AIRP-SD

Adaptive Integration of Research and Policy for Sustainable Development

- Prospects for the European Research Area -

Milestone One

by

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Contents

Preface

The EU-STRATA project: "Adaptive Integration of Research and Policy for Sustainable Development – Prospect for the European Research Area", is co-ordinated by the Sustainable Europe Research Institute (Austria) and involves five other project partners: the University of Durham (UK), the Wuppertal Institute for Climate, Energy and Environment (Germany), CEIFA Ambiente (Portugal), the Institute of Prospective and Technological Studies (EC-JRC-IPTS, Spain) and the Institute for the Protection and Security of the Citizen (EC-JCR-IPSC, Italy). The work of the project is strengthened by the formal involvement of research policy makers and administrators from several Member States of the European Union and a sounding board of actors and stakeholders.

This Milestone One Report is the first of three status reports, summarizing the interim findings of the first three work packages since the start of the project in January 2002. To strengthen this project we ask the reader of this report to **give us feedback** on our work by **filling out the questionnaire (Appendix II)** at the end of this report and to kindly return it to us. This feedback will be taken into consideration in our future work.

What is the aim of the project?
This project, conducted for the STRATA (Strategic Analysis of Specific Political Issues) Programme of the European Commission, meets the challenge that **sustainable development** presents for research policy and for the scientific community. The main objective of AIRP-SD is to address the urgent need to stimulate innovation in **R**esearch, **T**echnological development and **D**emonstration **(RTD)** processes in order to enhance the prospects of RTD contributing positively to processes and strategies leading to radical improvements in the sustainability of production-consumption systems.

Why is this important?
With the adoption of sustainable development as a policy goal of the European Union and its Member States, the question of how research policy might be used to promote and support sustainable development has grown in importance. There is intrinsic potential for research policy and practice to contribute to the process and goals of sustainable development. However, questions remain over how best to design and administer RTD programmes in support of sustainable development:

- how to build relevant RTD capacities and how to convert intrinsic potential into actual results. how might research and implementation programmes be oriented to serve the needs of sustainable development?
- how might RTD programmes be designed so their outcomes and impacts support the process of sustainable development and actually contribute to the attainment of sustainability goals?
- what kinds of research and supporting activities will contribute most effectively?
- which RTD capacities need to be strengthened, where and how?

What will the project do?
Over the past decade different RTD and implementation programmes have been initiated across Europe and other world regions which aim to support sustainable development. To large extent, because the challenges to science and research posed by sustainable development are so different from those traditionally faced, each programme, its design and the set of innovative methods it employs can be regarded as a "hypothesis" or set of "hypotheses" about the kinds of RTD activities that would best support the process of sustainable development and the attainment of sustainability goals. In the same vein, the implementation of each programme represents an empirical "test" of its underlying hypothesis in each applications context. In this project, the participants will learn from these "research policy experiments" and make an evaluation of the quality and effectiveness of each programme using a consistent methodology, based upon its impacts and achievements in relation to the challenges and goals of sustainable development.

Since there are many innovative programmes, we aim neither to be comprehensive nor representative, but rather for the selected programmes to illustrate a range of approaches that offer insights into what works well and why. Our case-studies will therefore reflect a diversity of programme constitutions, conceptualisations, designs, procedures, scales of inquiry, methods, and applications contexts. The only restrictions on our selection are that the RTD programmes should be innovative, well documented and (in the self-understanding of those involved in the programme) aimed at radically improving the sustainability of production-consumption systems. The project will evaluate the quality and consistency of each programme, identify strengths, weaknesses and best practices and assess the transferability of best practice. Through this, AIRP-SD will develop guidelines for strengthening the capacity of RTD processes generally to contribute toward sustainable development.

Friedrich Hinterberger
SERI, co-ordinator

1. Introduction

This report constitutes a status report of work in progress in respect of Work Packages 2, 3 and 4 of the project "Adaptive Integration of Research and Policy for Sustainable Development" (AIRP-SD), which is being conducted for the STRATA Programme of the European Commission.

WP2 intends to:

a. Identify relevant stakeholders from government, non-government and research sectors related to sustainable consumption and production and to integrate their participation with that of project partners and other members,
b. Identify national and regional research programmes which can serve as examples of successes and failures in understanding and achieving sustainability of production and consumption for programmes in Europe,
c. Identify innovative practices and processes in national and regional research programmes.

WP3 is to analyse what sustainable development implies for RTD processes, in terms of special qualities, capacities and challenges. **Questions** to be addressed in WP3 include:

- What special qualities and capacities must RTD programmes have in order for them to contribute to sustainable development?
- Why are these qualities and capacities needed?
- Which are the most important innovation challenges?

The **goal** is WP3 is to develop a normative definition of sustainable development and a conceptual model of RTD processes that are aimed at SD. The deliverable is to be a report that presents the conceptual model and a typology of challenges expressed in terms of those qualities and capacities of RTD programmes that need to be strengthened in order to contribute to sustainable development.

WP4 is to develop and **test a first version evaluation methodology** for assessing the achievements of RTD programmes in respect to the challenges identified in WP3. The methodology will be applied in Work Packages 5 and 6 to evaluate a set of case study RTD programmes and their constituent innovative approaches to the challenges set out in WP3. In addition, WP4 is to **propose a methodology for screening and selecting candidate programmes** for inclusion as case studies. This screening methodology is to be applied in WP2 in order to obtain nominations and descriptions of candidate programmes. Questions to be asked are:

- Which outcomes are novel and innovative RTD programmes intended to achieve?
- How can we measure and evaluate outcomes?
- What tangible evidence could be used to assess the capacities and effectiveness of innovations?
- Could stakeholders' opinions and perceptions be developed into an evaluation framework?
- Is it possible to develop a hierarchy of achievement to enable a ranking of innovative programmes and innovations?

Activities to be undertaken include using one or more innovative RTD programmes, interviews with relevant actors and literature reviews as a basis for developing and testing ideas about possible evidence-based indicators of outcomes and achievements of RTD programmes. These same sources are to be used also to report on the likely availability of suitable evidence.

The deliverable of WP4 is to be a report detailing the screening methodology for use in WP 2 and the preliminary evaluation methodology for use in WP5 and WP6.

1.1. Current Status

The current status of work on WP 2 as reflected in the milestone report is as follows:

- a set of preliminary stakeholders has been identified and nine of them, representing the areas of science, small- and medium- sized enterprises, industry, government, international organisations, trade unions, non-governmental organisations, the European Parliament and agriculture, have agreed to serve on the stakeholder board. They will review the Milestone reports and give feedback on the progress of the project.
- a number of national research programmes has been identified.

The current status of work on WP3 and WP4, as reflected in this milestone report, is as follows:

- a preliminary normative definition of sustainable development for use in the project has been defined in thematic and process terms
- a preliminary report has been written on the special challenges to RTD of sustainable development and this has been translated into a typology and a preliminary conceptual model of research for sustainable development specified in terms of broad and specific goals for RTD programmes
- a screening methodology has been defined for identifying and describing candidate RTD programmes for use as case studies later in the project
- a preliminary set of questions for consistency-based *ex-ante* evaluation of programmes has been proposed
- a preliminary set of questions for evidence-based *ex-post* evaluation of programmes has been proposed
- a preliminary approach to developing hierarchies of achievement has been proposed

This report will first present the work status of WP3 and WP4, since the screening methodology applied in WP2 has been developed in these other Work Packages. The report is structured in the form of an argumentation, which reflects that AIRP-SD is, in essence, an heuristic project, in which the participants will need to continually present, test and revisit our working assumptions and hypotheses.

Section 2 sets out the **aims and objectives of the project**. Our initial hypothesis is that under favourable circumstances RTD processes can support progress toward sustainable development both directly and indirectly, not only by developing new technologies and achieving new knowledge, but also by contributing to social and political processes of awareness raising, problem solving, decision making and policy

making.[1] We recognise that sustainable development is a normative concept, which reflects the importance society places on equity between and among generational cohorts and on protecting ecological systems in which social and economic activities are embedded and upon which they depend. We take it as axiomatic that sustainable development requires paradigmatic change and, by definition, implies transition along innovation trajectories different from those now followed. We take it as axiomatic, also, that sustainable development is a process and its outcomes at any particular point in time are process-dependent. A working hypothesis for AIRP-SD is that sustainable development presents a set of challenges for research (including scientific, technological, moral, ethical and communications challenges) which imply new goals and objectives for scientific efforts in support of sustainable development.[2] While these challenges are not always specific to research for sustainable development, the requirement to address a substantial number of such challenges simultaneously in projects that are oriented toward sustainability makes very special demands of research for sustainable development. An assumption (that we will seek to test) is that progress in tackling these challenges and in building related capacities and competence will contribute toward a more effective process of sustainable development and to the achievement of normative outcomes.

A number of research programmes have been established that are using innovative approaches to address some of these challenges. Some of these are expressly oriented toward sustainable development. Others are not expressly or intentionally oriented toward sustainable development, but have sustainability-related objectives. AIRP-SD seeks to establish whether and how these challenges have been met in a set of case-study programmes and, also, how well they have been met. AIRP-SD also seeks to establish the conditions and contexts for the successful use of particular approaches. In practice, AIRP-SD is concerned to evaluate the innovative approaches that address these challenges rather than to evaluate RTD programmes *per se*. However, innovative approaches are embedded in research programmes, which undertake research in specific applications contexts. Moreover, any evaluation of achievement depends not only on assessing how well the procedural challenges that sustainable development poses for research are met, but also on assessing whether procedural and process improvements actually contribute to the attainment of normative goals relevant to sustainable development. By implication, the work of AIRP-SD must begin by developing a normative definition of sustainable development and a working hypothesis – a reference scenario – of the challenges that sustainable development poses for research. From our evaluation work, we hope ultimately to develop a normative description of research for sustainable development that is centred – not on challenges – but rather on innovative approaches that can successfully address these challenges and that might therefore be included as elements in future sustainability-oriented research programmes.

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[1] We qualify this assumption about the potential for RTD to enhance sustainable development, by saying that this depends upon favourable circumstances. In practice, there is evidence that in some cases the relationship between development and RTD is the other way round; i.e., that research is a result of, not a motor for, development (Osório-Peters 2002). An important implication for the work of AIRP-SD is that we will need to review the comparative importance of different circumstances in different contexts. This will be important for assessing the conditions for and transferability of best practice.

[2] This is not to say, however, that research that is not explicitly targeted or oriented toward sustainable development could not contribute to capacity building relevant for paradigmatic change or to the achievement of sustainability goals.

