

REINVENT – PROJECT NR 730053

Work plan

Deliverable 8.1

Astrid Byrman

2017-02-28

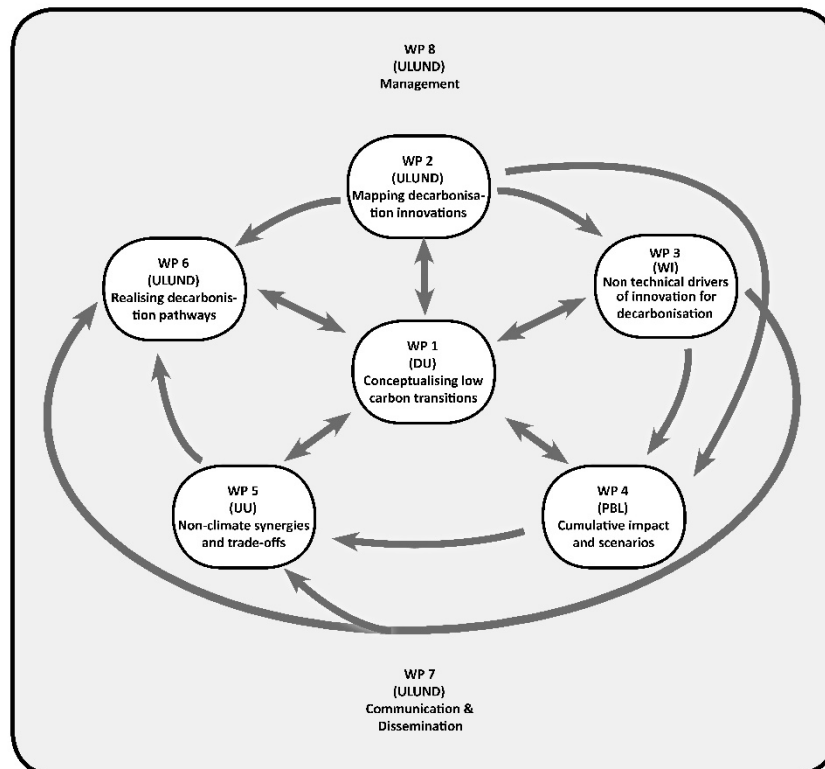


Work plan

This work plan contains an overview of all the work packages, their leaders, duration and tasks.

Along with their role and responsibilities in the Project Executive Board each work package leader is responsible for the execution of all work according to the plan in their own work package. They are in charge of implementing the work as defined in the WP descriptions, and will make necessary decisions together with the co-workers in the work package. The work package leader shall handle the daily management of the WP, reallocate resources within the WP when needed, and assure quality of the preparation of the work package related deliverables.

The figure below shows how the work packages of REINVENT are related:



The management of REINVENT is the topic of work package 8 and the communication is handled in work package 7. These two are therefore related to all the others, whereas work packages 1-6 focus on the research itself. In WP2, a broad mapping of innovations and initiatives for decarbonisation is undertaken. Subsequently, the results from WP2 are fed into WP3 where 15-20 cases are studied in-depth.

In WP4, pathways are explored that are consistent with long-term climate objectives and that describe the position of the four sectors in a wider European and even global context. The

latter is necessary because international linkages such as international climate and trade policy, – but also to show the global impact of policy action. The pathways in WP4 are co-designed with stakeholders using input from WP2 and WP3.

Obviously, the different pathways also have implications for other issues. These non-climate synergies and trade-offs are analysed in WP5. WP6, finally, is designed to turn results into practice building on the various results across all REINVENT work packages.

Work package 1

Leader: Harriet Bulkeley, Durham University

Other participants: PBL, ULUND, UU, WI

Duration: December 2016 – November 2020

The first work package focuses on elaborating the theoretical and conceptual foundations for REINVENT. This work package therefore links to all other work packages and its timeline continues throughout the proposal. The communication between WP1 and other WPs goes in two directions: WP1 absorbs the lessons learned in the other WPs but also guide the analysis in these other WPs based on a joint learning process.

To reach the objective is a shared undertaking where leading researchers join forces in exploring new and complementing approaches to conceptualising transitions. Selected advisory board members and partners with an interest will be involved through consultations and project meetings.

The challenge of decarbonising the economy and society has been analysed from at least three perspectives:

- (a) studies of environmental governance
- (b) studies of socio-technical transitions and
- (c) wider scenario analysis.

In each case, much of the focus has been on economic sectors where carbon dioxide emissions are a direct output – for example, energy and transport. Considerably less attention has been given to sectors where the ‘carbon content’ of the economy is less visible, but that still have a considerable contribution to the overall greenhouse gas emissions. These sectors are at the heart of the REINVENT proposal, and are steel, plastics, paper and meat and dairy.

The aim of WP1 is to draw on the existing state of the art and stakeholder perspectives in order to develop a new analytical approach capable of advancing our understanding of decarbonisation. We will focus especially on the political, geographical and material dimensions of decarbonisation in these sectors, which have to date been overlooked in the literature yet fundamentally shape the potential for transformative decarbonisation. We will use this process of review and appraisal to identify how to conceptualise and determine the critical drivers, dynamics and implications of decarbonisation in these sectors.

Objectives

WP1 will undertake an interdisciplinary review and appraisal of the literature on decarbonisation transitions in order to obtain a broad understanding of key dynamics of decarbonisation processes in critical sectors – and in particular REINVENTs four key

resource-based economic sectors. More specifically, the objectives can be formulated as follows. The WP aims:

- To develop a shared understanding of the key drivers, dynamics and implications of decarbonisation to be analysed in REINVENT with stakeholders
- To create an analytical framework to underpin the Work Programme and evaluate its contribution for understanding decarbonisation transitions in the light of research findings from WP2-6
- To use the analytical framework to integrate and synthesise the REINVENT project findings and identify their significance for research, policy and practice.

