European Agency for Safety and Health at Work

EUROPEAN RISK OBSERVATORY

EN

WORKING PAPER

ISSN 1831-9343

Foresight of New and Emerging Risks to Occupational Safety and Health Associated with New Technologies in Green Jobs by 2020

TE -RO-11-001-EN-N

European Agency for Safety and Health at Work

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FORESIGHT OF NEW AND EMERGING RISKS TO OCCUPATIONAL SAFETY AND HEALTH ASSOCIATED WITH NEW TECHNOLOGIES IN GREEN JOBS BY 2020

PHASE 1
KEY DRIVERS OF CHANGE

More information on the European Union is available on the Internet (http://europa.eu).

Cataloguing data can be found on the cover of this publication.

Luxembourg: Office for Official Publications of the European Union, 2011.

ISBN: 978-92-9191-406-7

doi:10.2802/56173

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1. Introduction

This report describes the work carried out in Phase 1 of the project 'Foresight of New and Emerging Risks to Occupational Safety and Health Associated with New Technologies in Green Jobs by 2020' commissioned by the European Risk Observatory (ERO). The aim of Phase 1 is to identify key contextual drivers of change that could contribute to creating new and emerging risks associated with new technologies in green jobs within ten years. This report serves as an interim report to the whole project, which has three phases, described below.

2. Background

Over the last fifty years many of the occupational safety and health (OSH) hazards have evolved relatively slowly. The combination of the accelerating pace of technology change and the potential moves towards a green economy mean that it will be increasingly important to anticipate new and emerging risks.

The overall aim of the project is to produce sets of scenarios for 2020, covering a range of new technologies in green jobs and the impact they could have on workers' health and safety, in order to inform EU decision makers, Member States' governments, trade unions and employers, so that they can take decisions in order to shape the future of occupational safety and health in green jobs towards safer and healthier workplaces.

The decision to pursue a scenario-building project arose out of a workshop hosted by the ERO in October 2008. The ERO wished to build on earlier forecast exercises, comprising Delphi studies in four different risk areas, which had produced useful summaries and prioritisation of key risks as assessed by experts. However, it was felt that in order to consider likely health and safety risks further into the future, an alternative technique should be used. The scenario-building approach was selected as a suitable vehicle to provide a forward look. In order to limit the scope to manageable proportions, new technologies in green jobs were selected as the target area. The rationale behind this choice was twofold. First, new technologies is an area where we are most likely to be confronted with new risks and the Community strategy on health and safety at work 2007-2012 emphasises 'risks associated with new technologies' as an area where risk anticipation should be enhanced. [1] Secondly, the impetus to 'green' the economy, associated with a strong emphasis on innovation in this sector, gives an opportunity to anticipate potential new risks in these developing green jobs and make sure their design integrates workers' safety and health.

3. Project structure

The project has three distinct phases:

- **Phase 1** involved the identification of key contextual drivers of change that could contribute to creating new and emerging risks associated with new technologies in green jobs by 2020. The drivers identified will be used in the generation of a set of scenarios.
- **Phase 2** will be the identification of the key technological innovations that may be introduced in green jobs over the next ten years that may lead to new and emerging risks in the workplace or have a positive impact on workers' safety and health.
- **Phase 3** will comprise a series of workshops to be held across Europe to generate the scenarios, based on the findings of Phases 1 and 2.

4. Scope of the project

It is important at the outset to clarify the definitions of the terms 'new and emerging risks', 'new technologies' and 'green jobs' and the interpretations of those definitions appropriate to this project.

4.1. New and emerging risks

EU-OSHA defines new and emerging risks as follows:

‘An "emerging OSH risk" is any occupational risk that is both "new" and "increasing".

By "new" we mean that:

- the risk did not previously exist and is caused by new processes, new technologies, new types of workplace, or social or organisational change; or,
- a long-standing issue is newly considered as a risk due to a change in social or public perceptions; or,
- new scientific knowledge allows a long-standing issue to be identified as a risk.

The risk is "increasing" if the:

- number of hazards leading to the risk is growing, or the
- likelihood of exposure to the hazard leading to the risk is increasing, (exposure level and/or the number of people exposed), or the
- effect of the hazard on workers' health is getting worse (seriousness of health effects and/or the number of people affected).’

4.2. Green jobs

There are many definitions of ‘green jobs’. Green jobs used to be considered as those involved with protecting biodiversity and the natural environment, but they now include areas such as low-carbon jobs, energy efficiency, and carbon finance. They can also go beyond ‘direct’ green employment into the supply chain, even though they may not supply green industries. Nuclear energy might be green to some, in the context of its low-carbon credentials, but not to others. [2] Some commentators distinguish ‘green jobs’, which contribute to improving or preserving the environment, from ‘green collar jobs’, which are green jobs that are also ‘decent’ jobs in that they are good for the worker as well as the environment. Others talk about ‘greening the workplace’. The US Blue Green Alliance describes a green job as ‘a blue-collar job with a green purpose’. [3] Although this is the view of a particular group, when we come to consider our remit of new and emerging risks in green jobs, the blue-collar label might not be too far adrift.

Pollin et al, [4] break green jobs into three categories:

- Direct Jobs: first round of job changes resulting from changing outputs in target industries.
- Indirect Jobs: subsequent job changes resulting from changing inputs required to accommodate the above.
- Income induced jobs: additional jobs created by changes in household incomes and expenditures resulting from both above.