Against this backdrop, **Section 2** sets out the goals and approach of AIRP-SD. **Sections 3 and 4** set out a basis for the normative and axiomatic definition of sustainable development that forms a point of departure for the project. They establish a set of thematic priorities for research for sustainable development. **Section 5** identifies a set of procedural challenges that sustainable development poses for research. These procedural challenges are combined with the thematic priorities to give – as a first working hypothesis – a normative definition of research for sustainable development; i.e., a referential checklist of procedural challenges and thematic priorities that research for sustainable development should be designed to address. **Section 6** uses this working hypothesis to pose questions useful for evaluating actual research programmes and their constituent innovative approaches and applications contexts. **Section 7** describes a method by which the AIRP-SD project might identify a diverse set of innovative programmes as candidates for evaluation in later phases of our project. Section 8 discusses the stakeholder board selection process and progress on the identification of innovative research programmes and their constituent innovations.

2. Project aims and approach

The project "Adaptive Integration of Research and Policy for Sustainable Development" (AIRP-SD), is being conducted for the STRATA Programme of the European Commission. The underlying basis for the project is the challenge that sustainable development presents for research policy and for the scientific community. The main objective of AIRP-SD is to address the urgent need to stimulate innovation in Research, Technological Innovation and Demonstration (RTD) processes, so that these enhance the prospects of RTD contributing positively to processes and strategies leading to radical improvements in the sustainability of production-consumption systems.

With the adoption of sustainable development as a policy goal of the European Union and its Member States, the question of how research policy might be used to promote and support sustainable development has grown in importance. There is intrinsic potential for research policy and practice to contribute to the process and goals of sustainable development, but questions remain over how best to design and administer RTD programmes in support of sustainable development, how to build relevant RTD capacities and how to convert intrinsic potential into actual results. How might research and implementation programmes be oriented to serve the needs of sustainable development? How might RTD programmes be designed so their outcomes and impacts support the process of sustainable development and actually contribute to the attainment of sustainability goals? What kinds of research and supporting activities will contribute most effectively? Which RTD capacities need to be strengthened, where and how?

Fortunately, a basis for answering these questions is beginning to emerge. Across Europe and in other world regions, many different RTD and implementation programmes aimed at supporting sustainable development have been initiated over the past decade. To large extent, because the challenges to science and research posed by sustainable development are so different from those traditionally faced, each

programme, its design and the set of innovative methods it employs can be regarded as a 'hypothesis' or set of 'hypotheses' about the kinds of RTD activities that would best support the process of sustainable development and the attainment of sustainability goals. In the same vein, the implementation of each programme represents an empirical 'test' of its underlying hypotheses in each applications context. What is missing in order for us to learn from these 'research policy experiments' is to make an evaluation of the quality and effectiveness of each programme using a consistent methodology that is based upon assessing its impacts and achievements in relation to the challenges and goals of sustainable development.

AIRP-SD will make such an evaluation across a selection of case-study programmes. Since there are many innovative programmes, we aim neither to be comprehensive nor representative, but rather to illustrate a range of approaches that offer insights into what works well and why. Our case studies will therefore reflect a diversity of programme constitutions, conceptualisations, designs, procedures, scales of inquiry, methods, and applications contexts. The only restrictions on our selection are that the RTD programmes should be innovative, well documented and (in the self-understanding of those involved in the programme) aimed at radically improving the sustainability of production-consumption systems or at envisioning, exploring and initiating transition pathways to radically different and more sustainable futures.[3] The project will evaluate the consistency and achievements of each programme, identify strengths, weaknesses and best practices and assess the transferability of best practice. Through this, AIRP-SD will develop guidelines for strengthening the capacity of RTD processes generally to contribute toward sustainable development.

Our starting point is to construct a normative definition of sustainable development (SD). Clearly, constructing such a benchmark is not easy owing to the complexities of the systems of interest and our approach cannot be to try to define (in moralistic tones) what sustainable development is. Rather, our approach is to construct a normative definition of sustainable development in terms of broad thematic priorities and generic procedural challenges that give rise to a related set of potential goals and potential achievements of Research for Sustainable Development (RforSD). Our approach is to say that thematic issues such as resource use and equity are necessary elements in sustainability-targeted research and are amenable to scientific inquiry. Research for sustainability is asked neither to make a choice nor to give a moral evaluation on individual choices made, but it is a genuine task of research to analyse

[3] It is important here to note that radically different socio-economic futures can be achieved through smooth and evolutionary change processes that operate over long periods. These may constitute incremental sequences of innovations on several co-evolving innovation fronts and/or responses to new interpretations of societal goals. This is an important point on several counts. Change processes that lead to radically different socio-economic futures need not be economically or socially disruptive, especially if the change processes are begun early enough to give a long lead time for adaptations, for learning and for any modifications of technological infrastructures. With long lead times, any requirements for modifications of capital equipment or for capital equipment replacement can be integrated into usual capital replacement cycles to reduce unnecessary write-down costs (Simonis 1993, Weaver 1995). The potential (and desirability) for compatibility between evolutionary change processes and radically-different socio-economic futures also implies that it is not necessary to draw artificial borderlines in RTD activities. RTD that is oriented toward radically different socio economic futures is potentially quite compatible with and could be designed to draw upon as well as to reinforce the body of conventional (incremental) research. A focus on evolutionary transition pathways would therefore not only lead to smoother and more cost-effective transition processes and to processes that are compatible with the evolving political economy, but also to maximising the effectiveness of supporting RTD efforts.

the consequences of different options based upon normative values. Science can explore, for example, the implications for development choices of acknowledging different resource limitations or of employing different definitions of equity. Accordingly, without prejudice to choices made in the matter, RTD programmes for sustainable development should address priority themes and have a clear approach for handling issues such as resource use and equity that is consistent in discourse during the programme and with the stated goals and objectives of the programme. Our task within AIRP, therefore, is to identify which challenges, which questions and which roles for research should be seen as key-issues, no matter which research programme for sustainability.

In principle, we should thus be able to define:

1. A set of thematic priorities and generic procedural challenges, including related goals and potential accomplishments, for research programmes that are sustainability-oriented. These may relate to RTD processes, capacity-building or to capital building on the assumption that these add/contribute to sustainability.
2. A set of programme characteristics (institutional architecture, process, methods, etc.), which include innovative approaches to tackling the thematic priorities or meeting generic procedural challenges.
3. A set of dimensions and quality criteria against which to judge the success of the programme.
4. A set of impacts of programmes that relate to achievements vis-à-vis the thematic priorities/challenges/tasks/goals.
5. Characteristics of the applications context.

Programme characteristics (2) and features of the applications context (5) relate respectively to HOW and HOW WELL the programme is likely to meet its goals (1). Our first hypothesis is that the characteristics and features of RTD programmes influence the type and quality of RTD outcomes vis-à-vis the challenges/tasks/goals. Our second hypothesis is that the characteristics of the applications context (including the nature of the sustainability issues being addressed, cultural factors, etc.) influence the type and quality of programme outcomes and the transferability of 'best' practice.

Because we are ultimately concerned with evaluating programmes, we are in effect concerned with the quality of programmes; i.e., **how well they are conceptualised** in relation to SD challenges, **how well they are designed** to meet their goals/objectives and **how well they accomplish outcomes** relating to SD. These outcomes may relate to process changes, capacity building or different forms of capital building. In practice, much of our evaluation will have to be based upon *ex-ante* evidence and upon consistency checks: i.e., evaluation based upon the extent to which programmes that their originators declare to be expressly targeted on sustainable development are consistent with a normative definition of sustainable development and with other references, such as official policy statements. However, there may be some programmes, now completed or near completion, where there is *ex-post* evidence of actual outcomes, for example in relation to the development of active new innovation networks, shared understandings of problems/solutions, action plans toward solutions,

etc.[4] In *ex-post* evaluation, we should additionally be able to obtain stakeholders' perceptions and judgements about the quality of the programmes in which they were involved (or from which they were excluded). There may also be evidence that programme's have leveraged their own impacts by influencing other RTD programmes or that they have achieved other spin-off successes.

In order to develop an evaluation methodology, we therefore need to have some notion about what constitutes sustainable development, what challenges sustainable development poses for research, what goals and roles this implies for research for sustainable development and what indicators and principles should (normatively) be present in SD-oriented programmes. Our normative vision of sustainable development may well not be exhaustive, but it should give us a good list of candidate system attributes to begin an evaluation process. The above suggest that in order to proceed with the development of an evaluation methodology, we first need to address two main questions:

1. What is the meaning of 'sustainable development' in this project? (Addressed in Chapters 3 to 6).
2. How can we distinguish between research for sustainable development (RforSD) from traditional R&D as regards a) thematic priorities, and b) process challenges? (Addressed especially in Chapters 4 and 5).

3. Sustainable development

Sustainable development is a concept with a normative (prescriptive, paradigmatic) character. As pointed out by many analysts, sustainable development is a teleological concept. The concept represents a set of values and expresses goals, which may or may not be reachable and which may change and need to be refined or even redefined over time. The importance of the concept is that it points out a direction, which is different from the current developmental trajectory and which offers scope for delivering improvements in development performance on a range of criteria that are important, but which are relatively neglected in the prevailing development paradigm. Indicators for monitoring progress toward SD must be related to SD goals. As SD is a normative concept, criteria to assess the sustainability of political measures, technologies, social innovations etc. can only be defined with respect to these goals. Thus, we need to clarify the main goals of SD before we can discuss criteria and indicators of RforSD.

Since, sustainable development is a teleological concept, attempts to operationalise SD may best be approached using a hierarchical definitional framework. Fundamental principles are proposed on the highest conceptual level, more operational guiding principles deriving from these are developed on a second level and specific policies and measures for use in particular applications contexts are developed on a lower, third, level. At the highest level, there is widespread acceptance of the general, non-operational definition adopted by the Brundtland Commission. Sustainable development is development that meets the needs of the present generation without

[4] There is certainly evidence, for example, of the effectiveness of the Dutch Sustainable Technology Development Programme (DTO/STD) in building social capital and technological capital.

compromising the ability of future generations to meet their own needs (WCED 1987). The intellectual origins of this non-operational definition can be seen in proposals by Tietenberg (1984), Repetto (1985), Solow (1986) and Pezzey (1989), which refer to the maintenance of living standards, the stream of utility or the discounted present value of utility.

At the second level, several studies have proposed more operational guiding principles. Daly (1992), for example, postulates that sustainable development is a normative concept that requires solutions to three levels of problem in the following priority order: [5]

1. Scale: the economic system should be adapted to the carrying capacity of the ecological system (so-called 'ecocapacity');[6]
2. Distribution: finite resources should be equitably distributed (within and between present and future generations).
3. Efficiency: within the framework of ecological limits and equitable distribution of property rights, an efficient allocation of resources is needed, in order to ensure sustainable development.