Task 1.1: Interdisciplinary Review and Appraisal of State-of-the-Art Literature (Lead DU)

Our first objective is to conduct a systematic review and appraisal of the existing literature to examine how the drivers, dynamics and implications of decarbonisation are currently understood in order to determine the utility and limits of these approaches for the REINVENT project. This review will document how the processes and practices of decarbonisation are conceived as well as evidence of as to how decarbonisation is undertaken on the ground. It will provide an important conceptual basis for the mapping and case study analysis of decarbonisation in WP2 and WP3 and involve the following steps:

- a. Design of a Review Protocol to standardise the approach and facilitate interdisciplinary dialogue (DU)
- b. Review of environmental governance literature to determine the political, geographical and material dynamics shaping the governing of decarbonisation at different stages of the value-chain (finance, production, consumption) (DU; ULUND)
- c. Review of transition studies literature to determine the political, geographical and material dynamics shaping innovation for decarbonisation and their relevance to the key sectors analysed in REINVENT (steel, plastic, paper, meat and dairy) (ULUND; UU).
- d. Review of wider scenario analysis and their relevance to the key sectors analysed in REINVENT (PBL)
- e. Produce a project report setting out how the politics, geographies and materialities of decarbonisation transitions have been analysed to date, the utility and limitations of these approaches for REINVENT. This task will be led by DU, who will also undertake the design of the Review Protocol and together with ULUND review the environmental governance literature. ULUND will lead the review of the transition studies literature with contributions from UU. DU and ULUND will produce the project report.

Task 1.2 Determining the critical drivers, dynamic and implications of decarbonisation through stakeholder dialogue (Lead ULUND)

The second objective of WP1 is to foster a shared understanding of how to analyse decarbonisation transitions between project partners and the REINVENT stakeholder

community. This will take place through a workshop which will subject the findings from task 1.1 to critical scrutiny and identify the critical drivers, dynamics and implications to form the core of the REINVENT process. ULUND will organise and host the workshop, which will be attended by all project participants, REINVENTs project partners, and 4-6 additional representatives of key stakeholder organisations with expertise on the industry sectors to be investigated in REINVENT. ULUND will write a project briefing on the process and outcomes of the workshop.

Task 1.3 Reconceptualising Decarbonisation: Creating the REINVENT analytical framework (Lead DU)

The third objective of WP1 is to create the analytical framework that will underpin the REINVENT work programme and contribute to advancing our understanding of decarbonisation transitions beyond the current state-of-the-art. The first step will be to identify the areas of synergy and divergence across the literature reviewed in task 1.1 as well as within the stakeholder/partner dialogue process undertaken in task 2.2. We will focus on our core aims of understanding the political, geographical and material aspects of decarbonisation transitions.

Second, we will focus on each of these dimensions in conceptual terms, ‘stripping back’ the jargon used in different disciplines to determine the core analytical building blocks that need to be considered (e.g. agency, power, structure, drivers, barriers) and the processes and practices through which they are constituted (e.g. agency may have an institutional and material dimension).

Third, we will consider how in practical terms decarbonisation is seen to take place on the ground and capture the diverse range of factors seen to affect the politics, geographies and materialities of decarbonisation at different stages of the value-chain and in the four sectors. The core foci (politics, geography and materiality), conceptual dimensions and practical attributes of decarbonisation will be used to form the analytical approach for the project and deployed in WP3-WP6. DU will lead this work, with contributions from ULUND and UU, which will be formulated in a project report which will set out the framework and how it should be applied in the subsequent WPs.

In the final year of the project, we will revisit the analytical framework developed in the light of the findings emerging from WP3-6 and consider how it has advanced the state of the art in our understanding of decarbonisation transitions. DU will lead this work, with contributions from ULUND and UU, which will lead to a project working paper and the submission of an article to an internationally peer-reviewed journal, such as *Global Environmental Change*.

Task 1.4: Integration and Synthesis to advance understanding of decarbonisation transitions (Lead ULUND)

The final objective is to use the analytical framework to integrate and synthesise the REINVENT project findings and identify their significance for research, policy and practice. We will do this in three ways:

- a. The development of an edited book (targeted at Routledge) based on the findings from the REINVENT project using the analytical framework to organise, integrate and evaluate the findings produced across the other WPs and determine the key contributions from the project for the research community. We will hold a book-writing workshop, develop and submit a book proposal, and hold a writing retreat to enable this process.
- b. The development of a high-profile article in e.g. Nature Climate Change to summarise the key findings and their implications for research, policy and practice for decarbonisation.
- c. A synthesis report for policy-makers and practitioners that identifies how politics, geography and materialities shape the key drivers, dynamics and implications of decarbonisation and the consequences for how the governing of climate change needs to be transformed. ULUND will co-ordinate this Task, with DU leading on the production of the book and book-writing workshops, ULUND leading the journal paper and the synthesis report.

Work package 2

Leader: Teis Hansen, Lund University

Other participants: DU, UU, WI

Duration: July 2017 – November 2018

Decarbonisation requires innovations in many different forms, including technological, social, organisational and business-model innovation. This WP will pay close attention to the diversity of low carbon transitions that are in the making. Combining a large-scale survey with in-depth innovation biographies, the WP will provide both a comprehensive overview of key characteristics, drivers and barriers of decarbonisation innovations in the four sectors, and a detailed analysis of selected innovations with significant decarbonisation potential.

The initiatives are selected according to the framework and the criteria developed in task 1.2. The survey and the innovation biographies will provide the basis for the case-studies in WP3, and the assessment of cumulative impacts in WP4, and for lessons learned regarding scaling-up, and building momentum for, decarbonisation (WP6).

Objectives

- Review and analyse the decarbonisation potentials and capabilities in four sectors
- Map a large number of past and emerging decarbonisation innovations
- Identify decarbonisation innovation patterns and trends through quantitative and qualitative analysis and assess their implications
- Identify emerging pathways and gaps to decarbonisation within each sector.

Task 2.1. Review potentials and capabilities (Lead ULUND)

Task 2.1 will provide a systematic review of existing knowledge of decarbonisation potentials and capabilities within the four sectors in the European context. Building on advances in review methodologies, this task will synthesise existing insights on the technical and non-technical aspects of decarbonisation in the four sectors. The review will distinguish between the three stages in the value-chain (investment, production and consumption), based on the

common framework established in task 1.2, but will also highlight interrelations between the stages. The review will clarify the main decarbonisation options and barriers identified in previous work and establish basic principles about the sectors and value-chains.

Task 2.2. Mapping innovations for decarbonisation (Lead ULUND)

Task 2.2 is a central element in WP2 and the project as a whole. It consists of a mapping of a large number (~80) of innovations for decarbonisation throughout the value-chain in each sector. The mapping will record key features of the innovations, including:

- Characteristics of the innovations (for example: type, degree of novelty, drivers, barriers, impacts)
- Initiating and participating actors and their characteristics (e.g. sector, networks, capabilities, interests)
- Geographical dynamics (where and how the innovation has been introduced, where and how the innovation has diffused).

The mapping exercise will cover both successful and less successful innovations, as well as both innovations that are widely diffused and innovations that are still in their formative phase.

