to a team with a clear focus on a particular area of research. Such a center may bring together faculty members from different disciplines and provide shared facilities. The term is also used in some countries to describe interdisciplinary teams and facilities within or across research organisations that provide research support predominantly to business and industry.

Competence Centres may exist within a single research institution (bringing together expertise from different departments and disciplines) or be formed from expertise drawn from different institutes.

Arnold et al (2004), observing that competence centres within Universities had, by 2004, become "an international phenomenon," stated that:

> *"it is not clear that competence centres were theorised as something conceptually distinct in the early stages… However, competence centres now have some recognisably special features relating to their role, especially:*
>
> - *They are normally funded by three partners: industry, university and a state agency. They are intended to have an effect on university resource allocation and strategy, in addition to reinforcing university-industry links. To this end, they involve an unusually high degree of subsidy, often around 60%.*
> - *They involve long term contractual arrangements, requiring a much bigger commitment than traditional project-by-project funding of collaborative R&D*
> - *They create new on-campus structures, and therefore make new organisational and structural demands on the universities*
> - *They are interdisciplinary and generally problem-focused in the research they do, demanding 'horizontal' networking across traditional university structures*

[21] Evaluation of the Seventh Framework Programmes (http://ec.europa.eu/research/evaluations/index_en.cfm?pg=fp7 Accessed 7 Nov. 2011)

[22] These discussions were in the context of a section of the conference specifically dedicated to the future of the ERA-NET instrument: "The future ERA-NET instrument: increasing impact and flexibility."

- *Their long-term presence on campus and their engagement with postgraduate education draws them into closer contact and co-operation with universities' 'core business' of education and research than is often the case with linkage actions, which tend to focus more purely on research*
- *By drawing industry personnel onto campus to join in research, they also extend academics' networks into the industrial research community*
- *It is central to the idea of competence centres that they aim to do more fundamental types of research than is normally possible in industry, or even in conventional academic/industrial collaboration."*

Several European countries have put in place programmes of competence centres. Here we describe programmes in Sweden and Switzerland, as illustrative.

The Swedish Competence Centres (NUTEK) Programme was launched in 1995 as an initiative in university-industry collaboration. Distinctive features included: a very high level of subsidy (up to two thirds), so that the centres can perform comparatively long-term research; and the long period (10 years) for which the centres received funding. These features were to allow the centres time to establish their reputations and build critical mass, to enable two whole generations of PhDs to be educated, and to encourage industry to take a long-term view that extends beyond single product generations. Peer reviews of the programme have confirmed its success in terms of scientific achievement and industrial relevance. An evaluation by the Technopolis group led to a recommendation to "maintain a rolling programme of competence centres", which "should form an important part of the R&D funding portfolio in the future" (Technopolis, 2004).

The Swiss National Competence Centres in Research (NCCRs) are a research instrument of the Swiss National Science Foundation. NCCRs promote long-term research projects in areas of vital strategic importance for the development of science in Switzerland, for the development of the Swiss economy, and for addressing needs of Swiss society. The NCCRs are intended to strengthen the Swiss research community in areas in which there is already a great deal of knowledge and outstanding research achievements. To do so a network of partner institutions in which researchers collaborate closely on an interdisciplinary basis is established around a centre of competence at a university or other higher-education research institution. Synergies are created within this network while the interfaces between the various disciplines are intended to give rise to new insights and innovation. The intent of the NCCRs is to generate a critical mass of expertise and state-of-the-art knowledge to enable Switzerland to keep pace with major research nations and to directly reinforce its scientific competitiveness. The instrument promises funding on a timescale that is unprecedented in Switzerland. The maximum funding duration is 12 years, considered to be a period long enough to enable new research fields to be developed and research approaches to be adopted on a trial and error basis. The instrument was launched in 2001. To date there have been four calls and the programme presently includes 27 NCCRs. NCCRs have proven to be a successful means of generating original and innovative research and for achieving knowledge and technology transfer.
NCCR's covering topics with RD4SD relevance include:

- The ecoinvent Centre - a Competence Centre of ETHZ, EPFL, PSI, EMPA and ART - is the world's leading supplier of consistent and transparent life cycle inventory (LCI) data of

known quality with the database ecoinvent data v2.2 and offers science-based, industrial, international life cycle assessment (LCA) and life cycle management (LCM) data and services.