In a related study, Weterings and Opschoor (1991,1992) sought to quantify the limits to ecocapacity and to explore the scale of the challenge that living within ecocapacity limits and sharing ecocapacity imply. Their study accepted that a number of different positions could be assumed in attempts to demarcate ecocapacity, ranging from laissez-faire to cautious (Opschoor and van der Ploeg 1991). Adopting a prudent or precautionary stance, the study translated the principles of sustainability outlined in the Brundtland Report (WCED 1987) into quantitative estimates of average per capita annual entitlements to resources and waste emission, based upon the assumption of equal per capita entitlements to resources. The time horizon for the estimates was 50 years. Two different methods were used for making the translation, but both led to a similar result. Per capita emissions of pollution and consumption of resources need to be reduced, generally to less than 5-10 percent of the levels experienced in

[5] Such second-level definitions are seldom 'complete' in themselves and are seldom non-contentious. For example, there are many relevant system qualities that relate to process and system dynamics that are not covered by Daly in his definition. His listing says nothing about capacity building, participatory/transparent decision making or individual rights or social justice or precaution or endogeneity, etc. This is not to diminish his or any other contribution, but only to point out that these are contributions, and do not of themselves provide a complete normative picture. It is therefore necessary to look to several definitions to discern a wide set of guiding principles. This search is in progress.

[6] Dissent enters when discussion turns to the role of the environment both as a factor of production in economic processes and as a direct provider of services that contribute to life quality. This moves the discussion into difficult terrain, since it turns attention to the state of the environmental stocks and to the integrity of the functioning ecosystems that provide productive potential. Substitutability – of different forms of capital and of economically provided services for those now provided directly by nature – is the central issue of dispute. This is a difficult issue and the debate can easily become mired by semantics and the tension of different disciplinary assumptions. Especially, a division has arisen between economists and ecologists with the latter arguing that there are much more severe limits to substitutability than economists choose to recognise or admit (e.g. Boulding 1966; Daly 1990; Ayres 1998). Ayres, especially, has argued that some classes of natural resources and some environmental services are essential, non-substitutable and non-replicable and, also, that some are threatened by today's economic activities and development pathways (e.g. Ayres and Kneese 1971; Ayres 1978; Ayres 1998). As several others before him, Ayres argues that there must be ecological limits to economic activities and he moves the discussion along by trying to specify which important environmental qualities should be preserved and why. Nonetheless, aware of the dangers involved he stops short of setting out quantitative limits.

industrialised societies today. This contrasts starkly with present and anticipated rates of eco-efficiency improvement.

The study concluded that, whereas sustainable development is often interpreted in terms of improving the environmental performance of our existing ways of creating wealth, the scale of the challenge it represents – ten, twenty and even fifty-fold reductions – is evidence that such approaches are not enough. Sustainable development needs to be interpreted as a strategic challenge, which will require solutions that break existing trends in current development processes. Against this backdrop, it is noteworthy that, whereas there have been intensive research and scientific efforts on some aspects of SD (for example, the carrying-capacity of ecosystems, the technical aspects of dematerialisation), little work has been done so far on ethical and economic aspects, such as distribution and allocation. Moreover, to date, few studies have addressed the linkages between these various aspects. The study by Weterings and Opschoor is exceptional in this regard. The coherent analysis of all three elements (scale, distribution, and allocation) is therefore a potential defining thematic priority for RforSD. This requires that RforSD concern itself with the definition and exploration of alternative socio-economic futures.

As to scale and distribution (two of Daly's elements), it is interesting that the F-10 and F-20 resource productivity improvement (RPI) targets that have been used in some RforSD programmes are explicitly developed from a consideration of these two aspects and by an explicit attempt to solve the 'problem' of unsustainable production-consumption entirely through an efficiency approach. A radical dematerialisation of production-consumption systems would in principle avoid the need for any compromise or trade-off between objectives. In principle, we could halve resource throughput and have an equitable access to resources around the world while maintaining or even increasing welfare if we can achieve F-10 to F-20 RPI. However, as pointed out in the Netherlands Case Study (Weaver and Jansen 2001) of the recent ESTO project report (ESTO 2002), this position is ambiguous. In fact, to avoid trade-off, a F-10 to F-20 RPI is a *necessary* condition. But it is not a *sufficient* condition. There would be need also to ensure that any improvements in RPI were actually used to reduce resource throughput (achieve greater environmental protection) and to redress the widening rich-poor gap in global access to resources (greater global equity). It would also be necessary to ensure that the technological means for achieving the improvement in resource productivity did not polarise wealth and power or increase risk or vulnerability. In effect, we would need for RTD programmes to be linked to complementary policy programmes and for there to be explicit consideration of the precautionary principle. This suggests that thematic priorities and procedural challenges are necessarily fused in RforSD and that the two may not be easily separated in evaluative analyses such as the one proposed in the present study.

Although sustainable development may be a much-debated concept, there is less of a debate over the unsustainability of the present development paradigm and the present development trajectory and trends. Concerns are raised especially over the gap between rich and poor, which is growing both between and within countries, and for resource depletion, pollution and environmental change, as a consequence of present patterns of resource use, which are intensifying and becoming more generalised. Equally, there is a growing consensus that the present development paradigm unnecessarily increases conflict between different development objectives, making

them incompatible. As a consequence, trade-offs between objectives imply that progress in one is only achievable at the expense of deterioration in another. A logical conclusion is that there is an increasing urgency to restructure unsustainable patterns of production and consumption by reorienting the trajectories of development. In turn, this argues for RTD activities that especially deal with restructuring of unsustainable patterns.

Against the backdrop of this on-going debate on the definition of sustainable development, it is useful to state some basic propositions that are intrinsic to the search for sustainable development:

1. Development is a continuous, dynamic, co-evolutionary process involving a search for improvement.[7] The purpose of development is to increase quality of life.
2. Sustainable development embraces concern for the welfare of present generations and concern for the welfare of future generations, which is to be achieved *inter alia* through environmental protection and greater equity within and between generational cohorts.
3. The current development paradigm and trajectory are unsustainable. Moving toward sustainable development will therefore require fundamental paradigmatic change or "system renewal".
4. System renewal is a long-term, continuous process of innovation and restructuring that should lead to fundamentally new relationships between elements of the developmental system and to fundamentally improved outcomes of development processes on a continuing basis.
5. These outcomes should include radically improved socio-economic futures, with improved environmental performance and greater equity
6. The transition process needs to be smooth and to be politically and socially acceptable, technologically feasible as well as economically affordable and efficient.
7. There is need for the decision processes surrounding transition to follow well-established democratic principles, which include:
    - participation
    - transparency
    - subsidiarity
8. There is need for the decision process surrounding transition to demonstrate concern for:
    - social justice
    - individual rights
    - precaution
9. There is need to develop new stocks of capital and capacities relevant to transition processes and to sustainable development.[8] These include, especially:

[7] The historical record shows that the process of development is episodic and that output and productivity growth in different periods have been stimulated by changing structures of economic activities and technological change associated with clusters of co-related and co-evolving technologies, organisational arrangements and institutions. These clusters describe entire social, technological and economic systems of production and consumption, which are dynamic and evolving but which have coherence through mutually-reinforcing feedback relationships between and among system components.

[8] We are aware that there is dispute and discussion over the terminology that might be applied, especially in regard to the appropriateness of terms – such as capital – that derive from economic analysis but are applied here in relation to environmental or social qualities. There is a substantial literature emerging in

- capital that might substitute for diminishing stocks of environmental capital and that might help make more productive use of those stocks; (e.g., scientific capital, technological capital, human capital, social capital)
- capacities for continuous learning and adaptation

4. Multiple challenges of sustainable development

Sustainable development poses special challenges to science, technology, public policy and democracy. These arise because:

1. The systems we are dealing with are complex, incompletely understood and fast changing. They are vulnerable to our decisions and actions and are characterised by potential instability and irreversibility.
2. We have multiple stakeholders and conflicting objectives, all of which have to be reconciled in goal-setting and decision-making processes.
3. Not all stakeholders are able directly to represent themselves and their interests in decision making processes (e.g., future generations, children, the poor, the disadvantaged, the inarticulate, people who reside in distant political jurisdictions or countries, other – non-human – life forms, etc.)
4. Decision criteria may be fuzzy, context-dependent and unstable.
5. There is an interdependence between different spatial levels of the developmental system (local, national, regional and global) and because there is strong 'path dependency' in developmental processes, which implies not only that the present is affected by the past, but also that the present opens up or constrains future development opportunities.
6. We are dealing with distributed innovation systems, with many decentralised and individual but interdependent actors who need to act together in a co-ordinated fashion in order to bring about change.
7. Because of the co-evolutionary nature of change processes, there is a need to integrate and co-ordinate behavioural, technological, institutional and other innovations, so that these develop in the same direction and to a consistent timeframe.
8. Changes in the institutional framework of policies and regulations may be an essential pre-requisite for transition.
9. Change in the direction of sustainable development implies system renewal or paradigmatic change, which requires that we achieve 'leaps' or 'jumps' in system performance and that we act strategically.
10. This requires a long-term approach, which is inconsistent with the short-term decision and action horizons of research projects and political/business decision making.
11. Because we are dealing with long time horizons and with dynamic, uncertain systems, there is need for continuous monitoring and adjustment and for a capacity to adapt to surprises that are inevitable.
12. Science and technology are not necessarily a source of answers or solutions, but can be a part of the problem. There is need to build awareness of the limits on the certainty of outcomes and awareness that science-based interventions in complex

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the intrinsically interdisciplinary research field that deals with quantitative and qualitative issues of substitutability and complementarity.

> natural processes can constitute, in themselves, a self-renewing source of problems that may jeopardise community livelihoods, health and future economic prospects.[9]

Complexity, uncertainty and irreversibility have implications for science for sustainable development. Since our concern is for the interaction between ecological systems and socio-economic systems, there is a need to integrate a wide range of specialised knowledge from different subject areas in order to develop solutions to crosscutting problems. Furthermore, because solutions to developmental problems need to be adapted to the implementation context, general solutions are unlikely. There is a need to combine expert knowledge with local knowledge in the development and implementation of customised solutions. We have incomplete and imperfect knowledge. There are substantial risks and there is a real danger of perverse outcomes from interventions. Our technologies and interventions are increasingly powerful, and outcomes (both good and bad) are intrinsically uncertain. We therefore, need to exercise precaution. While the role of science will be to try to reduce uncertainty, this may not be possible in some cases and, in others, reducing uncertainty may imply experimentation and risk taking. There is a need for scientists to communicate residual uncertainty and risk clearly to stakeholders.