Different definitions or interpretations of them will suit the purposes of those using the terms. Politicians, for example, will be eager to take a broad approach to the definition in order to boost the numbers of those apparently in green jobs. In the OSH arena, we will want to be more critical in our definition, focusing on potential risk rather than inflating numbers.

An often-quoted definition of green jobs is that used by the United Nations Environment Programme. [5]

‘We define green jobs as work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high

efficiency strategies; de-carbonise the economy; and minimize or altogether avoid generation of all forms of waste and pollution.'

This definition usefully describes the areas of work potentially covered by the green label, but in terms of jobs, including as it does administrative jobs, it gives a huge scope to green jobs. Pollin et al, [4] give a list of typical jobs that might be associated with various green activity areas in Table 1.

At the kick-off meeting for this project the European Risk Observatory clarified its requirements and interpretation of the above definitions in the context of this project. It advised that the aim was to investigate *new types* of risk related to *new* technologies within green jobs. So the primary interest is in those *working with* or *directly* affected by the new technologies, rather than those merely associated indirectly with the new technologies. 'White collar' jobs in a green industry are not of interest. *New combinations* of risk are of interest, for example in the installation of solar panels, where electrical risks combine with the risk of working at height. Jobs in green industries where the risks are the same as other jobs, for example transport of green goods, are not of interest. *Novelty* is of more interest than the increase or decrease of known risks. The focusing of attention in this way makes the task more manageable and potentially more useful.

Table 1: Green recovery in the US

Strategies for Green Economic Investment	Representative Jobs
Building Retrofitting	Electricians, Heating/Air Conditioning Installers, Carpenters, Construction Equipment Operators, Roofers, Insulation Workers, Carpenter Helpers, Industrial Truck Drivers, Construction Managers, Building Inspectors
Mass Transit/Freight Rail	Civil Engineers, Rail Track Layers, Electricians, Welders, Metal Fabricators, Engine Assemblers, Bus Drivers, Dispatchers, Locomotive Engineers, Railroad Conductors
Smart Grid	Computer Software Engineers, Electrical Engineers, Electrical Equipment Assemblers, Electrical Equipment Technicians, Machinists, Team Assemblers, Construction Labourers, Operating Engineers, Electrical Power Line Installers and Repairers
Wind Power	Environmental Engineers, Iron and Steel Workers, Millwrights, Sheet Metal Workers, Machinists, Electrical Equipment Assemblers, Construction Equipment Operators, Installation Helpers, Labourers, Construction Managers
Solar Power	Electrical Engineers, Electricians, Industrial Machinery Mechanics, Welders, Metal Fabricators, Electrical Equipment Assemblers, Construction Equipment Operators, Installation Helpers, Labourers, Construction Managers
Advanced Biofuels	Chemical Engineers, Chemists, Chemical Equipment Operators, Chemical Technicians, Mixing and Blending Machine Operators, Agricultural Workers, Industrial Truck Drivers, Farm Product Purchasers, Agricultural and Forestry Supervisors, Agricultural Inspectors

Source: Robert Pollin et al: Green Recovery: A program to create green jobs and start building a low-carbon economy, PERI, 2008.

5. Phase 1 - Contextual drivers of change

Phase 1 of this project concerned the identification of contextual drivers of change that could contribute to creating new and emerging risks associated with new technologies in green jobs. This phase comprised three Work Packages (WP):

- WP 1.1 –- a review of the literature on contextual drivers of change resulting in an initial list of drivers;
- WP 1.2 – a consultation exercise carried out by interviews with experts and by a web-based exercise to consolidate the list of drivers;
- WP 1.3 – a voting exercise to prioritise the drivers and produce a list of suitable key drivers to be used in generating a set of scenarios in Phase 3 of the project.

5.1. Work Package 1.1 – Review of existing information on contextual drivers of change

The aim of Work Package 1.1 was to undertake a review of existing information (foresight, forecasts, studies, surveys, scientific reviews, statistics, etc.) in order to identify contextual drivers of change.

5.1.1. Literature review methodology

An initial literature review was carried out by the Health and Safety Executive's Library and Information Services (LIS), which have access to a wide range of subscription databases. Searches were carried out on the following databases:

ASSIA Applied Social Sciences Index and Abstracts – a database covering social services, psychology, sociology and health information.

Ebsco Host A portal for e-journals published by numerous publishers. It includes Tables of Contents for 26,000 journals.

IBSS International Bibliography of the Social Sciences – this covers all social science fields including economics, social policy and social services, political science, law, accounting and finance, health and psychology, international relations and sociology.

OSH ROM This contains bibliographic databases including: CISDOC (International Labour Office); NIOSHTIC (United States National Institute for Occupational Safety and Health); HSELINE; MHIDAS; RILOSH (Canada); MEDLINE OEM.

Other (priced) databases – Enviroline, Environmental Engineering, Compendex, BIOSIS, Economist, Management Contents, Management and Marketing Abstracts, Wilson Applied Science and Technology, New Scientist, NTIS and CAB.

Searches that focused specifically on 'drivers' for green or environmental jobs produced little in the way of leads, presumably because drivers themselves are not the primary focus of most of the literature and may not appear in keywords. Opening the search to green jobs generally increased the number of hits dramatically, but with less discrimination. There is a large amount of material available on green jobs, much of it fairly recent. Most of the references found to be most useful date from the last three years.

The formal searches carried out by LIS yielded over 350 hits. The project team sifted these on the basis of age, geographical coverage, accessibility of the material and relevance as indicated by the title or abstract, where available.

The formal searches were supplemented by independent searches by the project team, relying largely on the Internet, covering a range of sources and websites of relevant organisations. In addition, information on environmental drivers from earlier work by team members was made available.