Additionally, assessments of the innovations regarding their carbon, economic, social, political and environmental impacts (i.e., including non-technical factors), will be included. The mapping will be based on multiple existing sources such as the UNFCCC NAZCA database, PATSTAT patent database as well as industry-specific databases on climate change initiatives. Input from task 2.1 will also contribute to the mapping as well as interviews with stakeholders from the sectors and desktop analysis of e.g. EU industry roadmaps for the four sectors. The result will be a searchable database in Access or similar software, which will be utilised in the subsequent tasks. The mapping is structured according to a common analytical framework (task 1.1).

Task 2.3 Create innovation biographies (Lead ULUND)

Task 2.3 consists of writing a number of so-called innovation biographies for 5-10 innovations, which were identified as having significant impact regarding decarbonisation and co-benefits in task 2.2. The selected innovations will be distributed across the four sectors and the different parts of the value-chain (investment, production and consumption) and will include successful and less successful innovations. Innovation biographies are a method developed under the FP6-funded EURODITE project. It is a longitudinal qualitative methodology that focuses on capturing the importance of critical events, contextual settings and collaborations for innovation processes. Specific attention is given to the importance of combinations of different forms of knowledge and other resources for the innovation process. This will in the current task provide an in-depth understanding of how key decarbonisation innovations happened (or failed), which will provide an important input to the detailed analysis in WP3.

Task 2.4. Quantify patterns and trends (Lead ULUND)

At the core of task 2.4 is quantitative analysis of the innovation database, which will analyse drivers and barriers for decarbonisation innovations, which may support the design and set up of strategies and policies to facilitate future innovations in the considered sectors. Focus will be on identifying under which conditions successful decarbonisation innovations are introduced and diffused. This also includes an analysis of the benefits of different types of innovations (according to sector and part of the value-chain) in terms of decarbonisation and co-benefits.

Task 2.5. Identify pathways (Lead ULUND)

The final task in WP2 synthesises the insights generated in tasks 2.1-2.4. By drawing together the results of the first four tasks, the aim is to identify where in the different parts of the value-chain innovations have led or are about to lead to new ‘pathways’ for decarbonisation (i.e. where they begin to have a cumulative effect and gain momentum), where success is limited, and what the implications for strategies and policies are. While we will outline differences between the four sectors, the focus is primarily on identifying possibilities for cross-fertilisation across the sectors. To conclude this task input is provided on decarbonisation pathways to the interim workshop in task 3.3.

Work package 3

Leader: Stefan Lechtenböhmer, Wuppertal Institute

Other participants: DU, ULUND, UU

Duration: December 2017 – August 2019

The mapping conducted in WP2 forms the basis for in-depth case studies drawn from all four sectors (steel, plastics, paper, food) and in the three stages of the value-chain (investment, production and consumption/waste) in WP3. The case studies pay attention to the social, economic and political challenges (including financial, regulatory and cultural barriers) that innovations for decarbonisation encounter, and to the distribution of costs and benefits (within and between sectors and social groups) emanating from such innovations. Results from WP3 (e.g., an evidence based scheme of non-technical drivers) will feed into WP6 (a framework guide for managing technological transitions).

Objectives

- Develop methodological toolbox for in-depth case studies
- Develop a protocol for analysis (based on task 1.2)
- Conduct 15 to 20 in-depth case studies that in great detail examine the role of non-technical factors and drivers of innovation for decarbonisation
- Derive an evidence based scheme of (non-technical) drivers of innovations and potential influencing factors for future low carbon innovations
- Explore and analyse social, economic and environmental impacts at the sector level and over the value-chain.

Task 3.1 Develop protocol for analysis and methodological toolbox (Lead DU)

In relation to the conceptual framework developed in WP1, this task establishes a detailed research protocol suited for in-depth analysis and cross-case comparison. It guides the case studies so they are carried out in a transparent and structured manner that enables a combined analysis over all cases per sector and hence a combination of the findings. The protocol serves as an explicit guide on all aspects of the proposed methodology. For example, the protocol refers to the method of innovation biographies, which will build the methodological framework to evaluate and integrate the analysed innovations along the value-chain (see also task 2.3 “Create innovation biographies”). The research protocol links different aspects of the project coherently and includes a detailed description of all applied methods (e.g. participants, research design, required materials, procedure) and of the proposed analysis methods (e.g. quantitative and qualitative, mixed methods, Advanced Study Visits). It also covers practical issues, a timescale and needed references and appendices.

The selection of methods for analysing the in-depth cases can include: e.g., document analysis, interviews, experiments (e.g., participatory observations), field visits (such as observing a sector conference or stock-taking meetings, e.g. on the role of cooperative initiatives for decarbonisation or UNEP Finance Initiative annual meeting in Geneva), stakeholder dialogue and multi-sited ethnography (following the object). Each case will be approached using a systematic combination of methods aligned with the case/sector/stage.

Task 3.2 Select innovation cases (Lead WI)

The cases are selected on the basis of the survey conducted in WP2, existing research results and methods regarding innovation processes, e.g. <http://www.casi2020.eu>. The results of task 3.2 (and 3.3, see below) will lead to a selection of innovations, which cover every industry sector considered in REINVENT and all key stages of the value-chain (financing, production and consumption). With regard to the value-chain stages production and consumption, specific cases for each industry sector will be analysed, focusing on process technologies, end-user products or distribution modes individual to each industry. For each sector, about 3-5 specific cases will be analysed. In addition to that, four industry cross-cutting cases will be assessed for the value-chain stage of financing. The cross-industrial character of these cases is due to the fact that financial mechanisms are usually not specifically designed for single industry sectors but of modular nature, which can be slightly adapted to an individual industry's needs.

The following criteria will be used to determine the selection of cases: the type of innovation (e.g. technical, service/process, social, economic or political), stage of innovation (e.g. pilot or demonstration projects at smaller scales or in protected niche markets, broad implementation), the potential synergies or trade-offs with other sustainable development goals (besides GHG mitigation, e.g. cost reduction, employment effects, competitiveness, environmental quality, resource efficiency), the innovation's drivers and barriers (e.g. funding schemes, political framework and environmental issues) and also the degree of involvement of various stakeholders (e.g. industry, politics, civil society or research and education). For the transferability of the innovation patterns several aspects, which define the environment of the

considered innovations, such as economic, political and social tensions or controversies, could be crucially important.

Other important selection criteria are related to the learning process between innovators/innovative industries and potential adopters and the dissemination and market uptake of innovations.