- The Competence Centre Energy and Mobility (CCEM-CH) – a partnership of ETHZ, EPFL, PSI, EMPA and FHNW – focuses on the efficient provision of energy services, efficient and « zero-emission » energy conversion and on the substitution of fossil energy carriers by low-CO2 primary energies. CCEM-CH contributes to the lowering of CO2-emissions, increasing security of supply, decelerating the depletion of non-renewable resources, and reducing dependence on imported fossil energy carriers.
- The Competence Centre Environment and Sustainability (CCES) – a partnership of ETHZ, EPFL, PSI, EMPA, EAWAG and WSL – is largely based on the long-range re-orientation and focusing of the critical mass and excellence in science and engineering already existing at the partner institutions.

5.3 Knowledge Innovation Communities (KICs)

Knowledge Innovation Communities are structures created under the framework of the European Institute of Technology (EIT), an institute of the European Union located in Budapest, Hungary, which was established in March 2008 and set up in 2009. The EIT's activities are supported by the legally and operationally independent EIT Foundation. The EIT's mission is to increase European sustainable growth and competitiveness by reinforcing the innovation capacity of the Member States and the EU. To do so, the EIT has created integrated structures (Knowledge Innovation Communities or KICs), which link the higher education, research and business sectors to one another thereby boosting innovation and entrepreneurship.[23] KICs focus on priority themes with high societal impact. KICs should achieve impact by generating innovations that contribute to economic growth in their thematic area and to solutions of the Grand Challenges.[24] The first KICs to be established had the themes: Climate Change and Mitigation, Sustainable Energy, and Information Communication Technology. In subsequent rounds further topics have been added.[25] The themes that KICs address will be expanded over time, but no further review is scheduled before 2017. The final decision on new KICs is taken by the European Parliament and Council based on a Commission proposal.

KICs are organised as separate legal entities, which provide the physical infrastructure to bring together individuals from universities, research centres and businesses in geographical locations (16 centres) where all KIC partners work together face-to-face. The KICs implement specific projects, educational programs, funding schemes, etc. Key actors in KICs include: businesses (including SMEs); entrepreneurs; research and technology organisations; higher education institutions; investment communities (private investors and venture capital); research funders, including charities and foundations; local, regional and national governments. According to the EIT Regulation, the activity of a KIC must involve at least three independent partner organisations. The partners must be established in at least three different EU Member States and must include at least one higher

[23] Both the EIT and KICs are described in detail in the EU Case Study. See: Jäger and Jäger, 2011. A presentation on KICs was made also at the Lund Workshop, December 2012.

[24] A successful KIC theme must reflect an additional and compelling contribution to innovation as envisaged by the EIT, and must be able to attract significant EU and private funding. The guiding principle for selecting KICs is their ability to create lead markets beyond normal programmatic funding by integrating stakeholders from the knowledge triangle of both global and regional significance.

[25] Human Life and Health; Human Learning and Learning Environments; Food 4 Future; Manufacturing by and for Creative Human Beings; Security and Safety; and Mobility and Smart Cities.

education partner and one private company. With the intention of strengthening the innovation capacity, KICs may also include non-Member State partners.

5.4 Platforms

The concept of a 'platform' is more nebulous, but common features of platforms appear to be the bringing together (physically or virtually) of different interest groups and perspectives on a subject matter with the aims of information exchange, sharing experiences, and/or specifying and implementing a commonly agreed agenda or programme. Examples abound of intergovernmental platforms, stakeholder platforms, interdisciplinary platforms, community of practice platforms, etc., all of which stress the idea of a forum for information exchange, discussion and consensus building. The concept may also refer to the technological or other basis for the means of communication and information exchange among a group, such as the electronic platforms described earlier in this report that use web-based technologies to develop and share information, as a basis for communication and as a means for storing and accessing information. Typically, platforms have a host and/or sponsoring organisation (a facilitator). The facilitator maintains the platform, organises its activities, and provides support services. These may include technical means, a secretariat, etc.