The academic press did not yield a lot of relevant information. The most useful sources proved to be reports by and for government departments and other bodies. These are written from global, European and national perspectives.

5.1.2. Global studies

The most comprehensive global study was 'Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World', produced by the Worldwatch Institute and Cornell University for the United Nations Environment Programme (UNEP) as part of the joint UNEP, International Labour Office, International Organisation of Employers and the International Trade Union Confederation Green Jobs Initiative. [5] Various shorter summaries are also available.

The UNEP report considers the definition of green jobs and measurement of them. It contains a chapter on green policies and business practices, which includes a 'Policy Toolbox'. This deals with drivers of green jobs under the categories Financial and Fiscal Shifts – shifting subsidies from fossil to renewable energy; rethinking R&D priorities; international development finance; carbon trading and ecological tax reform; and Mandates – extended producer responsibilities; eco-labelling; and energy targets and mandates. The bulk of the report deals with eight areas of work with the potential for green jobs (see Table 2), which may be useful in Phase 2 of this project.

The International Labour Office (ILO) has produced several reports taking a global view. One in particular, by Sanchez and Poschen cites key drivers for green jobs as: mapping skills requirements and skills development; climate change investment; catering for the special needs of SMEs[1], and enabling technology transfer. [6]

The Global Climate Network identifies government policy, including targets, finance and training as key drivers for low-carbon job creation. In addition it identifies adjustment policies for activities that lose jobs as a result of green job creation. [7]

Table 2: Shades of green: pro-environmental measures in major segments of the economy

Energy supply	Integrated gasification/carbon sequestration; Co-generation (combined heat and power); Renewables (wind, solar, biofuels, geothermal, small-scale hydro); fuel cells.
Transport	More fuel-efficient vehicles; Hybrid-electric, electric, and fuel-cell vehicles; Car-sharing; Public transport; Non-motorized transport (biking, walking), and changes in land-use policies and settlement patterns (reducing distance and dependence on motorized transport).
Manufacturing	Pollution control (scrubbers and other tailpipe technologies); Energy and materials efficiency; Clean production techniques (toxics avoidance); Cradle-to-cradle (closed-loop systems).
Buildings	Lighting, energy-efficient appliances and office equipment; Solar heating and cooling, solar panels; Retrofitting; Green buildings (energy-efficient windows, insulation, building materials, heating, ventilation and air conditioning); Passive-solar houses, zero-emissions buildings.
Materials Management	Recycling; Extended producer responsibility, product take-back and remanufacturing; De-materialization; Durability and reparability of products.
Retail	Promotion of efficient products and use of eco-labels; Store locations closer to residential areas; Minimization of shipping distances (from origin of products to store location); New service economy (selling services, not products).
Agriculture	Soil conservation; Water efficiency; Organic growing methods; Reducing farm-to-market distance.
Forestry	Reforestation and afforestation projects; Agroforestry; Sustainable forestry management and certification schemes; Halting deforestation.

Source: Green Jobs - Towards Decent Work in a Sustainable, Low-Carbon World, UNEP/ILO/IOE/ITUC, September 2008

[1] Small and Medium Sized Enterprises

5.1.3. European studies

The European Commission's own reports were a very fruitful source of information. DG[2] Environment's website in particular contains a useful list of references. [8]

An excellent suite of reports was produced by GHK and others for DG Environment and DG Employment. In their paper 'Links between the environment, economy and jobs', they introduce Drivers of Environment Related Economic Activities - a reasonable proxy for 'green jobs'. [9] Five high level drivers elegantly capture virtually the whole picture:

- The natural environment – the stocks and quality of the natural capital which is the input to, or focus of, different economic activities
- Political, economic and social pressures – the values, opinions, and economic wealth, which influence the choices and actions of the economic actors.
- User demand and social pressure – the demand (by consumers, corporate or public buyers) for products (goods and services) that worsen/improve environmental performance directly or, through supply chains, indirectly;
- Products and industry requirements – legal or voluntary requirements of production or products (e.g. pollution control regulation, product standards, eco-labelling) to achieve set levels of environmental performance.
- Economic/financial incentives – any economic or financial incentive to produce or consume certain products and services with associated environment impacts e.g. Common Agricultural Policy (CAP), structural funds, ethical investment, taxes and subsidies.

A series of annexes is referred to in the GHK report. These comprise a separate volume, which is very interesting, but has never been published. It is, however, available from DG Environment Library and Information Services. [10] Annex B of that document includes a matrix mapping the five high level drivers across ten groups of environmental activities and giving more specific drivers.

The most important drivers *now* were found to be:

- The natural environment – long-term sustainability;
- Political, social and economic context – awareness of risks, media and politicians' interest;
- Government investment and policy activities;
- Competitiveness;
- Demand (for natural resources);
- Legislative and financial drivers.

The report goes further and considers also the drivers that are going to become the most important in the next twenty-five years.

In their reports for DG Employment, GHK consider case studies of 15 companies' responses to climate change. In a synthesis of the overall findings they identify key drivers for action, and further identify key drivers by sector. [11, 12].

The main drivers are:

- Corporate Social Responsibility (CSR) and reputation – the impact on branding;
- Competitiveness – reducing carbon dependence;
- Regulation – EU-Emission Trading Scheme and Renewables Directive;

[2] Directorate General

- Physical effects of climate change – for example, exposure to risks from water shortages.