Task 3.3 In-depth case analysis (Lead WI)

Based on task 3.2 the case studies will cover the four sectors and the three steps of the value-chain. A selection of 3-5 industry-specific innovations for the process and consumption value-chain stages in the considered sectors and 4 cross-cutting innovations in the financing sector will be analysed as in-depth case studies (see in the box below). Overall, we plan to investigate a total of 15 to 20 cases.

As part of the first phase, all case studies within single and across sectors will be kicked-off and conducted to understand the inner logic and dynamics of each case. The results of this phase will be shared and discussed with project partners and industry partners from all sectors at an interim workshop (e.g. with round table discussions per sector). The aims of the interim workshop are a) to reflect on the outcomes of each case; b) identify interdependencies and linkages between the cases both within and among industry sectors.

The sectoral round table sessions shall convene about 3-5 experts from the respective industry branches. Based on this, the second phase focuses on gaining a deeper understanding on these inner- and inter-sectoral interdependencies and dynamics among the innovations at different value-chain in the sectors. Cases in the steel sector will be led by UU, ULUND and WI, in the paper sector by UU and ULUND, for plastics by WI and ULUND and in the food sector by UU and ULUND due to their track records, contacts and experience in these industries and production processes. DU will bring in specific competences on cross-cutting innovations in the finance and investment parts of the value-chain and DU as well as ULUND cover issues regarding consumption.

Applying and testing the conceptual framework, the cases would chart the innovation biographies of each decarbonisation initiative and provide an overview why and how the selected innovations have been successful. The considered parameters include actors, drivers, discourses, technologies involved in the innovation's development and diffusion as well as the social, institutional, legal, financial and material barriers encountered, i.e. the 'inertia and lock-in's. For all parameters, it will systematically pointed out to which degree they are affected by specific framework conditions at different policy decision-making levels. It will be considered how inertia and lock-in shape the degree to which different kinds of innovations realise their potential or not, and what where the drivers that lead to a breakthrough of the innovation analysed. This process will provide the basis for the comparative analysis of the innovations in task 3.4 and the impact assessment in task 3.5.

The second phase commences with a "Synthesis Workshop". The generated innovation biographies will finally be presented in a factsheet format. The factsheets shall be shared and discussed at the "Synthesis Workshop" with stakeholders from the different value-chain stages in the sectors. The "Synthesis Workshop" shall convene representatives of those parts

of the value-chain, which indicate the highest concentration of innovations in the branches under consideration. The “Synthesis Workshop” shall convene about 3-5 experts and give them the opportunity to a) give a thoroughly feedback to the charted drivers or barriers for innovation in their industry and b) raise important aspects for understanding the impacts of the selected innovations along the value-chain that will be analysed in task 3.5. The outcomes of the “Synthesis Workshop” will amplify the innovation factsheets and be documented for the following work steps in task 3.5. The “Synthesis Workshop” will be an important step to prepare the comparative structured analysis of the case studies (task 3.4).

Task 3.4 Comparative structured analysis of case studies' results (Lead WI)

Case studies will be lead by one participant who has the highest competence according to the sector, step in value-chain and location of the respective innovation. One or two participants will complement methodological or value-chain oriented competences and may carry out interviews according to geographical proximity.

Case studies are tailored to the specific case based on the findings from WP2 and using the methodologies from task 3.1. We expect to carry out 8-12 interviews, two field visits and two workshops plus desk research in a typical case study. Results as well as identified impacts will be reported in a structured way based on WP3.1 and feed into the innovation database in order to enable the analysis in task 3.4 and task 3.5.

The results of the 15-20 cases will be analysed in a structured way based on the design of innovation patterns developed in WP1 and applied in WP2. It will derive an evidence-based scheme of non-technical drivers (and barriers) of innovations and on potential influencing factors for future low carbon innovations. For this, cases will be grouped according to sectors and along value-chain and key influencing factors. By this the first hypotheses elaborated in the innovation biographies from task 2.3 will be deepened and developed.

At the core of task 3.4 is a qualitative (and if feasible quantitative) analysis of the innovation database which is compiled in WP2 and complemented by the results from the cases carried out in task 3.3. This will reveal patterns, trends, and associations, which may support the design and set up of strategies and policies to facilitate future innovations in the considered sectors in WP6.

This analytical task will include all gathered data resulting from previous steps (WP2 and task 3.3) and involve four focus groups with members from the selected industries at the end of task 3.4, in which all cases will be presented, discussed and evaluated with regard to key drivers or barriers for innovations that have been identified and are of relevance for all industries.

Task 3.5 Environmental, economic and social impacts (Lead ULUND)

At the centre of this task will be an analysis of the considered innovation's impacts and implications in environmental, economic and social terms (including gender issues) at the sectoral level and along the value-chain. This is conducted as a qualitative and interview based investigation and analysis of stakeholder perceptions concerning impacts and

implications in environmental, economic and social terms. The assessment of the aforementioned impacts of the innovation case studies will follow a matrix structure which encompasses the following elements for each innovation case study:

A) Potential contribution to decarbonisation: Here, it will be distinguished among the potential width and depth of an innovation's energy and GHG mitigation potential. In particular, we characterise the relative order of magnitude of the energy or emission reduction, which can be achieved in comparison to a standard or reference technology. Width describes how widely an innovation can be applied in the respective industry.

B) Life cycle costs: This parameter will qualitatively assess the economic viability of an innovation. As most industry innovations imply long-term investment cycles which are affected by several dynamic aspects (e.g. fuel costs, electricity rates, energy system costs), we will chose a two-step approach to reflect the dynamic development of an innovation's life cycle costs: As a first step, we will assess the innovation's economic viability under current conditions; as a second step, a future estimate will be given which captures the innovation's costs when it has achieved a certain level of maturity. The estimated date when this maturity is expected to be reached will be provided as well.

C) Social implications: This aspect covers a broad range of social aspects, which emanate from an innovation's application and diffusion. We distinguished between inner-industry or – company implications and local/regional implications. The former encompass implications such as changes in working patterns or knowledge needs deriving from the installation of new technical processes. Local or regional implications describe social impacts within municipalities or regions, which imply a high concentration of production plants from the considered industries and are particularly affected by job losses, changes in social norms or working patterns (including gender aspects).

As a first step, the project team will conduct a review of existing studies and papers on the impacts of the selected innovation (e.g.; through content analysis). In addition to this review relevant results from the previous tasks will be included. Based on these insights, the project team will insert first inputs into the matrix structure and, at the same time, identify knowledge gaps, which require direct exchange with experts from the considered industries and further relevant stakeholders (e.g. from trade unions, municipal authorities, civil society). Therefore, in a second step, stakeholders with know-how on the previously identified knowledge gaps will be consulted to close the gaps. Ideally, the industry experts will be those that already have been involved in the workshop and round table process outlined in task 3.3 and task 3.4.