The inherent complexity, high stakes and urgency of sustainable development is not something that can be handled by technological advances alone. New quality assurance processes are needed for science and policy for sustainability, based on wide societal and ethical reflections. The deep involvement of policymakers and the public in the quality assurance of innovations in science and technology thus becomes necessary. Scientists must learn as well as teach. Policy makers must specify their needs and accept uncertainty as well. The general public must use their discrimination on scientific questions as on all other questions of public concern. The old conception of scientific communication as a one-way traffic of information from experts to the

[9] This point has been particularly stressed by Funtowicz et al. Advances in science are opening up new domains of potential technological innovation with potentially vast consequences. Science offers potentially very powerful technologies, with both upsides and risks. The pursuit of sustainable development through science and technology is therefore risky, and some of these risks are inherent in the potentialities of science and technology themselves. Knowledge and technology permit more sophisticated interventions in ecosystem functioning and the components of life itself, yet our knowledge of the systems in which we intervene is incomplete and lags behind our interventions. Science-based intervention has, in the past, contributed to industrialisation processes that have proven highly disruptive to ecosystems at local and global levels. Some new, commercially-attractive technologies may also be incompatible with ecological stability and environmental quality goals. Analogously, commercially-driven innovation and technology transfer can work to heighten socio-economic stratification, and so worsen poverty for disadvantaged populations rather than reduce it. One feature of many new domains of science-based innovation is their intervention in complex biological and ecosystem processes where quality assurance in terms of outcomes is almost impossible to conduct – in part because some of the adverse consequences can be very long-term and are also difficult to control. There are many examples of effects that can be felt over long time spans and of interventions in social, economic and ecosystem processes that, once initiated, cannot easily be mastered (GMOs, BSE, etc.). Many of the 'miracles' of increased productivity within the agro-food industry have heightened the vulnerability of food production systems to technological, economic or social disruptions. In the fishing industry, they have increased the likelihood of species extinction. The complexities of modern science-based production and environmental engineering practices pose radical new challenges for public policy. The new context requires procedures for evaluating science and technology contributions against criteria of sustainability, which in turn requires awareness-building of the need for such evaluation and capacity-building for such evaluation.

public has to be replaced by a notion of partnership through reciprocal learning among those involved in the process (Funtowicz et al 1998).

Development processes involve many stakeholders and present us with multiple- and often conflicting objectives, which have to be reconciled in goal-setting and decision-making processes. All stakeholder groups should be appropriately represented and their concerns should be identified and represented in design and decision processes. In this regard, it has been suggested (Chung and Lo 2002) that parties with one or more of the following characteristics should count as a stakeholder group:

i. Those who might be affected positively or negatively by decisions on the issue in question
ii. Those having direct decision-making power on the issue
iii. Those having a high degree of reliance on the decision outcome of the issue
iv. Those whose activities are substantially affected by the decision outcome (e.g., society in general and future generations).

This last group is included to reflect, in particular, intergenerational equity.

Decision criteria may be fuzzy, contingent on context and unstable. By way of example, the debate on resource productivity improvement and its role in sustainable development centres on the relationship between technology and resources. The history of technological change is nothing if it is not one of resource substitutions. Against this backdrop, some argue that it is meaningless to pinpoint any resource as critical, because what we consider to be a resource is a function of technology, and technology – and hence the resource base – is always shifting. Should we define sustainability in terms of critical resources, resource productivity improvement or in terms of the rate of resource substitution? There are parallel debates over the meaning of greater global equity. Equity in what? Equity in access to resources? Equity in access to the technologies that enable useful goods and services to be produced from resources? Equity in access to GNP? Equity in consumption? Because of these complications, any normative statement about what constitutes sustainability is likely to fall on a continuum between the extremes of precision and fuzziness. Precise criteria are likely to be most easily communicated and understood and also most easily made operational, but they are also likely to be potentially ambiguous and misleading and, therefore, also most vigorously contested. Vague and fuzzy criteria are likely to be less easy to define, to communicate and to make operational, but may be more appropriate, less misleading and less contestable. This sets a challenge for science to articulate and analyse the interdependencies among objectives and development trajectories using co-evolutionary approaches.

Different spatial levels of the developmental system (local, national, regional and global) are interdependent. There is a need, therefore, to ensure compatibility between objectives and actions at different spatial levels, especially to ensure that higher-level objectives and higher-level contexts guide local actions. At the same time, there is a need to ensure that the regulatory and policy framework at a Meta level facilitates, rather than obstructs, sustainable solutions at lower levels. Above all, there is a need to avoid independently determined short-term actions that have the potential for destructive and irreversible impacts on the system as a whole.

We are dealing with distributed innovation systems, with many decentralised and independent actors who need to act together in a co-ordinated fashion in order to bring about change that is in everyone's best interest. The dimensions of this problem are well understood, but they are not easily tackled. The basic problem is that there are intrinsic biases against strategic, co-operative actions that are in the interest of everyone. When dealing with a distributed innovation system, there is need for common understanding to be developed around problem definitions and solution possibilities and for the development of strategies for implementing change. Since actors are interdependent, not only do actions need to be co-ordinated, but also a basis of trust needs to be established between actors so each has confidence in the others.

Since the current development paradigm is not sustainable and since there is a strong path-dependency in development processes (Nelson and Winter 1987), moving in the direction of sustainable development will require system renewal. Whereas most RTD activity is based on incremental improvement within the framework of the prevailing development paradigm and can be based upon using the past as a basis for forecasting future contexts, science and RTD for sustainable development must necessarily be involved with prescription rather than with prediction. One implication is that RTD for sustainable development cannot rely on the past as a guide to the future, since the very objective is to manage transition from the present socio-economic situation to a radically different future. Another is that, because of the long-term time horizons involved and uncertainty (including uncertainty about precise ends and means), management of change needs to be by a process of feedback and correction, using targets, indicators and monitoring processes to guide and steer change.

5. New challenges, roles and goals for science and RTD

The characteristics of the problems posed by sustainable development – complexity, multi-criteria decision-making, irreversibility, multiple actors, etc. – imply new challenges for RforSD. In turn, these imply new roles for science and scientists and new goals for research activities. Firstly, they imply a need to redirect scientific effort, which is mostly oriented toward incremental improvement in the systems of wealth creation within the prevailing development paradigm, so that this targets the thematic priorities and process challenges posed by SD. Secondly, they imply that research and scientific effort become integral elements of the process by which society moves toward sustainable development, endogenous to it, rather than simply adjunct or exogenous endeavours. Thirdly, they specify new roles for scientists within the process of sustainable development, as initiators, facilitators and co-ordinators of change, as mediators in processes of decision making, as communicators, as teachers and learners, and as disseminators.[10] This implies that much RforSD will necessarily

[10] This is not to imply, however, that science is uniquely responsible for these tasks. There will be contributions needed also from the rest of society (e.g., in politics, media and education). It is to imply, however, that science – just as the rest of society – will need to take on new roles. This has several implications. New roles for science will imply the need for financial and other resources to be devoted within research budgets to the fulfillment of these new roles; for example, for communications. It also implies that there is need to consider the linkages between the roles of science in sustainable development and the roles of the rest of society. Which models for co-operation between scientists and the rest of society work best? In regard to the link between science and policymaking, for example, how does the

be action- or implementation- oriented. Finally, they imply new goals for science and research, related to outcomes that are different from the usual scientific products of new discoveries, new theory, data, models, information and publications. In addition to conventional 'scientific and technological capital', these new outcomes include additions to human, social and institutional capital, new capacities and a new orientation of societal effort in the direction of sustainable development. These outcomes will include improved procedures for communication, decision-making, risk assessment and articulation, the management of uncertainty, quality-assurance, etc.

The urgency and scale of the sustainability challenge will require a shift in the priorities and orientation of science/technology. In essence, it will require that scientists address the most urgent problems in society in proportion to their importance and that a greater appreciation is developed in scientific and development fora of the virtues of mundane science oriented toward everyday problems. The objective of scientific endeavour in this new context may well be to enhance the process of the social resolution of the problem, including participation and mutual learning among stakeholders, rather than a definitive 'solution' or 'technological implementation'. This is likely to require procedures and mechanisms for guiding scientific work and technology applications toward innovations that respect fundamental sustainability values, such as local ecosystem resiliency, energy efficiency, food security and enhanced problem-solving capacities of local populations (Funtowicz et al 1998).

Funtowicz et al (1998) have developed a classification of the challenges to science posed by sustainable development. Challenges to science fall under the following heads: technical challenges, empirical/methodological challenges, moral/procedural challenges, challenges relating to the priorities and orientation of science efforts, challenges relating to quality assurance and to loss of trust in scientists and policy makers. As to technological challenges, there is need for science and RTD to help deliver leaps in technical, economic and environmental performance of technologies and for technologies to be developed that meet multi-criteria performance objectives. As to empirical and methodological challenges, there is need for science to help achieve a better understanding of our environment and the planetary life support system and of the nature of interactions between ecological and socio-economic systems. To achieve this better understanding of our environment and the planet's life support system, we have to deal with complexity, irreversibility and uncertainty over the long term. In turn, these give rise to moral and procedural challenges. There is need to define the roles of science-based knowledge and innovations for goals such as poverty reduction, governance of technological and environmental risks and sustainable ecosystem management. There is need also for effective communication of scientific information to achieve these goals, for effective communication of uncertainty and for effective communication of the limits of science in its ability to provide solutions.

These challenges can be translated into a set of broad and more specific goals of RTD for sustainable development (*Table 1*).

American policy-making model of think-tanks compare with the European separation of science and politics?

Table 1: Broad and specific goals of research for sustainable development (adapted from Jansen *et al* 1992, Funtowicz *et al* 1998, Weaver *et al* 2000)	
Social resolution of problems	- brings together actors and stakeholders to revisit and redefine problems on a first principles basis - helps stakeholders to establish shared goals that represents an explicit identification of the kind of socio-economic order they wish to strive for - helps stakeholders to envision, explore, evaluate and initiate pathways to radically different futures - seeks to ensure that all stakeholders are represented in decision processes and to improve the transparency of decision making - establishes mechanisms and processes for accommodating dispute, conflict resolution, compromise building, etc. - communicates with policy makers over the need for a facilitating meta-framework of policies and regulations
Communications "to bridge communications gaps in such a way that a process of mutual learning and trust can be established among all the parties"	- establishing better lines of communication between scientists, policymakers and the public concerning the gravity of environmental and economic problems - establishing better communication between scientists, policymakers and the wider political community about risks of technologies and quality assurance - establishing lines of communication for the transfer of knowledge, especially for building up endogenous capacity in localities with less-developed science resources, improving their natural resource management and ecosystem management capabilities and making possible a more effective harnessing of advances in science and technology
Scientific "development of a process or processes that will ensure involvement of all appropriate scientific inputs and expertise"	- brings together all appropriate scientific input and expertise (integrates physical, engineering, social and natural sciences) - deepening of co-operation between local and external experts to ensure full understanding of the socio-economic, cultural and ecological circumstances as a precondition for successful science-technology implementations - co-ordination of environmental data - integrating data/models - strengthening the scientific basis for sustainable management - better processes for communication between scientists, policymakers and public at large - filling a 'knowledge gap' about the technological and policy responses to problems of unsustainable development - seeks continuously to experiment and to monitor own performance, to learn and to apply lessons from own and from others performances, and to leverage own impact by disseminating information about successes/failures
Risk management "development of processes that make risks transparent to stakeholders"	- development of procedures that implement a precautionary principle - development of a quality control process to guide science and technology that is based on explicit ethical, political and epistemological reflection - development of processes for assessing scientific uncertainty,

	for accommodating scientific dispute and for integrating stakeholder interests/perspectives in relation to technology and environmental risks - development of processes that make the distribution of benefits, costs and risks and any uncertainties in these transparent - development of mechanisms to identify and avoid individual short-term actions with irreversible and damaging impacts on the system as a whole
Transition management	- development of processes by which we reach an explicit identification of our goals and of the kind of future socio-economic order we wish to strive for together with the policies that encourage research, knowledge exchange and science applications – a permanent social learning – in pursuit of these - development of tools and information in support of transition - help stakeholders and actors to develop strategic action plans for transition along preferred pathways, which assign responsibilities and timeframes for action - development of mechanisms for ensuring linkage and compatibility between actions at different spatial scales and timeframes