The authors also make the following observation:

- The main drivers have related to policies rather than the physical effects of climate change;
- Regulation is more important than CSR except for airlines;
- In employment terms, impacts have been in relation to skills rather than numbers employed. There is a need for new skills and upskilling, especially in technical areas.

The World Wildlife Fund issued a report 'Low Carbon Jobs for Europe', which focuses on the opportunities offered by financial stimulus to counter the global recession. [13]

5.1.4. National studies

A range of studies relating to individual country situations was examined. These are summarised in Annex 1.

The key objective of this report is to provide a list of contextual drivers to take the scenario project forward. In the interests of brevity we have described only a small selection of the reports consulted in order to give a flavour of the range of material available. A fuller list of references consulted with brief comments is presented in Annex 1.

5.1.5. Hierarchy of drivers

The drivers discussed so far are fairly high-level drivers, in effect groupings of drivers, which can all be unpackaged into lower level drivers. In a scenario-building exercise we need to have a sufficient number and diversity of drivers to allow debate and possible regrouping. We are faced with the challenge of picking the right level in a 'hierarchy' of drivers.

At the top level – we have the environment in its broadest sense. Everything else derives from this – climate change, the need for affordable and sustainable energy, sustainable manufacturing, environmental protection and public attitudes to all of these.

At the next level down 'Environment' can be divided into two key areas:

- Climate change – the need to respond to it.
- The supply of natural resources and the need to maintain them.

Below this level we can look to five or six high level drivers, for example GHK's five drivers above. The American Council for an Energy-Efficient Economy's six driver version below is essentially very similar but with the addition of technological developments ('better mousetraps'), although these are specifically aimed at energy efficiency and not green jobs more generally. [14]

- Energy prices;
- The supply straitjacket;
- Climate urgency;
- Consumer and shareholder activism;
- Global competition;
- Better mousetraps (technological developments).

In order to provide material for the next stage of Phase 1 of this project, WP 1.2, the drivers of change referred to in the reports reviewed were extracted, collated and, where appropriate, amalgamated to produce a set of sixty-nine drivers sorted by STEEP[3] categories. These are presented in Annex 2. It is important to remember that the scope of the report is 'identification of key contextual drivers of change that could contribute to creating new and emerging risks associated with new technologies in

[3] Societal, Technological, Economic, Environmental and Political

green jobs by 2020', i.e. it includes potential risks to health and safety, not just the creation of green jobs. Thus drivers such as ageing population are valid, since although they do not drive the creation of green jobs, they may bring potential risks to green jobs specific to ageing.

5.2. Work Package 1.2 - Consolidation of the list of contextual drivers of change

The aim of Work Package 1.2 was to consolidate the results from WP1.1 using the expertise of key people who are aware of contextual drivers of change not yet described in published material.

5.2.1. Methodology

The consolidation stage was based on two consultation exercises.

In the first consultation exercise, telephone interviews were carried out with 25 selected experts. The selection of interviewees was intended, as far as possible, to identify people from a range of organisations, with a variety of backgrounds and experience in order to bring a range of views to the exercise.

The second consultation exercise, run alongside the interview programme, consisted of a web-based questionnaire. Participants were asked to select the drivers that in their views were most important from the list of 69 shown in Annex 2.

5.2.1.1. Interview programme

The project team identified and interviewed, by telephone, twenty-five experts. In addition, a written response was received from the European Trade Union Institute. The interviewees are listed in Annex 3.

Interviews were based on the 'Seven Questions' technique, which was developed by SAMI Consulting and is now widely used in scenario-building exercises. [15] It features in the UK Government's Horizon Scanning Centre's Futures Toolkit. [16] The questions are designed to be 'open' so as to give interviewees the freedom to develop ideas in a relaxed setting.

In most cases, interviews were recorded, with the interviewee's permission, in order to facilitate accurate reporting. Interviewees were advised that interviews would be non-attributable, so comments could not be linked to any individual. Therefore, they were invited to give their own views and not necessarily those of their organisation.

The question set used is given below:

Question 1

"Having read the literature review of contextual drivers of change, what do you see as the main drivers in the report affecting New and Emerging Risks to Occupational Safety and Health Associated with New Technologies in Green Jobs by 2020?"

- Is there anything additional that was not in the literature review that you feel is a relevant driver?
- Are there any drivers that don't belong?
- Are there any drivers you disagree with?
- Which drivers are most likely to drive new technology?

Question 2

Clairvoyant

If you could spend some time with someone who knew the outcome, a clairvoyant or oracle if such existed, what would you want to know (i.e. what are the critical issues)?

Question 3

An Optimistic Outcome

Optimistic but realistic. What would be a good outcome and what would be the signs?

Question 4

A Pessimistic Outcome

How could the environment change to make things more difficult? What could go wrong?

Question 5

Looking Back

Looking back 10 years, what successes can we build on and what failures can we learn from?

Question 6

Looking Forward

What decisions need to be made in the near term to achieve the desired long-term outcome?

Question 7

Epitaph

If you had a mandate, without constraints, what more would you need to do?

5.2.1.2. Internet questionnaire

A questionnaire was created in SNAP Survey software, [17] which has been used by HSL for numerous surveys.

The questionnaire contained the 69 drivers and their descriptions as shown in Annex 2.

Participants were asked to use drop-down menus to select their top three drivers from each of the categories: Societal, Technological, Economic, Environmental and Political. In addition, space was made available for free text comments.

The questionnaire was publicised via articles in HSE's Science and Research Outlook newsletter [18] and in the EU-OSHA's OSHMail newsletter. [19] In addition, the existence of the questionnaire was picked up by independent websites such as Hazards, [20] which gave further publicity to the questionnaire. Overall, about 50,000 people were potentially exposed to the questionnaire.