The direct exchange with industry experts and other stakeholders will be organised as semi-standardised interviews based on a questionnaire, which takes into account specific features of the innovations considered in the expert's industry. In a third step, the project team will revise and extend the matrix content based on the inputs of the experts. The matrix content will be summarised in multi-dimensional illustrations (e.g. spider web charts) for each innovation to easily understand their systemic impacts.

Work package 4

Leader: Detlef van Vuuren, PBL

Other participants: DU, ULUND, UU, WI

Duration: December 2016 – May 2020

This WP will create decarbonisation pathways for the steel, plastics, paper and meat/dairy sectors in the context of economy-wide scenarios. This will be done in an interactive process of co-creation. The work will explore the cumulative impact of innovations/initiatives from WP2 using the IMAGE and WISEE models, but also do a meta-analysis of existing visions and scenarios in the sectors and assess technology options. A stepwise approach will be taken. First, we will combine the output of the IMAGE and WISEE models with a meta-study of existing bottom-up scenarios to derive consistent first-order decarbonisation pathways for the REINVENT sector. These scenarios and sectoral pathways describe decarbonisation actions, starting from the global objectives agreed at COP21, indicating the role of the EU and finally indicating consistent pathways for each sector. The analysis will be put in the context of the so-called Shared Socio-economic Pathways (SSPs) that are currently being developed for climate research and assessment by the IPCC, which allows direct further use of the REINVENT work in other research projects and assessments.

While the IMAGE model provides a broader picture of mitigation action, the WISEE bottom-up energy system model further elaborates trends in the focus sectors in REINVENT by using engineering analysis and assessment techniques. Subsequently, these first-order scenarios and the sector pathways form, in a process of co-creation, an important input for the stakeholder involvement and the case studies (WP2/WP3) guiding the analysis and discussion, but also encouraging to develop alternative insights as feedback into the scenario process. The European-wide pathways and scenarios examine the cumulative potential impact of the innovations in terms of greenhouse gas emissions, both within Europe and the global scale.

Also the impacts and implications for other sectors will be explored (e.g. what kinds of electricity systems will be needed to support transitions based on these scenarios). These final scenarios will serve to provide an overall picture of all sectors and their inter-linkages with the results from the sectors studied in depth. It is a basis for the analysis of co-benefits of the decarbonisation scenarios.

Objectives

The overall objective is to co-create knowledge and co-design pathways for the steel, plastics, paper and meat and dairy sectors, and to put this information in the context of the economy wide, global deep decarbonisation objectives. For this purpose we

- (a) assess the cumulative impact of innovations/initiatives from WP2,
- (b) do a meta-analysis of existing visions and scenarios in the sectors and assess technology options, and
- (c) compare the contribution of the innovations/initiatives in the four focus sectors to the overall decarbonisation objectives set-out in the Paris agreements (COP21).

The models IMAGE and WISEE are used here. First order pathways and scenarios, background knowledge and results from WP2-3 provide the basis for engaging in co-creation and co-design.

The following concrete objectives can be differentiated:

- Analyse existing scenarios and visions as input to co-creation of knowledge and co-design of scenarios
- Prepare (first order) sector pathways and background scenarios as an input to co-creation of knowledge and co-design of scenarios
- Undertake with other WPs 6 workshops (on steel, plastic, paper, meat/dairy) and develop consistent sector pathways
- Develop final scenarios based on workshops and input from WP2 and WP3.

Task 4.1. Existing visions and scenarios (Lead WI)

Meta-analysis of existing visions and scenarios for decarbonisation and analysis of basic preconditions and options for decarbonisation (e.g., electro-winning, hydrogen and power-to-plastics) as a background for co-creation and co-design processes. The meta-analysis will be used as an input for the EU decarbonisation scenarios in task 4.2.

Task 4.2 EU decarbonisation scenarios (Lead PBL)

Development of first-round decarbonisation scenarios for the EU as a whole in a global context and technology pathways as well as scenarios for the REINVENT sectors we analyse in detail. Technology pathways and scenarios will serve as an input for task 4.3 as well as for discussion and analysis in WP3. Several decarbonisation scenarios for the EU will be developed and then described sector by sector (focussing on different technologies). The scenarios will be developed using the integrated assessment model IMAGE (allowing to make a smooth transition between COP21's global targets and the sectoral trends) and the engineering model WISEE providing technology pathways. For this a soft-link will be made between these models.

Task 4.3 Co-design and co-creation of pathways (Lead WI)

Building on the information derived in WP2 and WP3 as well as task 4.1 and 4.2, the scenarios will be developed and used as a basis for co-creation of knowledge and co-design of pathways for deep decarbonisation together with stakeholders. This includes a series of workshops with key stakeholders from REINVENT sectors and from two stages of the innovation value-chain respectively. The workshops will be co-organised with other WPs (in particular WP3) to ensure that the workshops not only focus on the technical aspects of the transitions (as described by model output) but also on the role of actors, incentives and key trends in each of the sectors. It will be explored whether it is possible to combine the sectoral workshops in order to not only focus on each sector itself, but also to discuss the linkages between the transitions (e.g. morning/afternoon). The result of task 4.3 is a set of revised sectoral pathways which will be quantified in the WISEE model and implemented in IMAGE.

Task 4.4. Cumulative impact of innovations for decarbonisation (Lead PBL)

The sectoral results (including 4.3) will be used to estimate the potential cumulative impact of innovations mapped in WP2 and WP3 on GHG emissions taking account of their potential synergistic effects or trade-offs. This will be combined to derive full energy and GHG emission scenarios using IMAGE together with WISEE. The results will also be used in further economic analysis in WP 5 to assess macro-economic impacts.

Work package 5

Leader: Agni Kalfagianni, Utrecht University

Other participants: DU, PBL, ULUND, WI

Duration: November 2017 – July 2020

This work package will use the decarbonisation scenarios developed in WP4 as well as the insights of other WPs, to analyse the possible consequences for objectives other than climate policy, with particular focus on the recently established Sustainable Development Goals (SDGs). This will be done mainly at the macro-level (thus complementing the case-studies performed in WP3), using input-output and global value-chain analyses, life cycle analyses, the integrated assessment model IMAGE and global governance approaches.