Examples of stakeholder platforms are the European Technology Platforms (ETPs). In March 2003, the European Council called for a strengthening of the European research and innovation area by "creating European technology platforms bringing together technological know-how, industry, regulators and financial institutions to develop a strategic agenda for leading technologies". ETPs were set up as industry-led stakeholder forums with the aim of defining medium to long-term research and technological objectives and developing roadmaps to achieve them. They work on developing and updating agendas of research priorities for their particular sector, which are used as inputs to help define European research funding schemes. Agendas are developed through dialogue among industrial and public researchers and national government representatives, which helps to create consensus and to improve alignment of investment efforts. ETPs are also used to foster public-private partnerships to address technological challenges relevant for sustainable development, the improved delivery of public services and the restructuring of traditional industrial sectors.

ETPs are bottom-up, industry-led initiatives. As a part of its commitment to a structured dialogue on research priorities, the European Commission has supported the development of ETPs and carries out a facilitation role. The Commission maintains an ETP website, which hosts an ETP newsletter and regular ETP leaders' seminars, communicating about policy developments and ensuring timely exchange of best practices. [http://cordis.europa.eu/technology-platforms/home_en.html]. The Commission also participates in ETP events as an observer; but the EC does not own or manage the ETPs, which are independent organisations. Some ETPs are loose networks that come together in annual meetings, but others are establishing legal structures with membership fees. There are currently 36 ETPs in five research areas: energy, ICT, the bio-based economy, production and processes, and transport.

5.5 Programmes

A related concept is that of a Programme, which typically implies a thematically-based and connected set of activities and projects that, again, may be facilitated by a lead organisation.

An example of a programme is the U.S. National Academies Science and Technology for Sustainability (STS) Program in the division of Policy and Global Affairs, which has been established to encourage the use of science and technology to achieve long-term sustainable development. [http://sites.nationalacademies.org/PGA/sustainability/index.htm]. The goal of the STS program is to contribute to sustainable improvements in human well-being by creating and strengthening the strategic connections between scientific research, technological development, and decision-making. The program concentrates on activities that are: cross-cutting in nature, requiring expertise from multiple disciplines; important both in the United States and internationally; and effectively addressed via cooperation among multiples sectors, including academia, government, industry, and non-governmental organizations (NGOs). The NA STS Programme includes a coherent set of mutually reinforcing activities and projects [Box 4].

Box 4: Activities and projects of the US National Academies Science and Technology for Sustainability Program

Core STS activities are:

- Roundtable on Science and Technology for Sustainability: Established in 2002, the STS Roundtable provides a forum for sharing views, information, and analysis related to harnessing science and technology for sustainability. Members of the Roundtable include senior decision-makers from government, industry, academia, and non-profit organizations who deal with issues of sustainable development, and who are in a position to mobilize new strategies for sustainability [http://sites.nationalacademies.org/PGA/sustainability/PGA_048724].
- Network for Emerging Leaders in Sustainability (NELS): Launched in 2008, NELS is a series of events for early career professionals from federal and local agencies, the National Research Council, NGOs, the private sector and foundations, in the Washington DC area. NELS includes leaders with diverse backgrounds and expertise, from natural resource management to energy policy to public health, who desire to foster relationships to more effectively bring about a sustainable future. [http://sites.nationalacademies.org/PGA/sustainability/NELS]
- Building the Foundations of Sustainability at the Academies: A monthly e-newsletter Sustainability at the Academies provides updates highlighting activities related to sustainable development throughout the National Academies. The newsletter is available at: [http://sites.nationalacademies.org/PGA/sustainability/PGA_048722]
- Sponsor-Requested Workshops and Studies: Sponsored studies that enlist foremost scientists, engineers, health professionals, and other experts to address the scientific and technical aspects of sustainable development [http://sites.nationalacademies.org/PGA/sustainability/PGA_048726].