5.2.2. Results

5.2.2.1. Interview programme

The duration of interviews ranged from about twenty minutes up to a maximum of 100 minutes.

Although only the first question asks about drivers specifically, the responses to other questions gave a great deal of useful information about drivers and other aspects. In addition to helping with the consolidation of the driver set, the information collected will be useful later in the project. For example, a significant number of potential health and safety issues that will be of use in Phase 2 of this project were suggested.

Some interviewees focused on specific drivers from Annex 2, but in general their responses were pitched at a higher aggregate level. This was expected and in any case it was intended that the original list of 69 drivers would need to be simplified considerably.

Several interviewees sought clarification on whether the questions related to drivers for the creation of green jobs, or to drivers for health and safety risks in green jobs. They were advised to respond in

whichever way they felt more comfortable. In practice, those with OSH expertise tried to deal with risks rather more than others, who focused on drivers for the creation of green jobs.

Some were not comfortable with 'green jobs' as a concept, saying it is a political terminology. They would prefer to avoid the label and work towards all jobs being healthy and safe and green, i.e. sustainable. A recurring theme was that 'green' does not necessarily mean 'good' and that a job does not deserve the description 'green' if is not safe and healthy. At the same time, several interviewees felt that 'green' and 'safe' aspirations sat well together.

Direct responses to Question 1 – 'What are the drivers?' revealed the most common responses to be grouped around:

- Public opinion;
- Economic factors;
- Technological development;
- Security of energy supply;
- Climate change;
- Government interventions.

These are very similar to the high level drivers identified from the literature, as described in section 5.1.

Question 2 – 'What would you ask a clairvoyant?' showed that the most common questions were:

- Did climate change turn out to be real?
- What is the energy mix in 2020, i.e. what technologies have been developed and adopted?
- What are the health and safety risks in 2020?
- Did politicians rise to the challenge?
- Is the world fair, or have all the dirty jobs gone to the developing world?

In Question 3, 'An optimistic outcome', most interviewees wanted to see a big shift to sustainable technologies, so that we meet our emissions and other targets, and for health and safety to be 'built in', i.e. taken into account early in any development.

Question 4, 'A pessimistic outcome', saw concerns about 'business as usual', a continuing economic downturn that prevents moves towards sustainability, and a fear that we might choose the wrong technological pathway.

In Question 5, successes identified were the tremendous advances in technology, globalisation (although an opposite view was expressed later), and progress on dealing with environmental pollution. Failures were that the EU didn't start soon enough in responding to environmental challenges, that we failed to anticipate a range of health and safety (H&S) issues, e.g. the impact of globalisation, of contractorisation and sub-contracting, and that there has been insufficient collaboration between governments.

In Question 6, 'What needs to be done now?' by far the most common response was around government interventions – taxes, stable energy policies, regulation, and creating the right environment for sustainability. The next most common response focused on the need for greater collaboration at all levels, for example between governments on emissions targets, and between regulators, investors and researchers so that health and safety is designed in.

In Question 7, 'If you had the power, what would you do?' the collaboration theme continued, with a couple of respondents wanting to 'force collaboration'. The importance of government interventions was also cited frequently.

Examples of some of the points made during the interviews along with several quotes from interviewees are given in Annex 4.

The interview transcripts were structured, where possible, in short paragraphs dealing with a single issue to allow coding and sorting to produce a workbook. The workbook contains the information obtained from the interviews arranged in a way that allows identification of the key issues

The first few scripts were analysed in order to provide a 'trial agenda' of headings into which to sort the material. This subsequently developed as further scripts were added to provide the 'natural agenda' for the project. Individual paragraphs were sorted into appropriate sections to produce the workbook. Each paragraph could appear in more than one section, depending on its content. The sorting of the information in this way allowed the most important drivers of change to emerge. Overall, 130 sections in 25 groupings were identified.

In addition to assisting with identification of the key issues, the workbook will be a useful source of information in later stages of the project.

The top-level headings from the natural agenda are shown below.

Societal

- Public opinion
- Health and safety
- Social stability
- Demographics
- Working life
- Building and urban design

Technological

- Energy technologies
    - Renewable energy technologies
    - Fossil fuel technologies
    - Electricity
    - Nuclear energy
- Other technologies
- Sectors

Economic

- Economy
- Globalisation
- Consumer behaviour
- Competition
- Green jobs

Environmental

- Climate change
- Environment

Political

- Government interventions

- Incentives
- Controls
- Energy security
- Energy policy

The contents of the workbook were analysed by the project team to identify those drivers judged by the interviewees to be the most important.

As discussed above, the high level drivers identified in the interviews were similar to those identified in WP 1.1. As before, the challenge remains to pitch the final list of drivers at an appropriate level to take forward to the scenario-building process of Phase 3. So the target was a manageable number somewhere between the five highest-level drivers and the 69 drivers from WP 1.1 shown in Annex 2. Following a review of the workbook, complemented with the results of the Internet questionnaire (5.2.2.2), a consolidated list of 16 drivers was drawn up (see 5.2.3).

5.2.2.2. Internet questionnaire

The purpose of the Internet questionnaire was to expose the results of WP 1.1 to a wider audience than could be achieved by the interview programme alone. Although the survey could not gather the depth of information offered by interviews, it provided a source of endorsement of the findings of the interviews and the opportunity to identify any omissions.