Objectives

The main objective of this work package is to analyse the impacts and implications of the pathways and the energy and GHG emissions scenarios developed in WP4 on macro-economic (e.g. on employment in the key economic sectors analysed as well as the overall competitiveness of the EU), environmental (e.g. the co-benefits and conflicts with biodiversity and land use), and social terms (e.g. how they contribute to gender and social equity).

In this context, we also examine the interaction between the EU climate policy and plans and the broader global sustainable development agenda, as expressed in the Sustainable Development Goals, which were adopted in September 2015 by 193 Heads of State and Government. The results of this work package have implications for WP6.

The following more concrete objectives can be derived:

- Analyse macro-economic, production network and value-chain implications
- Analyse the coherence between the EU climate policy and the global sustainable development agenda;
- Conduct an integrated analysis of economic, environmental and social equity impacts at the EU and global levels;
- Identify synergies and trade-offs at different levels of governance.

Task 5.1. Analysis of the macro-economic and production network implications of decarbonisation pathways (Lead ULUND)

This task will analyse the impacts of decarbonisation pathways in the four sectors as identified in WP4. The effect of innovations in these sectors on the entire EU economy will be

traced using input-output tables. This analysis will allow us to study the positive and negative effects on economic growth, wages and employment of

- (a) changes in food prices as a result of more demand for biofuels,
- (b) more expensive but carbon neutral steel, plastics, etc.,
- (c) changes in the price of energy.

Through this analysis we will also be able to discuss potential effects of decarbonisation on the competitiveness of the European economy. In the short to medium-term, international competitiveness is affected by the effects of decarbonisation on the supply costs of domestic (EU-based) industries in relation to their competitors abroad. In the long-term, international competitiveness is mainly determined by a wider set of economic and institutional factors. Through interactions with other WPs we will be able to draw conclusions about impacts on the short and long-term competitiveness of key industries in the four sectors. For this task we will use input-output data provided by the European Commission.

Task 5.2 Coherence between EU climate policy and the global sustainable development agenda (Lead UU)

This task will analyse the policy and institutional coherence between EU climate policy and the global sustainable development agenda, as expressed in the SDGs. Coherence in this task refers, therefore, to the systematic promotion of mutually reinforcing policies between climate policy objectives for the four sectors under study (food, steel, paper and plastic), as expressed, for instance, in the EU's 2050 low-carbon economy climate action and associated roadmaps, and relevant SDGs. Policy coherence will be examined along the environmental and social equity dimensions, as well as the interaction between the two.

Relevant SDGs in the environmental dimension are SDG7: Affordable and Clean Energy, SDG12: Responsible Production and Consumption, SDG13: Climate Action, and SDG15: Life on Land. Relevant SDGs in the social justice dimension are SDG5: Gender equality and SDG10: Reduced Inequalities (among socio-economic groups in the four sectors). Examples of policy coherence and incoherence include, for instance: the development of biofuel targets as a way to reduce emissions which may contribute to SDG13 but may conflict with SDG15, particularly biodiversity loss; likewise, carbon capture and storage may conflict with SDG10 if it is accompanied by displacement of vulnerable communities, for instance. The same holds for broad electrification of industrial processes which would contribute to SDGs 13 and 7 but conflict with SDGs 10 and 15 due to the huge space needed for massive renewable electricity generation.

Next to policy coherence the task will examine institutional coherence, i.e. the competing, overlapping or synergistic relationship between (state and non-state) institutions responsible for the implementation, monitoring and compliance of relevant SDGs and decarbonisation plans and policies at the EU. The task will contribute to a better understanding and long-term vision on low carbon technological development and deployment in Europe, within the context of broader global governance.

Task 5.3. Integrated analysis of economic, environmental and social equity impacts at the EU and global levels (Lead PBL)

This task will use Life Cycle Analysis (LCA) and the integrated modelling framework IMAGE in order to examine the interlinkages between the four sectors and the associated economic, environmental and social equity impacts for the EU and for the globe. LCA will be used to evaluate the impacts of specific transition activities over the whole supply chain. Manda et al. (2015) have shown how LCA can be used in a business context to assess the value of product innovations. This approach will be used at an aggregated level to map the key changes related to the SDGs over the supply chain in the form of impact factors across different sectors of the supply chain.

The IMAGE-model will be used to assess the possible impacts for a selection of environmental and social SDGs' indicators as identified in the previous task in order to evaluate non-climatic impacts, thus including sustainability of production and consumption, access to affordable, reliable, sustainable and modern energy, land use and biodiversity conservation. This task, then, provides a more comprehensive approach between decarbonisation innovations and their impacts, thus complementing the previous tasks.

Task 5.4 Identify synergies and trade-offs at different levels of governance (Lead WI)

This task aims to identify synergies and trade-offs between decarbonisation policies and initiatives and broader economic, environmental and social equity objectives as identified in the previous tasks. The task will rely on a series of semi-structured interviews with representatives from different socio-economic groups from the four sectors, taking into account also a balanced representation of male and female respondents. The results of the interviews will also be used to identify key elements of the envisaged interventions that will result in strengthening the synergies and reducing the trade-offs between decarbonisation policies and initiatives and broader economic, environmental and social equity objectives as identified in the previous tasks. Hence, this task will link closely with task 6.1 which aims to understand the challenges involved in scaling-up decarbonisation.

Work package 6

Leader: Johannes Strippel, Lund University

Other participants: DU, PBL, UU, WI

Duration: July 2019 – November 2020

This work package has the overall objective to create a practical framework for e.g., scaling up, creating momentum, evaluating transitions, and applying models. Future-oriented analyses of low carbon transitions often only examine techno-economic, environmental and socio-economic implications, and thus fail to explore issues such as agency for – and timing of – particular interventions. WP6 will turn governance, evaluation and modelling implications into usable criteria and identifiable steps forward for realising decarbonisation pathways.

The objective of WP6 is to transform scientific knowledge into a practical, high-impact framework that addresses cross-sectoral perspectives of the decarbonisation of the European

economy. To this end, WP6 will develop a Decarbonisation Pathways Portal where knowledge resources and tools for decision-support are located and collected in such a manner so that they can be readily accessed by relevant user groups involved in managing low carbon transitions.

WP6 focus specifically on the potential for scaling-up decarbonisation (task 6.1) and how momentum decarbonisation can be achieved (task 6.2). The practical and accessible Decarbonisation Pathways Portal will be developed in task 6.3 and refined through task 6.4. Finally, task 6.5 brings together the implications for modelling decarbonisation pathways.