The first two projects under the STS program were the Roundtable on Science and Technology for Sustainability and a workshop series entitled "Strengthening Science-Based Decision Making." The Roundtable provides a forum for dialogue among leaders from the communities of research, government, business, and environmental protection with a view toward strengthening strategic connections between scientific research, technological development, and action-oriented efforts to achieve sustainable improvements in human well-being. The workshop series sought to provide opportunities for scientists and governmental decision-makers in developing countries to discuss practical applications of science in decision-making and explore ways of strengthening knowledge-action partnerships.

Currently the STS program has projects on:

- Sustainability Linkages in the Federal Government: http://sites.nationalacademies.org/PGA/sustainability/linkages
- Symposium: Science, Innovation, and Partnerships for Sustainability Solutions: http://sites.nationalacademies.org/PGA/sustainability/SustainabilitySymposium
- Sustainable Acquisition: Fostering Sustainability Considerations into Public and Private Sector Procurement Tools and Capabilities: http://sites.nationalacademies.org/PGA/sustainability/GreenProcurementWorkshop
- Pathways to Urban Sustainability: http://sites.nationalacademies.org/PGA/sustainability/portlandurban
- Sustainability and the U.S. EPA: http://sites.natioanalacadaemies.org/PGA/sustainability/EPA

6. Implications for the VISION RD4SD initiative

The original proposal within the VISION RD4SD project was expressed in terms of a European Competence Centre (physical or virtual). Recent discussions, however, have referred to a European Platform. The organisational form and the geographical scope of the initiative remain to be decided and these decisions hold implications, also, for identifying potential stakeholders.

6.1 Organisation form

Given that much remains to be done to understand what constitutes good practice in sustainability research and what factors contribute to good (or bad) outcomes it may be premature to think in terms of establishing a Competence Centre for RD4SD, since this supposes that the needed knowledge – the reference framework – is available for dissemination when this is not yet the case and what is most needed now is to establish a mechanism through which such knowledge can be obtained. This more suggests the need to establish a 'platform' and/or 'programme' for a 'network' of interested parties (science policy makers and funders, researchers, and representatives of businesses and civil society organisations) that could provide for peer-to-peer sharing and systematic review of experiences, backed by a systematic research project to develop and implement a coherent methodology for evaluating and comparing experiences in different applications contexts in a consistent way.

Here, there are strong analogies between the current status of RD4SD and that of social innovation in that both fields are under-researched, under-theorised, and insufficiently understood. Both fields suffer from problems of measurement and valuation. In both cases, there has been a longstanding under-appreciation of the contributions (actual and potential) that the fields can make in addressing societal challenges and, in both cases, in a context of growing awareness over the number, scale, severity, and complexity of such challenges and their immunity to conventional approaches to problem solving, policy makers are beginning to show greater interest in exploring these potentials, and especially in stimulating and scaling up successful forms of innovation. The last FP7 SSH programme included a call for proposals to establish research projects and build networks among scientists, social innovators, funders of social innovation and beneficiaries of social innovation to explore social innovation practices with a view to developing a body of evidence about successful practice based on systematic review and meta-analysis of experience in a diversity of contexts and, from this, build a reference framework for social innovation practice [see: Social Innovation: empowering people, achieving change].

Current initiatives around the world for capacity building in sustainability science and related fields, such as that of the ISSS or the Australian National University, are also along these lines of establishing platforms for peer-to-peer experience exchange and for systematic review and reflection on experiences. They seek *evidence* from past and present practice that can be used to develop and test hypotheses about good and effective practices and to inform future practices. Although the initiatives have leadership, facilities and activities that are regionally based, they have international outlook. Both the ISSS and the ANU initiatives have or are establishing international conference series and are arranging conferences or co-conferences in other regions. This highlights a worldwide interest and that the topic will benefit from an exploration of the widest possible

diversity of experiences and cases, because this gives best scope to identify generic features *and* explore the importance of context.