It is important to point out that while some of these challenges are quite specific to RforSD, others are not. Some challenges – for example, the challenge of ensuring the involvement of all relevant scientific knowledge and expertise – are also faced in other areas of research. What is specific to RforSD, however, is that such a wide range of challenges is faced simultaneously in RforSD. This suggests the need for multi-capacity researchers and teams of researchers and, if RTD processes are to be efficient and effective, the availability of multi-purpose tools and approaches; i.e., ones that provide means for addressing several challenges simultaneously. In later revisions of this report, this issue of multi-purpose tools and methods will be addressed at greater length. However, for the present some important inferences can be drawn both about the nature of potentially useful innovative approaches for RforSD and for the evaluation of achievements in respect of the challenges that face RforSD. Clearly, innovative approaches and tools that are appropriate for addressing these challenges may come from other (non sustainability-oriented) domains of research. Equally, evaluation methods are available in the literature both within and outside the sustainability debate, in relation to applied, transdisciplinary, normative/prescriptive and implementation-oriented research. There is a substantial body of relevant literature of which we are aware and upon which we will draw in the development of our own evaluation methodology. This includes, for example, a special edition of Research Policy (number 27) on evaluation, several Technolopolis reports, several ESTO reports, the work of the IAstar project, etc.

6. Toward a preliminary evaluation methodology

Summarising the foregoing discussion, we can present a first proposal for a general normative definition of RforSD that we might apply in a wide range of cases, including to RTD efforts intended to improve the sustainability of production-consumption systems.

Research for sustainable development is motivated, action-oriented research, which supports an inclusive, strategic societal process that seeks to envision, explore and initiate radically-different socio-economic and environmental futures and to demonstrate that sustainable solutions are possible, in principle, if research, development and innovation processes are appropriately oriented and resourced. As thematic priorities, research for sustainable development targets radical improvement in environmental performance, distributional equity and efficiency. It also targets transition management and support for the policy making process. It targets the build-up of supporting capital, including scientific, informational, technological, institutional, organisational, social and human capital that will augment or increase the productivity of environmental capital, and of supporting capacities, including the capacity for continuous innovation, learning and change in society and for interdisciplinary analysis in science. As procedural priorities, research for sustainable development seeks to enhance the process of social resolution of problems concerning transition by acting as a facilitator/co-ordinator of change and by establishing procedures for participation, co-operation, conflict resolution, risk management and communication. It seeks also to develop mechanisms to ensure that gains made during RTD efforts are maintained and secured for their intended purposes (and not lost to rebound effects) and to develop mechanisms to ensure that progress is continued once publicly-funded RTD support ends. Since RTD efforts can only be small in relation to the overall challenge of delivering sustainable development, they should aim to achieve a 'ripple in the pond' effect, by establishing mechanisms that leverage their own impacts.

At issue in AIRP-SD is to determine for a set of case-study RTD programmes:

i. Whether RTD programmes address these challenges
ii. How RTD programmes address these challenges
iii. How well RTD programmes address these challenges
iv. Which approaches to addressing these challenges work best, where and why

Questions i) and ii) above can be addressed by asking programme designers and managers about their approaches in respect of each challenge. For illustrative purposes, a preliminary set of example questions is given in *Table 2* in relation to each thematic or procedural priority. This list is for illustrative purposes only, and should not be considered complete or exhaustive at this time. Further work is underway to refine and rationalise this list of questions. The approach to Question iii) depends upon whether or not the case-study programme has been active long enough to allow an *ex-post* evaluation. If not, only *ex ante* evaluation based upon the programme design and consistency checks with programme goals and objectives is possible. If it has, *ex-post* evaluation, perceptions of stakeholders and consistency checks can all be used as a basis for programme evaluation. *Ex-post* evaluation depends on gathering tangible evidence of outcomes and impacts of programmes, which relate to performance in respect to the thematic and procedural priorities and to interim goals related to capacity and capital building. Work is in progress on the development of relevant indicators and evidence of achievement for ex-post evaluation. A provisional set of evaluation questions is given later.

Since AIRP-SD seeks to make a comparative evaluation of innovative RTD programmes and to identify best practices, it is necessary to be able to compare programme achievements. Seeking evidence of a hierarchy of achievement probably does this most effectively. Clearly, it is possible to specify levels of achievement that are higher than are others. To involve stakeholders at all may be an achievement. To involve a large number of different stakeholders represents a higher level of achievement. To include the interests of stakeholders unable to represent themselves is also an achievement. To involve a large number of different stakeholders in an intensive, interactive and iterative mutual learning and information exchange exercise is a still higher achievement. If as a consequence of such an intensive, inclusive and interactive exercise, compromise positions are developed on formerly contentious issues, we will have achieved real results as well as augmented social capital. If there is evidence that the compromise leads to widespread social acceptance of a preferred solution, then we have a still higher level of achievement. In WP 5/6, we will want to consider the relative importance of different kinds of achievement and different levels of achievement.

Table 2: Evaluation questions to establish whether and how goals of RforSD are addressed in the case-study programmes

Goal	Question
Thematic priorities: "radical improvement in environmental performance, distributional equity and efficiency"	- How is the goal of greater environmental protection handled in your programme? - How is the goal of greater equity handled in your programme? - How are these goals integrated in your programme? - What mechanisms are used to ensure that the environmental protection and equity goals used in your programme are compatible with global constraints? - What mechanisms are used to ensure that any efficiency gains made through your programme are used to secure greater environmental protection and greater equity?
"the management of transition"	- What mechanisms are used to identify a full range of developmental goals? - What mechanisms are used to integrate multiple goals into the search for solutions? - What mechanisms are used to stimulate creativity in finding new solutions? - Who is involved in the search for solutions? - Who is involved in evaluating solutions? - How are preferences established among different solutions? - What mechanisms are used to translate long-term solutions into near-term actions? - How are responsibilities established for different near-term actions? - How are goals translated into targets, indicators and milestones? - How is progress monitored?
"support for the policy development and evaluation process"	- What mechanisms are used to identify institutional barriers to transition? - What mechanisms are used to explore and evaluate

	alternative policy contexts for development?
Procedural priorities: "to support participation, inclusion and transparency"	- Which actors are involved in your programme? - How do you secure their involvement? - Which stakeholders are included in your programme? - How do you secure their involvement? - What is the basis for decision making among stakeholders and actors in your programme? - How are the interests of those not able to represent themselves, such as future generations, included in decision making? - Are there clear and transparent criteria for decision making? - Which mechanisms and procedures are developed for handling conflict and dispute in your programme?
"to bridge communications gaps"	- How are links established among scientists, private interests, societal stakeholders and policy makers in your programme? - How are links established to policymakers in your programme over the need for a facilitating meta-framework of policies and regulations?
"to make risks transparent to stakeholders"	- What processes are used for assessing scientific uncertainty in relation to environmental, economic and technological risks in your programme? - Is the distribution of risk and any uncertainties in this assessed? - How are risks and uncertainties communicated to actors, stakeholders and policy makers? - Does your programme have explicit ethical, political and epistemological references to guide scientists and technologists in handling risk? - How do you operationalise the precautionary principle in your programme?
"to re-orient and re-structure scientific efforts"	- How is a full range of relevant scientific input and expertise brought into your programme? - How are different types of input and expertise integrated in your programme? - How is external and local knowledge integrated in the programme? - How do you ensure that the results of scientific inquiry are actually applied? - What would you consider are the main goals of your programme? - How do you measure the achievements of your programme? - What mechanisms are used to ensure that gains made during your programme are maintained and secured for their intended purposes? - What mechanisms are used to ensure that any progress made during your programme is continued after it has ended? - What mechanisms are used to leverage the impact of your programme?

RTD programmes targeting sustainable development should influence not only innovation processes, but also societal innovation contexts and corporate innovation cultures to make these more favourable for new solutions. These goals can be matched with a wide-ranging set of anticipated outcomes to provide a basis for evidence-based evaluation. For example, we might ask whether there is evidence of:

- A greater appreciation in society of the importance, magnitude and urgency of the challenge of sustainable development, of the shared responsibility for sustainable development and of the role of sustainable technologies in providing solutions.
- A clearer articulation by members of society of the demand for sustainable technologies and for a supporting Meta framework of policies and regulations.
- A change in corporate culture to perceiving sustainability as an important opportunity, not a threat.
- The emergence of new networks of stakeholders and actors in the search for solutions that transcend traditional divides of sectors, agencies, classes, etc.
- A process of mutual learning and trust among all the parties
- Partnership through reciprocal learning
- Scientists learning as well as teaching
- Stakeholders and actors changing position and moving toward compromise during RTD programmes
- Policymakers accepting uncertainty as well as specifying their information needs
- The general public using discrimination on scientific questions
- A more detailed definition of the technological challenge of sustainable development, of the technological possibilities for meeting that challenge and of the conditions on technological solutions.[11]
- Creative new solutions that embrace technological, behavioural and institutional responses
- A first set of illustrative technological solutions that could contribute to meeting future needs on a sustainable basis, described along with their cultural and structural context.
- A set of 'embedded' innovation lines continued independently by privately financed and managed RTD consortia in respect to research directions begun through the Programme.
- Spin-off innovation lines begun and continued without any direct Programme involvement, but influenced indirectly by the Programme and its methods.
- Collaborations on long-term innovation processes/projects for sustainable technology development.
- Learning within programmes, as evidenced by real-time monitoring in relation to indicators of achievement and any changes in approach in response to the need for correction or in response to lessons learned
- A method, guiding manual and transferable lessons for sustainable technology development.
- Training materials and trainers with experience of sustainable technology development

As regards item (iv) above, a wide range of factors could influence the success of programmes in meeting the challenges to research posed by sustainable development. The same or similar approaches might meet with differing success depending on

[11] This is important to provide a perspective on the programming and prioritising of R&D for business, technical institutes and universities, and a basis for the programming of policy.

aspects of the programme organisation and design or aspects of the applications context. In this context it should be borne in mind that there is no one concept of sustainable development, nor is there only one concept for translating sustainable development into a research context. Different countries have developed considerably different approaches concerning the focus, organisation and implementation of research activities in relation to sustainable development. Literature reviews are currently under way to identify potential factors in the success/failure of programmes as a basis for hypothesis development and (non-statistical) testing. In the interim, we can propose some candidate factors for illustrative purposes:

- the strength of political commitment to sustainable development
- the organisation of science generally within the relevant jurisdiction (especially, the strength of connections between general policy and research policy, the status of applied research and the approaches to building and maintaining scientific capital)
- whether there is a coherent theoretical, conceptual or methodological approach to sustainable development at the programme level
- the ambition and scope of the RTD programme (critical mass, synergy, etc.)
- the existing status of civic society

7. Toward a methodology for screening programmes

Our first task in selecting case study programmes is to identify the types of RTD programme in which we are interested, in principle. These need to be defined in terms that are sufficiently general to include programmes of potential interest but without risk of "catch-all" definitions. The foregoing discussion suggests that we are interested in recent or current RTD programmes that:

1. Are specifically targeted towards sustainable development, towards improving the sustainability of production-consumption systems, towards addressing challenges/threats to sustainable development or towards reducing the overall level of environmental pressure, especially by reducing or restructuring material and energy use.[12]
2. Are targeted toward greater equity in society, especially equity within and between generational cohorts.