Objectives

- to identify the key challenges in scaling up and mainstreaming innovation for decarbonisation within and between sectors
- to consider how new forms of scientific assessment might contribute to managing low carbon transitions
- to deliver a practical research and innovation framework which allows the co-design of pathways and scenarios with key economic and societal actors.

Task 6.1. Decarbonisation at scale (Lead ULUND)

To objective of task 6.1 is to better understand the challenges involved in scaling-up and mainstreaming innovation for decarbonisation. The task uses the REINVENT analytical framework, which emphasize political, geographical, economical and material dimensions of decarbonisation, and apply it on the findings from mapping innovations for decarbonisation (WP2) and the case-study work on innovations and their trajectories (WP3). The task will focus on implications for managing low carbon transitions in terms of agency, timing and accountability. The task will deliver a project report, which will support the edited book and the high profile article (task 1.4). ULUND will coordinate this task, with contributions from DU and UU.

Task 6.2 Momentum for decarbonisation (Lead DU)

The objective of task 6.2 is to address how momentum for decarbonisation can be achieved. The work is focussed on factors that are critical to ‘un-lock’ the lock-in of carbon in different political, geographical and material contexts. The work is oriented towards how shifts in investment patterns, financial mechanisms, regulatory incentives and multi-level governance arrangements (interaction between different levels/institutions) could be given momentum. The task utilises cases of successful innovation – innovations that were successful or seen to have potential in carbon terms and which also delivered non-climate benefits. Through collaborating with actors and the level of the ‘regime’, REINVENT is able to capture, from their perspective, where the pinch-points lie in taking up decarbonisation innovations.

The task will deliver a project report, which will support the edited book (task 1.4) and the high profile article (task 1.4). The two reports that address how scale and momentum can be achieved will be presented and deliberated at a high level panel at the REINVENT final conference. DU will lead the work with contributions from ULUND, UU.

Task 6.3. Decarbonisation Pathways Portal (Lead UU)

The objective of task 6.3 is to translate REINVENTs scientific insights into a practical research and innovation framework, which will allow the co-design of pathways and scenarios with key economic and societal actors. Task 6.3 will develop a Decarbonisation Pathways Portal, which will allow REINVENTs outputs to produce impacts. The portal is key to the capacity building route to impact, and contain easily accessible knowledge and tools that can be utilised by decision makers and user groups involved managing low carbon transitions. The Decarbonisation Pathways Portal will be particularly tailored for our four sectors and enable new models of co-design to be realised. UU will lead the task with contributions from all partners (ULUND, PBL, DU, WI).

Task 6.4. Assessing low carbon transitions (Lead ULUND)

The objective of task 6.4 is to develop a new approach to transition policy evaluation. The new approach shall complement conventional short-term climate policy evaluations, which are often focused on cost-effectiveness and emission reductions. Here we need new approaches and indicators to monitor progress, capacity and readiness for sustaining system wide transformation. This task will use an early version of the Decarbonisation Pathways Portal and develop the approach in collaboration with experts, users and policymakers. REINVENT will together with European Environment Agency (Copenhagen) and European Evaluators Network host joint workshop on new approaches to transition policy evaluations (Milestone), which will produce a policy briefing-note and a revised set of inputs to the Decarbonisation Pathways Portal. ULUND will lead this task with contributions from WI).

Task 6.5. Implications for modelling decarbonisation (Lead PBL)

The objective of task 6.5 is to examine scientific insights concerning the implications that decarbonisation pathways has for modelling (in our case using IMAGE and WISEE). The task will show how modelling can offer a better representation of mitigation options in key economic sectors and their interplay or co-evolution with other sectors and part of the system. Task 6.5 will host a workshop aimed at the wider modelling community to facilitate a broader discussion on the implications, potentials and limitations for modelling decarbonisation pathways and deliver a report on implications for modelling decarbonisation. PBL will lead the task with contributions from WI.

Task 6.6 Replicating innovation for decarbonisation (Lead LU)

To enable innovation for decarbonisation to be replicated, and thereby translate into impact, REINVENT will produce a 'Handbook of Decarbonisation Innovation for carbon-intensive sectors'. The Handbook, which will be developed through writing 'best practice notes for industry', will enable actors in these sectors to find new sources of finance (e.g. green bonds) and the different kinds of technical and social innovation that can be tried. The Handbook also contains information about how to assess the impacts and implications of these interventions. The Handbook is a key activity in the replication route to impact.

Work package 7

Leader: Lars J. Nilsson and Ekaterina Chertkovskaya, Lund University

Other participants: DU, PBL, UU, WI

Duration: December 2016 – November 2020

This WP will coordinate and supervise all dissemination and exploitation of the results achieved throughout the project. All communication and dissemination will follow REINVENTs Dissemination and Communication Strategy, DACS which will contain information about Scientific (including educational purposes towards students at under to post graduate levels), Industry and Political and Societal target groups; as well as guidelines for how and when different communication activities and media channels shall be used, description of certain major dissemination activities such as final conference of REINVENT, participants responsibilities for dissemination, list of media channels for certain communication activities and finally a description of how to monitor and report on all communication and dissemination in REINVENT.

Typical self-monitoring activities will be such as participant feedback from events, periodic survey of website visitors, website and portal downloads/viewing of material, social media access and streaming. DACS will also contain include information about how to act in communication and dissemination activities in the event any IPR issues.

Objectives

The overall objective of WP 7 is to guarantee that the results of REINVENT are exploited and disseminated to highest possible degree. Project relevant information and knowledge will be gathered, processed and spread to the project participants and to external identified target groups to promote and optimise the impact of use REINVENT findings. The communicated results will aid the decarbonisation of Europe by improving policy making and promote the industry, especially in the sectors studied to implement and improve decarbonisation strategies but in many parts with generalisability to other sectors.

Task 7.1 Dissemination and Communication Strategy, DACS (Lead ULUND)

Definition, implementation and continuous update of a Dissemination And Communication Strategy (DACS) include:

- Collect information about news/information channels
- Map stakeholders
- Discuss and implement information from the Advisory Board to make DACs as efficient as possible
- Align and implement the DACs document in Project Executive Board
- Launch press releases to public and specialist media
- Write and publish scientific articles
- Attend conferences
- Arrange one REINVENT Conference, the final conference
- Distribute scientific reports to identified target groups
- Produce and distribute mails about new reports and other news on the REINVENT website when new interesting information is launched

- Produce a biannual podcast
- Self-Monitoring on REINVENTs dissemination and communication activities.