This suggests that any initiative launched in Europe should also have a global outlook. One way forward would be to have programmes launched in different world regions and for these to be networked. The regional programmes would then cooperate to develop an international evidence base and the needed common RD4SD framework, but each regional initiative could be the local supplier to its region of RD4SD-related support services.

6.2 Coordination of the international effort

This begs a question: in the event of framing any European initiative in a broader international or global context, are there any European-based institutions that could have global appeal in the role of coordinator for these initiatives?

One organisation based in Europe with global outreach and membership, whose work is strongly relevant to RD4SD and which already has a long-established track record in pioneering sustainability science and exploring and developing the competences needed in RD4SD is IIASA. Is there a role for IIASA here? Given that there are several initiatives around the world currently, it will likely take an organisation that already has a global mandate to be coordinator of these. In principle, IIASA is potentially a logical choice of organisation to facilitate (via a secretariat based there) a global effort to develop guidelines for sustainability science. Most countries and regions with interests in RD4SD (Europe, North America, Asia-Pacific) have some engagement with IIASA already and selecting IIASA as coordinator of the global effort would potentially avoid duplication and competition among regional initiatives. Many of the pioneers of sustainability science have also been connected with IIASA. Such a coordination activity would be a natural counterpart and complement to IIASA's other roles, especially that in developing, hosting, and running integrated models. It could therefore make sense for the European effort to be based at IIASA and for IIASA to fulfil a combined role as facilitator of the European initiative and coordinator of the global efforts.

6.3 Potential stakeholders in any European initiative

The following is an indicative (and far from exhaustive) listing, organised to illustrate some stakeholder 'types' to involve and suggesting examples of each.

<u>Overarching organisations</u>

ICSU and the ESF have been mentioned already as potential facilitating organisations. ICSU could be appropriate for helping to launch a global initiative that might include a European initiative, while ESF could help launch the European initiative. As mentioned earlier, the ESF MO Forum on Science-in-Society (S-i-S) has expressed its wish to support capacity-building initiatives, mentioning that ESF and Science Europe could be the place to launch a proposal to members to initiate common S-i-S research programmes in cooperation with the European Commission.[26] The Council of the International Institute for Applied Systems Analysis, which represents the interests of IIASA's member organisations – typically science funding organisations in the various IIASA member countries – could also help launch an initiative if this were to involve IIASA.

[26] ESF MO Forum Science in Society, 2012, Science in Society: A Challenging Frontier for Science Policy, pg. 26.

Institutions of the European Union

Potentially supportive institutions of the European Union would include: the European Commission, the European Environment Agency, and the European Research Council.

Potential funding organisations

Potential funding organisations could include private foundations as well as public organisations. The European Foundation is a network organisation for private foundations.

Universities and research organisations

a) International (based in Europe):

- International Institute for Applied Systems Analysis (IIASA), Laxenburg

b) Pan-European:

- European Commission Joint Research Centre, Ispra.[27]

c) National

- Sweden:
  - Lund University Centre for Sustainability Studies [http://www.lucsus.lu.se/]
  - Stockholm Resilience Centre [http://www.stockholmresilience.org/]
  - Stockholm Environment Institute [http://www.sei-international.org/]
  - Beijer International Institute of Ecological Economics www.**beijer**.kva.se/

- The Netherlands:
  - Dutch Research Institute for Transitions, Erasmus University, Rotterdam
  - International Centre for Integrated Assessment and Sustainable Development (ICIS), University of Maastricht
  - Institute for Environmental Studies, Free University of Amsterdam
  - Alterra, University of Wageningen

- Germany:
  - School of Sustainability Science and Centre for Sustainability Management, Leuphana University
  - Environmental Policy Research Centre (FFU), Free University of Berlin, www.fu-berlin.de
  - Potsdam Institute for Climate Impacts Research (PIK)
  - Institute of Geography and Geology, Ernst Moritz Arndt University of Greifswald
  - University of Osnabrück

- Spain:
  - Institute of Environmental Sciences and Technology of the Autonomous University of Barcelona

- UK:
  - Environmental Change Institute (ECI), University of Oxford

[27] Important related work has been carried out at ISPRA for over a decade. The JRC was involved in the AIRP-SD project (2002-2004). Work has been carried out since, especially on effective communication at the science-policy interface (e.g. Guimarães-Pereira and Funtowicz, 2006).