[12] Almost all environment research is aimed at reducing environmental pressure. Conversely, very little research is oriented toward reducing the material throughput of our economies in absolute terms, albeit that a lot of research is aimed at reducing the material-, energy- and waste- intensity of our economies or the specific material-, energy- and waste- intensities of technologies. At issue here is to define which programmes are actually of interest to us: RTD programmes aimed at reducing environmental pressure in absolute, specific and relative terms versus RTD programmes aimed at reducing environmental pressure only in absolute terms. The nature of the materials and energy throughputs is also relevant. We cannot assume that reductions in materials and energy throughputs are always consistent with sustainability. An increase in the absolute throughput of photovoltaic energy might be a move toward sustainability, for example. Equally, an increase in the throughput of a less environmentally-damaging material might be warranted if this enables a reduction in the throughput of a more environmentally-damaging material. Likewise, a temporary increase in the materials throughput might be warranted if this is used to build public transport infrastructures to replace private car use in the long term. The formulation of this question is designed to take these considerations into account.

3. Are aimed at envisioning, exploring and realising radically different socio-economic futures.
4. Are aimed at improving the capacity for innovation and change in society.
5. Are using innovative organisational approaches within programme design and management, or that enhance innovation within research or that are developing and using innovative tools and methods.

[NB. As regards the first in the list above, it is important to know whether, in the self-understanding of those who set up a programme, they declared it to be targeted at SD. This is important, because we can then check to see what those who set up the programme understand by SD, check how consistent the programme is – in its conceptualisation, design, content and implementation – relative to its declared goals, and check consistency with our normative definition of SD. It is also useful to know whether the understanding of SD used in the design of a programme is developed from official definitions contained in policy references.]

Criterion (1) almost entirely excludes basic environmental research that has, by definition, no observable link to production and consumption patternsResearch on reducing material or energy use, will, however, remain relevant so long as this is oriented toward achieving absolute reductions in environmental pressure. Our concern is to distinguish the relatively small body of work that is truly ambitious in regard to environmental protection or sustainability from what is a huge body of less ambitious environmental research

Criterion (2) follows directly from the social element in our definition of sustainability. Within existing programmes questions of addressing equity are generally underrepresented. This suggests that we make equity an explicit screening criterion so that we identify programmes where equity has been considered and can evaluate how well and in what ways equity is considered. Similar remarks apply to criterion (3); Factor Four/Ten as well as research on new paradigms/visions and on new systems, e.g. for energy, mobility and food, are relevant here.

Criterion (4) is especially targeted towards identifying programmes where there has been an explicit attempt to achieve societal impacts through research. Based upon recent research findings (E.g., North 1990, 1998), the capacity for innovation and change in society depends upon flexible institutions and organisations that actively innovate. Thus, the participation of enterprises, environmental NGOs, and others within research, the targeting of their specific interests by research, and addressing framework conditions for action are potentially essential pillars for research programmes for sustainability. Again, it might be argued that sustainability research should address questions of real societal change and not only questions of academic interest. This should be factored into the evaluation methodology and is a particular strength of the approach to evaluation of Defila and Di Gulio (Defila and Di Gulio 1999).

Criterion (5) refers to research management and methodologies. There is evidence from previous studies that networks of research organisations are superior to single research organisations for reasons of adaptation, flexibility, and avoiding path dependencies (Luukonen 1998, Laredo 1998). Georghiou (2001: 902) concludes in his analysis on research collaboration in Europe that coordination between institutions presents a greater challenge than operating R&D programmes. According to his view, the subsidiary principle should also be applied in decision-making on research

programmes by institutionalising the concepts of variable geometry, bottom-up participation, and by supporting mobility of researchers. Thus, programmes that actively foster international networking activities among research organisations by innovative processes ought to be identified in order to find how this particular challenge has been met and in order that we might evaluate how well this challenge has been met in specific cases.

Similarly, since sustainability as a concept is based upon integrating the economic, social and environmental dimensions of development, we are interested to identify programmes that have developed innovative approaches for fostering interdisciplinary perspectives and interdisciplinary working. Defilio and Di Guilio offer insights into how interdisciplinary and transdisciplinary research might be evaluated (Defila and Di Gulio 1999). They warn, however, of the danger that interdisciplinarity can either be used as an excuse for methodological vagueness or for a hidden imperialism by one single discipline. Those who have reviewed single project appraisals for one programme are well aware of the different caveats! Our criterion hence includes a search for programmes that have used innovative approaches to foster interdisciplinary research, but this might well include innovative approaches that have fostered renewal within a single discipline as well as approaches that are used to foster collaboration between disciplines.
Our study can neither be comprehensive nor fully representative. Rather our study should explore elements in the success/failure of a small set of programmes/projects chosen to illustrate a diversity of design elements, innovative methods and applications-contexts. Since we cannot look at all programmes or even at a sample large enough to give us statistically significant or representative results, we need to work on the level of case studies. However, we need a structured approach for selecting case studies, as we want to ensure that we have a diversity of programme types and applications contexts, including some from Northern, Central, Southern, Eastern and Western Europe and some from further afield, some formally constituted and some informally constituted, etc. We also must ensure that our case study programmes are well documented or that we can easily obtain the information we need from programme managers. For this reason, we are interested in programmes that may already have completed and reported out, especially if these pioneered particular innovative approaches. Our criteria for selecting programmes therefore relate *either* to the characteristics of programmes, their constituent innovations and their applications contexts (i.e., the factors that might influence the success of programmes) *or* to the possibilities of obtaining information enabling us to evaluate achievements.

This suggests a structured approach to the programme screening exercise by which we will ultimately select case-study programmes from a set of candidate programmes. Importantly, we do not need to collect a full set of information for every programme. We can distinguish a hierarchy of information and only go on to collect more detailed screening information if nominated programmes meet essential selection criteria. Thus, there is a sequence to go through, as follows:

i. Members of the AIRP consortium approach potential informers in each country, giving them information about the AIRP project and its purpose and asking them a first set of screening questions about candidate programmes that they might know of in their country.

ii. The responsible consortium member checks to see whether the nominated programmes meet essential criteria (innovative/documented/etc.).
iii. If the programme meets essential criteria, the same AIRP member collects additional information that will enable us to classify the programme and its innovations.
iv. At WS 2, the consortium selects case-study programmes based upon these classifications so that they represent a diversity of approaches, methods and contexts.

In step (i), the programme informer actually makes the first selection on programmes that he/she knows about. He determines whether a programme may fit into the AIRP investigation. The questions to ask our informers are presented in a template (*Table 3*). A check against the answers to these questions will be sufficient for identifying candidate programmes. Informers could be asked to motivate their suggestions to the responsible AIRP contact.

In step (ii), upon request of the responsible AIRP member, the programme administration / management may deliver administrative data (*Table 4*) including a short (2 page) description of the programme.

Table 3: Screening questions to identify candidate programmes

First Informer Template **- Screening Data for Case Study Selection -**
1. Do you know of any recent or current RTD programmes in your country that are specifically targeted towards sustainable development, towards improving the sustainability of production-consumption systems, towards addressing challenges/threats to sustainable development or towards reducing the overall level of environmental pressure, especially by reducing or restructuring material and energy use? **Name:** **Contact:**
2. Do you know of any recent or current RTD Programmes that also target greater equity in society (esp. equity within and between generational cohorts?) **Name:** **Contact:**
3. Do you know of any recent or current RTD Programmes that are aimed at envisioning, exploring and realising radically different socio-economic futures? **Name:** **Contact:**
4. Do you know of any recent or current RTD Programmes that are aimed at improving the capacity for innovation and change in society? **Name:** **Contact:**
5. Do you know of any recent or current RTD Programmes that are using innovative organisational approaches within programme design and management, or that enhance innovation within research or that are developing and using innovative tools and methods? **Name:** **Contact:**

Table 4: Administrative Data for Case Study Selection

Administrative Informer Template
1. Name of Programme
2. Description of the programme (see Questions below)
3. Funder of Programme
4. Manager/coordinator of programme
5. To whom is the programme directed?
6. Size of Programme (Euros/Year) + (Number of projects)
7. Start and finish dates of Programme

On the basis of the administrative data including the programme description, WP 2 members make a first assessment to check that they can answer the **following questions:**

- Which are the main policy references for the Programme, if any?
- What are the Goals/Objectives of the Programme?
- In what ways, if at all, are these related to sustainable development or to renewal of production/consumption systems?
- Is there anything innovative about the Programme, such as theoretical frameworks, methodologies, organisational procedures, engagement of stakeholders, use of interdisciplinary or integrative concepts, etc?
- What will be the main achievements of the Programme?
- What evidence is there that these achievements will be attained (ex-poste or ex-ante)?
- Is the Programme well documented?

Responsible WP 2 members check this preliminary evaluation with the Programme administration / management. If the programme meets our essential requirements (i.e, is renewal-oriented, innovative, well documented and there is evidence of impacts),

the responsible consortium member seeks any additional information still needed to address the points below:

- What is the system of interest or study of the programme, such as sustainable development of a region, chain analyses of a sector such as transport, cross-sectoral, human-ecological interactions?
- If the Programme is system-focused, what is the scale of the system of interest (local, national, regional, global)?
- What is the Field of Study of the Programme (natural sciences, technology, engineering *versus* social sciences and humanities *versus* human-natural systems interactions)?
- What is the Type of Study of the Programme (pure-basic *versus* strategic-basic *versus* applied *versus* experimental development)?
- What is the focus/emphasis of the Programme[13] (listing/classification on weak-strong continuum)?
- What concept or hypothesis underlies the Programme and its design (what is sustainable development for you)?
- What features of the Programme design are relevant to the attainment of Programme Goals/Objectives such as criteria for selecting projects, joint funding to engage different stakeholders, interdisciplinary, linking experts from different levels (local – external), learning by doing, providing funding for stakeholders, representation of future generations, other species or people from other nations?
- What methodological features are relevant to the attainment of Programme goals/objectives such as backcasting, envisioning alternative futures, stakeholder analyses, technology assessment, adaptive management, policy exercises, risk assessment, etc?
- What project selection procedures are relevant to the attainment of Programme goals/objectives?