Task 7.2 Developing tools to support the implementation of DACS in REINVENT (Lead ULUND)

- Launch and maintain REINVENT external website according to the Communication Strategy (DACS)
- Produce information material about REINVENT, such as PPT-presentations, templates and general text information to be used for popular, scientific and political purposes.
- Collect and update contact information towards relevant stakeholders and media channels
- Produce posters and roll-ups to present REINVENT.

Task 7.3 Monitoring Public, Specific Scientific media and the political and popular debate in REINVENT research areas (Lead ULUND)

- Keep track on when and where opportunities arise to do engage in the debates
- Identify interesting physical meeting forum, exhibitions and conferences for exposure.

Work package 8

Leader: Lars J. Nilsson and Ekaterina Chertkovskaya, Lund University

Other participants: DU, PBL, UU, WI

Duration: December 2016 – November 2020

The main work of the management, co-ordination of the partners' work, reporting to the Commission, and dealing with risks and other issues will be done by the project co-ordinator, ULUND.

Objectives

The main objective of this work package is to form the basic management framework providing an efficient, flexible and active project management of REINVENT. The basis of this is a clear distribution of responsibilities that is transparent to all partners. The management ensures proper decision making and management of resources in order to make the project run smoothly and deliver maximum scientific quality results and maximum impact and exploitation. This WP also stimulates the dialogue in REINVENT between relevant industry representatives and academics in order to keep REINVENT on track towards relevant results for industry and policy. The objective is to:

- Achieve the contracted results, including handling the project reporting and accounting
- Ensure an effective daily administrative and technical management
- Ensure a consistent high quality of work in the project and in the reports produced
- Efficiently deal with risk and other issues as they arise

- Ensure proper internal communication within the consortium for smooth operation and trust between partners
- Ensure correct and efficient communication with the European Commission
- Build a complete partner structure
- Ensure co-ordination of project-related activities both internally between the WPs and Advisory Board and externally with other stake holders.
- Ensure that the project include all needed partners, Advisory Board Members and participants.

Task 8.1: Technical Management - Scientific leadership (Lead: ULUND)

Lund University (ULUND) will fulfil the coordination responsibilities, as described in the contract with the European Commission and will supervise the reporting of all activities, which is crucial for the overall progress of the project. As the Project Co-ordinator, ULUND is responsible for the overall project coordination, which includes research content leadership, strategic management tasks and supervision of the overall project progress. In cooperation with the Project Executive Board and the European Commission (EC), the Co-ordinator may decide on critical strategic issues. The Project Co-ordinator (ULUND) will chair of the Project Executive Board that consists of all work package leaders and will also chair the Advisory Board. The Executive Board will meet physically at least two times, and have four additional meetings over the phone or on-line, per year.

The Advisory Board will have two physical meetings per year (at least during the two first years) and two phone or online meetings per year.

Task 8.2: Internal Communication Management (Lead: ULUND)

ULUND will constitute and act as the main contact for all inquiries concerning REINVENT, as well as be responsible for communication between the consortium and the Commission. Further tasks include:

- Compilation of the key findings from WP1-6 into a condensed final project report.
- Co-ordination of deliverable submission to the Commission and communicating requirements for modifications to the partners involved.
- An internal communication plan will be designed to provide a common platform for effective communication, documentation, identification of deviation and correction throughout the project. It will describe the general approach to quality assurance as well as the guidelines and procedures to be followed for documentation, production of deliverables, reports and communication between partners.
- Set up and maintenance of an internal site for storing documents.

Further, the purpose of this activity is to foster and ensure an appropriate level of communication within the project for scientific exchange and collaboration, as well as for

matters related to project management and administration. The Project Management Office will define the project's overall communication infrastructure, but will be aided by Lund University Support Functions for setting up and maintaining this infrastructure.

Task 8.3 Data management plan (DMP) (Lead: ULUND)

The Project Co-ordinator and all other work package leaders in the Project Executive Group will develop a Data Management Plan, DMP during the first six month of the project. The DMP will be designed so that new data developed in REINVENT including description of quality control processes are displayed in a transparent way to its stakeholders and others. The DMP will be a part of the Dissemination and Communication Plan, DACS, developed in WP7 and synchronised with the internal communication plan. Furthermore, the DMP will be aligned with REINVENTs partners and guarantee that no confidential information will be publicly displayed. The DMP will contain information about:

- The handling of research data during and after the project.
- What data will be collected, processed or generated.
- What methodologies and standards that will be applied.
- Whether data will be shared /made open access and how.
- How data will be curated and preserved.

Task 8.4: Administrative Project Management (Lead: ULUND)

In order to allow the Project Co-ordinator to focus on strategy, leadership and scientific coordination, his administrative project management burden will be shared by the Project Co-ordinator Assistant and the Project Office. The Project Co-ordinator Assistant, Ekaterina Chertkovskaya, is also together with Lars J. Nilsson the work package leader for WP7 and hence will have an overview off all communication strategies within REINVENT. The administration includes:

- Supervision of reporting schedule and duties, collecting reports from participants.
- Supervision of detailed work plan and project schedule, collecting deliverables, identifying delays in deliverables, coordinating the development of contingency plans.
- Quality assurance of scientific and technical results.
- Handling day-to-day business, processing external and internal requests, identifying contact points.
- Overseeing all tasks related to management, regarding matters which cannot be handled by the Project Management Team.
- Preparation and support of auditing, such as preparation of cost statements and documents for auditing.
- Completing the list of partners and advisory board members

The operational management will define and implement processes, such as contract amendments, and provide appropriate tools and templates for their realization. The different work package leaders will be assisted in fulfilling their obligations. These supportive activities include resource monitoring and control, cost and related communication, and activities associated with work packages and tasks.

Task 8.5: Risk Management (Lead: ULUND)

The European Commission will receive regular reports on the project progress. These will be provided at work package and task levels. Adherence to EC guidelines will be monitored in order to guarantee transparency not only in dealings within the project, but also with the European Commission and other stakeholders. After collecting and aggregating the technical and financial data from the partners, the processed information will serve as a basis for the risk analysis and quality check by the Co-ordinator. The main tasks for Risk Management are:

- Progress management and risk contingency planning for the project.
- Any minor deviations from the plan will be reported to the Project Co-ordinator, who will consider the problems and, where appropriate, make recommendations for implementing the contingency plan(s) associated with the work package(s) in question.
- In the event of serious problems, the Project Co-ordinator will convene the Project Executive Board to determine the best route forward and will advise the EC's Project Officer of the problem and seek approval for the proposed solution.