Given the very large potential audience for the questionnaire, the number of replies received, at 49, could be considered rather surprising. However, it was not untypical for an unsolicited survey of this type and sufficient responses were obtained to provide useful information. [21] Also, many recipients of the OSHmail newsletter receive it in a language other than English, so they might have been unwilling to undertake a questionnaire in English.

Responses were obtained from 17 countries, mostly in Europe, but also from the USA, Australia, Bangladesh and Cameroon. Respondents included health and safety professionals, directors, trade union representatives and others whose interests in green jobs ranged from professional to ‘self-taught eco-warrior’. Of those who gave the information, 19 were public sector/government, 18 private sector, 3 academic, 2 trade unions and one from the voluntary sector. (Annex 6)

Participants were invited to select their top three drivers in each of the STEEP categories.

The questionnaire results for the top three drivers in each STEEP category were as follows:

Societal

- People's reaction to climate change and the extent to which they regard human activity as responsible.
- Public opinion on environmental protection generally.
- Increasing demand for low-carbon and environmentally friendly products and services.

Technological

- Renewable energy technologies
- Growth in waste management and recycling
- Nuclear energy

Economic

- Decreasing oil availability and increasing and more volatile oil prices.
- Shortages and increasing prices of natural resources (other than energy)

- Globalisation

Environmental

- Increasing need to manage water supplies
- Increasing frequency of natural disasters and/or freak weather
- Increasing responsibility on producers

Political

- Action to ensure that regulation enables rather than stifles development of green jobs. Removal of the barriers to the creation of green jobs.
- Actions to encourage research and development
- Actions to develop education and training to develop the necessary skills.

The results obtained are shown in graphical form in Annex 5.

Most of the drivers selected were consistent with the information derived from the interview programme. The only surprise was that the need to manage water supplies obtained the highest score overall. This driver was chosen by a wide range of respondents from a range of countries. This might be an issue for some parts of Europe, and while it was mentioned during the interview programme, it was not given much attention.

Seventeen respondents provided free text comments during the web consultation, covering all the STEEP categories. These comments were added to the workbook created from the interview responses.

5.2.3. The consolidated driver set

Following a review of the workbook and the results from the Internet questionnaire, 16 groupings were identified under the following headings:

1. Environment

The state of the environment is inevitably the key driver of green activities, either in terms of short-term issues such as pollution, or longer-term issues such as increasing carbon dioxide emissions and climate change, generally considered to be due to human activity.

Scientific and media reports of climate change and other environmental issues will drive public opinion, which may in turn influence politicians and industry to act. Increasingly extreme weather and other observable physical effects of climate change such as temperature rises and natural disasters that may be attributable to climate change will further drive public opinion, strengthening the position of pressure groups and potentially influencing government policies.

Climate change may lead to water shortages in parts of the world, e.g. southern Spain, so activities to store water and to use less water will become increasingly important. Desalination might become more important. Climate change may drive the need for more efficient and/or more local food production. This could lead to an increase or decrease in jobs, depending on the solutions adopted. Increasing energy costs could lead to a decrease in the transport of food, resulting in more local food production.

Other environmental concerns including famine, pollution, man-made disasters (especially those related to the energy sector), depletion of natural resources other than fossil fuels, for example the increasing demand for minerals and other commodities by emerging economies, will add to the issues described above.

2. Government incentives

Government incentives for green activities are likely to have a strong influence on the creation of green jobs. Examples of government incentives, which can be financial or enabling, include:

- Having clear and stable energy policies – taking a long-term view to create a favourable climate for investment will make investment in new technologies more attractive.
- Governments investing in research and development. Developing clear research prioritisation criteria in order to target funding towards environmentally friendly activities. Develop energy research capabilities and promote the development of technology clusters.
- Many companies developing green technologies are SMEs that need capital to invest in green technologies and insurance cover for speculative ventures. Governments offering technical assistance or innovative financing for private investment, e.g. by underwriting loans may encourage venture capitalist firms to recognise that green technology development can give significant business opportunities.
- Simplifying planning controls for green activities, implementation of waste collection and recycling schemes.
- Offering loans, subsidies, rewards or favourable tax regimes for:
    - Retrofitting of energy efficiency measures in existing buildings.
    - Car scrappage schemes that replace older polluting vehicles with more carbon efficient vehicles. Reduced tolls for energy efficient vehicles.
    - Recycling.
    - Less energy-dependent, less material-dependent and less waste-generating manufacturing processes and products.
    - Locally generated electricity. Feed-in-tariffs for solar energy were very successful in, for example Germany and Spain, and have had significant impact since their introduction in the UK in April 2010.
- Many observers fear that a shortage of skills will hamper the development of green activities and therefore green jobs. Action to encourage education in science, technology, engineering and mathematics, to identify the skills gaps and to provide relevant training will promote the creation of green jobs. Skill levels are important to health and safety.
- Where jobs in other sectors may be lost as a result of the creation of green jobs, action to retrain and redeploy displaced staff may reduce the risk of opposition to green job creation.

The extent to which incentives are successful in encouraging the creation of green jobs is key to the growth of the green sector.

3. Government controls

As an alternative to incentives for undertaking green activities, governments can impose controls on polluting activities. These controls include: regulation, taxing of high carbon and polluting activities, e.g. aviation and motoring and the removal of 'perverse' subsidies on fossil fuel activities in some cases.

Examples include:

- Landfill taxes to encourage reduction in waste and an increase in recycling.
- Carbon pricing and carbon trading, for example the EU's Emissions Trading Scheme (EU-ETS).
- Extended producer responsibility laws (requiring companies to take back products at the end of their useful life) for all types of products.
- A requirement for eco-labelling of consumer products to ensure that consumers have access to information needed to make responsible purchases. This will encourage manufacturers to design and market more eco-friendly products.