These questions are intended as a checklist. In practice, collecting this information should come about automatically if we get a good two-page description of each programme. It will only be necessary to ask specific questions on the check-list in the event that answers to these are not already discernible from the two-page description (see sample Administrative Data Sheet in Appendix I).

Final results are subject to discussion with the stakeholders and in Workshop 2, where the selection of programmes to be evaluated as case studies in WP5 and WP6 will be made.

13

Emphasis on demand-side	w…… s
Emphasis on supply-side	w…… s
Emphasis on risk management	w ..... s
Emphasis on technology	w…… s
Emphasis on attitude, understanding, value system	w…… s
Emphasis on methodology building	w…… s
Emphasis on learning	w…… s
Emphasis on communication	w…… s
Emphasis on stakeholder involvement	w…… s
Emphasis on actor-network building	w…… s
Emphasis on policy interface	w…… s

8. Screening of Countries for Stakeholders and Programmes

So far, the work has concentrated on

- Setting up a stakeholder board
- Identifying and contacting stakeholders
- Collecting information through the use of the "First Informer Template" and the "Administrative Informer Template", see Chapter 7
- Screening already collected programmes, especially ESTO

8.1. Stakeholder board

As part of the quality assurance measures for the AIRP-SD project a stakeholder board was formed. Its members will comment on the quality of the accomplished work and suggest ways to improve the work ahead.

The members were selected in the following process:

1. at the kick-off workshop of AIRP-SD the partners decided to find stakeholders for the following categories:
    - national government
    - industry
    - science
    - international organisations
    - non-governmental organisations (NGOs)
    - local government
    - consumer groups
    - small and medium sized enterprises (SMEs)
    - agriculture
    - trade unions
    - European Parliament
2. after the workshop, the project partners nominated potential candidates for the stakeholder board in each of the above-mentioned categories.
3. after ranking the potential stakeholder board candidates according to their relevance for the AIRP-SD project, the top ranked candidates were approached.
4. when a candidate agreed to become a member of the AIRP-SD stakeholder board, he/she received a "welcoming letter", outlining the report review process and dates when reports should reach them.
5. after a candidate had declined the offer, the next candidate on the ranked list was approached.

Currently 9 out of 11 stakeholder board categories could be filled:

Science:	Jan Rotmans (ICIS Intl. Centre for Integrative Studies)
SMEs:	Krzysztof Kwatera (PEPF Polish Environmental Partnership Foundation)

Industry:	Joachim Ganse (GERLING Assurance)
Government:	Hansvolker Ziegler (German Ministry of Research)
Intl. Organisation:	Dr. Jacqueline Aloisi de Larderel (UNEP UN Environment Programme)
Trade Unions:	Reiner Hoffmann (ETUC European Trade Union Institute)
NGOs:	Laura Radiconcini (Friends of the Earth Italy)
European Parliament:	Claude Turmes (Green Party Luxembourg)
Agriculture:	Rudolf Bunzel (European Commission, DG Trade, Dept. of Agriculture)

As yet, no stakeholder in the categories "consumer groups" and "local government" could be found.

To communicate with the stakeholder board members and other interested stakeholders a website (www.airp-sd.et) was created, which contains project-relevant documents. People who are interested in the development of the project but who lack the time or capacity to participate on the stakeholder board can review interim reports through this medium. These stakeholders are offered the possibility to be reminded of the arrival of new interim reports by registering at the site.

Accompanying Committee in Portugal
In addition to the stakeholder board a local "Accompanying Committee" was formed in Portugal as an innovative element in AIRP-SD. This committee is expected to meet during a workshop (probably in Lisbon) to comment on the case-studies. This workshop will probably take place in October (close to the date of the third AIRP-SD workshop). During the workshop, stakeholders will have the opportunity to discuss with us the general challenges of RforSD and the methodology that we will be used to carry out the local case studies. A second issue to be discussed with the participants is the further involvement of the Accompanying Committee in the project.

It is not intended to copy such an exercise in other countries, but to take it as a special feature in order to arrive at deeper insights for countries that do not have a tradition of explicit sustainability-oriented research.

8.2. Identifying Stakeholders

The following relevant stakeholders from government, non-government and research who are knowledgeable about innovative research programmes have been identified as of now:

Austria
Hans-Günther Schwarz, Federal Ministry for Transport, Innovation and Technology (BMVIT)

Belgium
OSTC, Belgian Federal Office for Scientific, Technical and Cultural Affairs
Hubert David, Environmental Council
André Rault, ACEA EUCAR (European Automobiles Manufactures Association)
Martin Rocholl, Friends of the Earth Europe

Finland
Leena Simonen, Ministry for the Environment
Sauli Rohinen, Sustainability Council

France
Sylvia Faucheux, C3ED Université de Versaille
Laurence Tubiana, Prime Minister's Cabinet
Candice Stevens, OECD, Directorate Science, Technology and Industry
Christian Brodhag, Ecole Nationale Supérieure des Mines de Saint-Etienne

Germany
Hansvolker Ziegler, BMBF
Udo Ernst Simonis, Science Center Berlin
Michael Glootz-Richter, Sustainable Development of the Urban Environment, Bremen

Hungary
Jerome Simpson, Regional Environmental Centre for Central and Eastern Europe

Italy
Laura Radiconcini, Amici della Terra

Netherland
A.P.Verkaik, INNONET, advisory body to the ministry of agriculture, also aware of international programmes in the field of agriculture
R Weterings, TNO, head systems innovation and life environment
Hans Linsen, former director research Unilever, Chairman programme committee
J Marks, NWO (Dutch scientific research Organisation), connected to ministry of education, culture and science, former member of STD steering group
Kees Vijlbrief, director dept Innovation and Technology, Ministry of economic affairs
Jaqueline de Larderel, director UNEP office Paris, member Factor 10 club
Larry Kohler, International Counsil for Science (ICSU)

Norway

Matthias Kaiser, NENT Den nasjonale forskningsetiske komité for naturvitenskapog teknologi

Poland
Andrej Kassenberg, Institute for Sustainable Development
Thomas Zylicz, Wasaw Ecological Center

Portugal
Isabel Guerra, Environmental Auditor of the Ministry for Social Equipment

Spain
Conchita Martínez López, Oficina Española de Cambio Climático

Switzerland
Jonathan Loh, WWF International, Conservation Policy Department

Daniel Klooz, Beauftragter f. Umweltschutz und Energie, Kanton Bern

UK
Duncan McLaren, Friends of the Earth
Julia Hertin, SPRU University of Sussex
Henry Leveson-Gower, Environment Agency

Sweden
Jon Möller, Agenda 21 Office, Stockholm
Uno Svedin (Director Formas);
Mans Lönroth (Managing Director, Mistra)
Marie Urwing (Research Officer, Mistra)
Charles Berkow (Environmental Co-ordinator Green Party in the Swedish Parliament and former Chair of Friend of the Earth Europe)
Keith Clement (Senior Research Associate, Nordregio)
Tomas Ekberg (Senior Research Officer, NUTEK, Vinnova)

Turkey

Fatih Mehmet Sahin, Scientific and Research Council

8.3. Identified Programmes

Key scientists, policy makers and other stakeholders were approached to identify innovative practices and RTD programmes based on a significant cross-section of experience in Europe in the study subject. A step-by-step selection process allows us to find relevant programmes and to exclude programmes that can be considered less innovative than others.

One point of departure has been the study by the European Science and Technology Observatory (ESTO). It covered the following countries: Austria, Belgium, Germany, The Netherlands, Portugal, Sweden, and U.K. Its drawback is that it could not cover all the EU member states. Non-EU states such as Japan or USA have not been covered either. The AIRP project aims to widen this scope by inclusion of programmes outside the ESTO scope. As a second drawback, ESTO seems too broad in terms of programme description within the countries chosen. A third limitation is that the ESTO work covered only ongoing programmes. It did not cover recently completed programmes, which are those most likely to be well documented. We are currently screening the programmes covered by the ESTO work in order to select those that meet our criteria and which have used innovative approaches. The process of transferring relevant information from the ESTO templates to the AIRP templates is almost finished and will be completed in May. Wherever possible the information is being updated and complemented though literature reviews and interviews.

Additional programmes are also currently identified in Portugal, Germany, Sweden, the Netherlands, Australia and Japan. Once identified, the administrative data template will be used to gather answers to the questions listed in Chapter 7.

It is obvious that more countries should be screened to find innovative programmes in a diversity of contexts. Regarding France, further information can be expected via approaching Sylvie Faucheux and Laurence Tubiana. In Ireland, Frank Convery is able to offer information. Several senior researchers with broad international knowledge, such as Udo Ernst Simonis, Jill Jäger and Pier Vellinga, are also being

approached for their suggestions on candidate programmes and first informers. We have still to undertake screening in Italy, Spain, Greece, and (at least with some selected examples) USA and Canada. Other parts of the world will not be covered except for Guinea-Bissau, as mentioned by CEIFA unless stakeholders will provide additional information.

In May and June, the project partners will considerably broaden the information base on innovative programmes. By mid June, the final report will entail a sound collection of administrative data templates for a diverse set of countries, a diverse set of innovative approaches and a diverse set of applications contexts.