    - School of Environmental Sciences, University of East Anglia
    - University of Cambridge, Cambridge Programme for Sustainability Leadership
    - Geo-Sciences, University of Edinburgh

- Switzerland
    - Centre of Development and Environment (CDE), University of Bern, Switzerland
    - ETH, Zurich

- Austria:
    - Sustainable Europe Research Institute, Vienna, Austria
    - Research Institute for Managing Sustainability (RIMAS), University of Economics and Management, Vienna.

- France:
    - University Aix-Marseille

- Italy:
    - Fondazione Eni Enrico Mattei (FEEM): www.feem.it

Boundary and interface organisations

The ad hoc study on interface organisations and mechanisms (Weaver, 2013) provides a typology and listing of interface organisations. Relevant interface organisations include: Ecologic, the Institute of European Environment Policy, the Wuppertal Institute for Climate, Environment and Energy, and the International Institute for Environment and Development.

European Projects:

The ad hoc study on interfacing also highlights that interfacing activities are becoming integrated into research projects. Major current projects with a focus on interfacing and integration include LIAISE, coordinated by Alterra [http://www.liaise-noe.eu/], which is centred on Impact Assessment. Current projects with interests in the field of Natural Capital and Ecosystem Services and in new modes of ecosystem-based governance for managing transitions in the ways ecosystems are managed include OPERAs, coordinated by Mark Rounsevell, University of Edinburgh, and OpenNess, coordinated by SKYE, the Finnish Environment Institute: [http://www.openness-project.eu/]. The Urban Living Lab projects of the JPI Urban-Europe will offer urban examples. Relevant upcoming projects include those to be funded under the recent FP7 SSH call on social innovation. There have also been research projects under FP7 to stimulate and/or to study participation, knowledge brokerage, and interfacing. Notable here are the knowledge brokerage projects, such as: PRIMUS, PSI-Connect, AWARE, BESSE, CORPUS, PACHELBEL, FOODLINKS, RESPONDER, and SPIRAL. Projects intended to engage civil society in research on sustainable development include: ESDINDI, CSOCONTRIBUTION2SCP, ENCI-LOWCARB, SUSTAINENERGY NET, and CSS. It could be useful to include the coordinators or coordinating institutions of these projects in any VISION-RD4SD initiative.

Relevant European networks

In addition to the European Sustainability Science Group and its affiliates and the VISION RD4SD project network, there are other important networks having predominantly European membership or with European leadership, mentioned earlier in this report, such as TIAS, but it is to be noted that

even if dominated by European members, with the internationalisation and globalisation of science, leading networks today are global networks. This applies to TIAS and most other networks listed earlier in this study.

Of the evaluation community networks, the most pertinent to the present initiative is the former Easy-Eco network, organised by RIMAS. Easy-Eco held important conferences and workshops on evaluating sustainability and was an important outlet for pioneering papers on the evaluation of participation in stakeholder processes for sustainable development (e.g. Warburton, 2002). RIMAS continues as an important leader of the sustainability evaluation community.

Related centres of expertise:
A centre of expertise in a parallel domain, which provides evidence-based advice on effective public engagement, is the Sciencewise Expert Resource Centre for Public Dialogue in Science and Innovation (Sciencewise-ERC): [http://www.sciencewise-erc.org.uk/cms/].Diane Warburton, who was a pioneer in researching participation, is Head of its Evaluation section and author of the recent report: Evidence Counts – Understanding the Value of Public Dialogue. [28] She also works for 'sharedpractice' an independent partnership dedicated to sustainable development and participatory democracy: www.sharedpractice.org.uk/