- Emissions targets.
- Developing green building regulations, energy conservation standards, or other requirements for new green buildings or retrofits of existing buildings. - Directive on the Energy Performance of Buildings (2003).
- Higher levels of tax for the most polluting vehicles. Developing energy efficiency standards (for appliances, vehicles, etc.).
- Requirement for biofuel content of diesel fuel.
- Proportionate health and safety legislation.

4. Public opinion

Public opinion on environmental issues and in particular climate change and the extent to which the public believe that human activities contribute to climate change, will influence politicians and businesses. Pressure groups and campaigns will influence governments, while commercial pressures will have more impact on producers.

If people believe that CO_2 emissions play a major part in global warming, then they will be increasingly likely to support low-carbon energy sources. However, the general public's growing intolerance of risk, coupled with their inability to properly assess risk, may lead to a reluctance to adopt new (green) technologies. A major accident involving new technologies, e.g. Carbon Capture and Storage, could seriously hold back development. On the other hand they may favour newer renewable and sustainable technologies over older, dirtier technology. Improved risk communication might affect people's attitudes.

Public opinion on other environmental issues and opposition to activities that damage the environment could drive the creation of green jobs in environmental protection. However, shortages of essential natural resources could eventually result in conflict between our material needs and protection of the environment.

Public opinion and competitiveness issues could drive Corporate Social Responsibility programmes leading to companies making efforts to operate more efficiently and sustainably.

5. Public behaviour

While public opinion in favour of green activities will influence the creation of green jobs, unless consumers demonstrate their support for green activities by their demand for green products, by their use of energy efficiency measures, changing their travelling patterns, e.g. by using fuel efficient vehicles, electric vehicles etc. or by choosing public transport, supporting recycling schemes, the incentive for manufacturers to offer environmentally friendly products will be diminished.

6. Economic growth

European economic growth will be a significant factor in the creation of green jobs. The state of European economies will have a significant effect on the availability of resources with which to tackle environmental issues. On the one hand a healthy economy and the availability of capital for investment could give business the confidence to invest in new technologies, driving the creation of green jobs. On the other hand, many governments may see the need to boost their economies in the wake of the global recession as an opportunity to green their economies by targeting environmentally sound activities. It may be that costs of major engineering projects will be lower over the next few years as contractors compete for business in a reduced market.

Green activities may offer commercial opportunities outside Europe for European companies. The global market for environmental products and services (efficiency, recycling, water sanitation and efficiency and sustainable transport) is reported to be currently €1000 billion, and could reach €2200 billion by 2020. Any future growth of the EU could lead to potentially bigger markets for green

technology. The availability of a sizeable domestic market for green products and services and a requirement for local content will [4]make developments more attractive to potential investors.

7. International issues

Globalisation, itself driven in part by the availability of cheap transport, is now leading to ever increasing demand for energy and natural resources as emerging economies, benefiting from global trade, increase their own use.

Increasing competition for natural resources from emerging economies and increasing use at home will lead to increased efforts in areas such as recycling, more efficient production and reduction of waste. In addition, competition from emerging economies in production drives cost cutting in Europe resulting in greater efficiency.

Emerging economies such as China and India are growing more quickly than OECD countries and their economic influence will increase accordingly. This could lead to increasing political influence, for example China's ability to affect decisions on carbon targets at the Copenhagen conference in 2009.

The current global economy has been enabled by, amongst other factors, increasingly liberal trade conditions. Continuation or re-emergence of recession could drive a return to protectionism. This could affect prices and availability of natural resources, including energy.

The continuing instability of the Middle East, Russian control of gas pipelines etc. give rise to concerns about fossil fuel security. Continuing conflicts or acts of terrorism that increase instability, will cause fears about oil supplies.

8. Energy security issues

The need or desire for energy security, in particular reduced dependency on imported oil and gas, is undoubtedly a major driver, alongside climate change, for the search for alternative energy sources and improved energy efficiency.

As easy to reach oil and gas resources decline and demand increases, there will be increasing pressure to improve fuel efficiency and to seek alternative, renewable fuel sources. In addition to its transport and heating uses, oil is a feedstock for many industrial processes and so shortage and increasing prices will drive efficiency improvements and use of alternative sources, such as biomass.

In addition to concerns about reserves of available oil and gas, the ongoing risks of conflict and unrest in some of the source countries is another factor in the desire for independence from imported energy.

9. Renewable energy technologies

The availability and affordability of renewable energy technologies, for example wind, wave and solar energy and biofuels, leading to increasing uptake of these technologies will drive the creation of green jobs. As the cost of energy from renewable sources decreases, whether as a result of technological innovation or as a result of subsidies and incentives, its popularity and rate/extent of adoption will increase. As renewable technologies develop, they will introduce new H&S risks, some known, some as yet unknown.

10. Fossil fuel technologies

Reliance on fossil fuels will continue for some years. The development and availability of technologies, for example CCS (including geoengineering approaches like ambient air carbon capture, ocean seeding) and clean coal technologies, to allow continued use of fossil fuels, will become increasingly important.

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Successful testing and development of CCS and clean coal technologies will result in increasing numbers of jobs in this sector, although numbers by 2020 may not be great. It is not universally agreed that such jobs qualify as green jobs. Since the technologies aim to reduce atmospheric carbon dioxide in order to combat climate change, then their role is indeed environmental protection. However, it might also be argued that they are not sustainable, long-term solutions and that they may just be shifting risks or creating other environmental risks.