Programmes with administrative data collected so far:

Austria:
- Austrian Programme on Technology for Sustainable Development (ATSD) "Nachhaltig Wirtschaften"
- Austrian Landscape Research (ALR), Programm Kulturlandschaftsforschung (KLF)

Belgium
- Programme de Recherche et Développement Technologies environnementales (Programme "Entreprises"), Prospective Research in Brussels
- GBOU (Generic Basic University Research)
- "Vlaamse Innovatie Samenwerkingsverbanden" or "Flemish Cooperative Innovation"
- Sustainable mobility
- Telsat 4 (supporting actions of the scientific support plan for a sustainable development policy, sustainable production and consumption patterns, supporting actions of the second scientific support plan for a sustainable development policy, standardisation and technical regulations)
- Levers for a Sustainable Development Policy

Germany
- Biodiversity and Biosphere research
- Research on the Environment – Socio-Ecological Research
- Mobility and Transport
- Construction and Housing
- Sustainable Economic Management / Framework for Innovation
- Renewable Raw Materials (Ministry for Consumer Protection)

Netherlands
- Sustainable Technology Development Programme (STD/DTO)
- Habiform
- Dutch Initiative for Sustainable Development (Nederlands Initiatief voor Duurzame - Ontwikkeling, NIDO)
- Economics, Ecology and Technology (EET)
- Advanced Catalytic Technologies for Sustainability (ACTS)
- CONNEKT
- The Centre for Soil Quality Management (SKB)

- Reduction of other – non CO_2 - global warming gases (Reductie Overige Broeikasgassen, ROB)
- National Advisory Council Agriculture Research (NRLO)
- Innovative Network for Agro and Green Space 2001 (INNONET)

Portugal
- PDCTDCN (SD-oriented programme focusing on the integrated management of natural resources in protected areas, "negative" example)
- CUFADA that is currently implemented in Guinea-Bissau. (CEIFA is now searching for reliable information sources about CUFADA and other programmes in Africa via looking for information sources in Portugal, e.g. Portuguese researchers and project managers that are/were directly involved in the implementation of the programmes "in situ").
- ADEPE that initially aimed at regional socio-economic development (research focusing on fisheries) and became an important motor of (sustainable?) development
- Research programme in the framework of the National Strategy for the Conservation of Biodiversity (upcoming)

Sweden
- Society, system and circulation
- Intersectoral programme no. 2O Economics for Sustainable Development
- Strategic Questions for Long-Term Sustainable Working Life
- Innovation systems supporting a sustainable growth
- Path to Sustainable Development – Behaviour, Organizations, Structures

Japan
- Millennium Collaboration Projects in Japan

<u>Screened programmes with no apparent programme relevant to AIRP</u>:

Belgium
- IWT-Vlaanderen KMO-Programma (SME-Programme)
- Antarctica 4
- Global Change and Sustainable Development
- Norms for food products
- Sustainable Management of the North Sea
- Global change, ecosystems and biodiversity
- Workers' healthcare 2

Sweden
- FAS: Swedish Council for Working Life and Social Research (established 2001)
- SRC: Swedish Research Council (established 2001)
- The Swedish Foundation for Health Care Sciences and Allergy Research (established in 1994)

9. Conclusion

As indicated earlier, the current status of work as reflected in this milestone report, is as follows:

- a preliminary normative definition of sustainable development for use in the project has been defined in thematic and process terms
- a preliminary report has been written on the special challenges to RTD of sustainable development and this has been translated into a typology and a preliminary conceptual model of research for sustainable development specified in terms of broad and specific goals for RTD programmes
- a screening methodology has been defined for identifying and describing candidate RTD programmes for use as case studies later in the project
- a preliminary set of questions for consistency-based *ex-ante* evaluation of programmes has been proposed
- a preliminary set of questions for evidence-based *ex-post* evaluation of programmes has been proposed
- a preliminary approach to developing hierarchies of achievement has been proposed
- a stakeholder board has been created and additional stakeholders are being identified
- research programmes from EU and other countries are being identified and screened
- innovative approaches to the key research challenges are being identified

It remains to refine and further elaborate the preliminary products, to develop perception-based assessment procedures, to check the likely availability of needed evidence, to pilot the draft evaluation methodology using one or more innovative national programmes and to identify and screen additional research programmes and innovative approaches.

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Appendix I

Screening administrative templates for Sweden, Belgium and Japan (one example each, further templates available)

a. Sweden

Administrative Informer Template
1. **Name of Programme** Paths to Sustainable Development – Behaviour, Organizations, Structures (Ways Ahead) [3R]
2. Description of the programme The aim of the programme is to combine knowledge on environmental and natural resource issues with existing and new knowledge on what guides our everyday behaviour and actions on the individual as well as on the society level. The aim also is to build up socio-scientific and humanistic research skills in order to make such research more a part of the work towards sustainable social development.
3. Funder of Programme 22 MSEK from MISTRA + 27 MSEK in financial support from others. In the early 1990s the money from the "Wage Earners Fund" were put into several Strategic Research Foundations one of them being the MISTRA programme. At the beginning of 2001, the foundation's capital amounted to MEURO 494. Between the inception of the foundation in 1994 and spring 2000, MISTRA's capital grew steadily from MEURO 257 to MEURO 494. Until the end of 2000, MISTRA has assigned some MEURO 84 to environmental research.
4. Manager/coordinator of programme MISTRA: The Foundation for Strategic Environmental Research (established 1994) MISTRA supports strategic environmental research with a long-term perspective, aiming to solve major environmental problems. The main part of MISTRA's funding is focused on broad-based interdisciplinary programmes. MISTRA, Gamla Brogatan 36-38, SE-111 20 Stockholm, Sweden. Phone: +46 88 91 10 20. E-mail: mail@mistra.org http://www.mistra.org
5. To whom is the programme directed? Research community
6. Size of projects 49 MSEK for programme
7. Start and finish dates of Programme Running 1996-2001

b. Belgium

Administrative Informer Template
1. Name of Programme Levers for a sustainable development policy
2. Description of the programme The programme has the following objectives : - aiding decision-making at the national level : here this programme refers to the sustainable development policy described in the governmental declaration of 7 July 1999. This policy aims "to harmonise the economy, the ecology and social protection in order to arrive at a society where environmental quality forms an integral part of every behaviour ". The government proposes to achieve these ambitious goals via a number of instruments and political measures, including an active environmental policy in favour of sustainable modes of production and consumption; control of the ecological repercussions of joint development projects; integration of the dimension of sustainability into economic indicators/balances; tax measures; legislation. The first objective is to provide scientific support for this political commitment. - aiding decision-making at the international level : the goal is to help political decision-makers meet the international commitments (e.g. UNCED of 1992 in Rio, etc.). Realisation of these commitments often requires scientific validation or argumentation, such as testing the implications or possibilities of certain commitments, effectiveness studies relating to instruments capable of satisfying these commitments, etc. - establishing and/or strengthening research capacities : the goal is to reinforce the research potential in Belgium. Thanks to this programme, research teams are offered the possibility of acquiring expertise with respect to problematics which until now have not been addressed in Belgium. This programme also allows them to become familiar with international expertise and know-how and supports basic research. The "Levers for a sustainable development policy" programme contributes to making the concept of sustainable development operational, so that it can be used on the political level. This mission presupposes not only study of the concept itself, but also an understanding of the human behaviours responsible for the essentially unsustainable character of development in the Western societies, as well as the way in which these behaviours can evolve. This is an overarching societal problematic involving all human-science disciplines. The programme's research projects can be grouped into 4 categories : **Causes of unsustainable development :** Two types of analysis make it possible to identify the reasons for the unsustainable character of human behaviours (the modes of consumption and production; the modes of habitation, living and transport). These are : • analysis of the sectors at the origin of pressures on the environment: primarily industry and households, but also the agriculture and transportation sectors ; • horizontal analyses relating to technology, the historical evolution of certain regions, etc. • Statistical efforts :

This is mainly research relating to "indicators" of sustainable development and the problematic of "use of environmental space". **Instruments:** There exists a series of instruments capable of reorienting policy in a more sustainable direction. The research primarily targets: the legal aspects of the instruments and regulation in general; tax instruments; life cycle analysis; voluntary instruments,... as well as the consequences of a sustainable development policy. **Decision-making and the role of social groups :** Some projects deal with aspects relating to decision-making (the role of social groups; methods and instruments for decision-making) as well as the dichotomy between green thinking and action in favour of the environment.
3. Funder of Programme Federal Office for Scientific, Technical and Cultural Affairs (OSTC)
4. Manager/coordinator of programme OSTC Marie-Carmen Bex (Tel.: 02/238.34.81, e-mail : bexm@belspo.be) Rue de la Science 8 1000 Brussels http://www.belspo.be/belspo/ostc/act_scien/fedra/prog.asp?l=uk&COD=HL
5. To whom is the programme directed? Universities
6. Size of projects/Budget 5,701,551.07 EURO
7. Start and finish dates of Programme From 1/12/1996 - 31/12/2001

c. Japan

Administrative Informer Template
1. **Name of Programme** Millennium Collaboration Projects in Japan
2. Description of the programme Funding of research projects as well as Forums on crucial long-term issues of the Japanese society, namely ageing society and sustainable development. The latter means projects on resource and waste management, energy, climate change, and regional initiatives.
3. Funder of Programme Japanese Cabinet Office / Japanese Economic and Social Research Institute (WI contact)
4. Manager/coordinator of programme **Japanese Economic and Social Research Institute / Nomura Research Institute / Mitsu Research Institute (WI contact)**
5. To whom is the programme directed? **Research community and policy-makers**
6. Size of projects appr. 50 projects, with appr. 500 T€ each
7. Start and finish dates of Programme Summer 2000 until Spring 2002

This programme can be considered innovative because it brings together international researchers from Japan, other parts of Asia, Europe and USA. Four Forums provide opportunities for exchange. Synthesis reports are written by ESRI, i.e. from a policy-makers perspective. High degree of participation from research in both programme formulation and synthesis reports. Poor participation from business, green NGO's and other societal groups. The programme has not yet been subject to any evaluation, but sufficient information can be provided by WI contacts.

Appendix II

AIRP-SD

Evaluation Questions for Milestone One

Please insert your answer right underneath each question. The more detailed you explain to us your opinion the better we will be able to improve our work.

1. Do you think that the project's researchers are working towards
    a. identifying relevant stakeholders from government, non-government and research sectors related to sustainable consumption and production and integrate their participation with that of project partners and other members?

    b. identifying national and regional research programmes which can serve as examples of successes and failures in understanding and achieving sustainability of production and consumption for programmes in Europe?

    c. identifying innovative practices and processes in national and regional programmes?

    d. providing an analysis to serve in the re-orientation and restructuring of RTD programmes to strengthen their capacities to tackle new challenges and achieve new outcomes?

    e. helping to develop cross-disciplinary- and cross-sectoral networks of actors, commonly understood problem definitions, shared visions of possible solutions, and action plans for achieving system renewal by drawing attention to these as challenges of research for sustainable development?

    f. developing a conceptual model of an RTD process intended to deliver sustainable solutions?

g. finding quantitative and qualitative *evidence-based* indicators that reveal the impacts, effectiveness, and cost-effectiveness of innovations in RTD programmes?

h. using these *evidence-based* indicators and scales to measure and rank the impacts, outcomes and achievements of programmes in order to evaluate the capacities of innovative national RTD programmes and their constituent innovations?

i. assessing RTD programmes through the use of opinion-based evaluations, which draw upon stakeholders' perceptions and experiences with innovative RTD programmes?

2. Do you have suggestion how we could improve the work
   a. methodologically
   b. content wise

3. Are you aware of any additional stakeholders, research programmes and innovative approaches we should contact (if so, please fill out the "first informer template")?

4. Should there be additional questions in the two templates used to find innovative programmes and approaches?

5. Are you aware of any relevant methodological studies that evaluate innovative programmes and their effects on society?

6. Are we making sufficient progress (see timetable, Appendix III)?

7. Please comment on the quality of the Milestone One report?

The AIRP-SD team is grateful for your valuable assistance and feedback in reviewing Milestone One.

Please return the questionnaire via e-mail (gisela.bosch@seri.at) or to the following address:
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Appendix III

Timetable and sequencing of workpackages