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[28] The Sciencewise- ERC evolved from the Sciencewise Programme, which was set up in the UK in response to the House of Lords Science and Technology Committee report entitled 'Science and Society,' published in 2000. The report highlighted the importance of public input into challenging areas of new and emerging science and called for much more meaningful engagement between scientists, policy makers and the public rather than only promoting the 'public understanding of science.' Sciencewise produces highly relevant reports on evidence-based policy, public dialogue, etc. [See, for example: Evidence Counts – Understanding the Value of Public Dialogue; http://www.sciencewise-erc.org.uk/cms/assets/Uploads/Strategic-Research-documents/Evidence-CountsFull-report.pdf]

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Appendix A:

ESSP Transitions into 'Future Earth'[29]

On 31st December 2012, the Earth System Science Partnership (ESSP) will close and transition into 'Future Earth' as it develops over the next few years. During this period, the GEC research programmes (DIVERSITAS: an international programme of biodiversity science, IGBP: International Geosphere-Biosphere Programme, IHDP: International Human Dimensions Programme on Global Environmental Change, and WCRP: World Climate Research Programme) will continue close collaboration with each other. 'Future Earth' is currently being planned as a ten-year international research initiative for global sustainability (www.icsu.org/future-earth) that will build on decades of scientific excellence of the four GEC research programmes and their scientific partnership, the ESSP.

Considerable ESSP scientific accomplishments include the design and implementation of an annual carbon budget trends and analysis; a digital global water atlas; a global analysis on human water security and biodiversity conservation; the establishment of a joint project on global environmental change and human health; and an innovative food systems conceptual framework. One of the lasting legacies of the ESSP Joint Project on Global Environmental Change and Food Systems (GECAFS) has been the creation of a 10-year Consultative Group on International Agricultural Research (CGIAR) collaborative research program with the ESSP on Climate Change, Agriculture and Food Security (CCAFS). Understanding regional environmental change and its implications for local sustainability have been a critical area for the ESSP, as illustrated by the establishment of the Monsoon Asia Integrated Regional Study (MAIRS), the Global Carbon Project's Regional Carbon Cycle Assessment and Processes (RECCAP) and GECAFS' regional science plans in the Caribbean, Indo-Gangetic Plain and Southern Africa. Another major achievement of ESSP - as a scientific partnership of the four GEC research programmes - is that it helped enable collaboration among DIVERSITAS, IGBP, IHDP and WCRP.

The ESSP has also nurtured a progressive outreach portfolio. For instance, the ESSP and the sponsor programmes (DIVERSITAS, IGBP, IHDP and WCRP) contribute to an annual research dialogue with the Parties at the United Nations Framework Convention on Climate Change (UNFCCC) Subsidiary Body for Scientific and Technological Advice (SBSTA). This on-going dialogue provides the research community with an opportunity to provide regular science updates to major science-policy processes. Another example of ESSP contributions to science-policy practice is the ESSP led scientific review of UNEP's Global Environmental Outlook-5. The ESSP also pioneered a peer-reviewed journal, Current Opinion in Environmental Sustainability (COSUST). This journal is open access for developing countries and is fast becoming a community platform for timely synthesis and review papers. COSUST will continue to be published by Elsevier, with contributions from the GEC research programmes and then 'Future Earth' as it becomes operational.

Ensuring there is no discontinuity during the transition phase into 'Future Earth', the four sponsor programmes (DIVERSITAS, IGBP, IHDP and WCRP) will continue to stimulate the ESSP Joint Projects (the Global Carbon Project (GCP), Global Environmental Change and Human Health (GECHH) and the Global Water System Project (GWSP)) and the Monsoon Asia Integrated Regional Study (MAIRS) as

[29] http://www.essp.org/

integrative, interdisciplinary, cross-cutting research activities, based on the knowledge and insights for each of the programmes, and relevant for each programme and beyond. Each programme will therefore take responsibility for one or more of the JPs/IRSs with effect from 1st January 2013, on behalf of all four programmes. IGBP will foster GCP, DIVERSITAS the GWSP, IHDP the GECHH, and WCRP will foster MAIRS. ESSP will be represented by ICSU on CCAFS' Independent Science Panel. These projects and activities will therefore continue to be part of the four sponsor programmes and DIVERSITAS, IGBP, IHDP and WCRP will continue to collaborate with each other until 'Future Earth'