11. Nuclear energy

Nuclear energy was not considered to be environmentally friendly when originally introduced. However, in the face of increasing carbon emissions a different view might be taken. One significant environmental group has changed its view of nuclear energy. Whether or not nuclear energy is considered to be green itself, the extent of its use will affect the numbers of other green jobs.

12. Electricity distribution, storage and use

As distributed generation of electricity by renewable sources such as wind turbines, small scale hydroelectricity and combined heat and power increases, ageing grids may be unable to handle two-way traffic or to cope easily with the fluctuating output from renewable sources. A Smart Grid will need to be developed, alongside better ways of storing electricity, for example improved battery technology, hydrogen, electric vehicles etc.

Development of smart grid technology and other associated technologies, resulting in more efficient use of power, would lead to green jobs. Development of a smart grid will require corresponding development of Information and Communications Technologies to control the grid.

Introduction of these new technologies for distribution, storage and use of electricity may bring new risks.

13. Energy efficiency improvements

Opportunities for green jobs will be created in the construction of new energy efficient buildings, in retrofitting energy efficiency measures to older buildings, in less energy-demanding manufacturing and in the adoption of more efficient means of transport, either alternatives to fossil fuel or making more use of public transport.

These in turn will be driven by increased awareness of the benefits, reducing or subsidised prices, policies and standards on energy efficiency and public procurement policies.

14. Growth in waste and recycling

Continued growth in waste management and recycling, driven by environmental concerns and shortages and prices of natural resources, will lead to increasing employment in this sector. International pressures and public opinion could mean that it may no longer be acceptable to export waste to developing countries. Increasing transport and labour costs overseas will also contribute to this trend. Jobs in this sector are often low quality jobs carried out by vulnerable workers. Risks can include manual handling during collection and sorting, potential exposure to dangerous objects, hazardous chemicals that may become concentrated during processing, biohazards, toxic or flammable gases etc. What we are manufacturing now will become waste during the next ten years. Examples include solar panels that contain toxic chemicals, low energy light bulbs that contain mercury, nanomaterials. Landfill mining is now being carried out as a way of recovering valuable materials from previously discarded waste. Food waste is increasingly being directed to anaerobic digestion.

15. Other technologies

Developing technologies other than energy technologies may influence health and safety risks in green jobs.

- Nanotechnologies - It is likely that nanotechnologies will contribute to green issues in various ways, for example changes in manufacturing resulting in saving of natural resources, novel materials, desalination, changes in food production, carbon nanotubes in new battery designs. New materials and nanoparticles may bring health and safety risks as well as environmental risks.
- Biotechnologies – The use of synthetic biology and genetic modification techniques to generate desired traits in crops and animals may have health and safety implications. Genetic testing could be used to identify those at particular risk from toxic substances.
- Climate change mitigation technologies, such as coastal defences, reinforcing of buildings, water management, harvesting, adaptation in agriculture - agroforestry. Efforts to protect and make the most efficient use of land could lead to increased food production and green jobs and may bring new risks.
- Sustainable Manufacturing/Green Chemistry - manufacturing making use of low-carbon technologies, renewable and non-toxic materials, recycling and low waste has strong green credentials, but new manufacturing methods and new or substitute substances may bring changes in health and safety risks.

16. Demographics and the workforce

Increasing population, worldwide as well as in Europe, is likely to increase the use of energy and natural resources, driving the need for ever more energy efficiency, sustainable development, recycling and other steps to reduce and manage the environmental impact of human activity.

Changing lifestyles may also affect the use of energy and other resources. Increasing urbanisation of populations and the increasing number of single households are likely to increase energy use.

Increasing numbers of older people in the general population and in the workforce will have an impact on energy use and the potential for health and safety issues. Older people tend to use more energy in the home, but less on transport. Older workers may be more susceptible to risks from new technologies and substances in the workplace.

As many post-war baby-boomers reach retirement there may be a loss of essential skills in the workplace and a resulting threat to health and safety in work generally, including green jobs.

Shortage of the skills necessary in some green jobs means that migrant labour is being used to fill vacancies. Migrant workers can be at greater risk of accidents and work-related ill health than local staff owing to language and cultural issues. They are also typically more often employed in more risky jobs, in more precarious conditions, and may receive less training.

Climate change might modify migration patterns (e.g. owing to scarcity of water in some regions of the world, etc.) and new populations of migrant workers with different characteristics might be found in the EU; or the migration flow might also be modified.

5.3. Work package 1.3 - Selection of key contextual drivers

The aim of Work Package 1.3 was to select the key contextual drivers from the consolidated set of sixteen drivers produced in WP 1.2.

5.3.1. Methodology

Selection of the key drivers was achieved via a simple voting exercise using the Web Community area on HSE's website. Participants were invited to score each driver from the consolidated list in terms of its importance to the creation of a green economy in Europe by 2020.

Participants were asked to score each driver from 1 (Low Importance) to 7 (High Importance). Short versions of the driver descriptions from Section 5.2.2 were reproduced in the voting table, with the longer descriptions available if required. The short descriptions are shown in Annex 7.

Those invited to vote comprised:

The 25 interviewees from WP 1.2;
The Project Team (5);
The EU-OSHA Director and Project Manager from ERO (2);
Government, Employer and Trade Union representatives from the European Risk Observatory Advisory Group (EROAG) (6);
A selection from those who responded to the web survey in WP 1.2 (12).

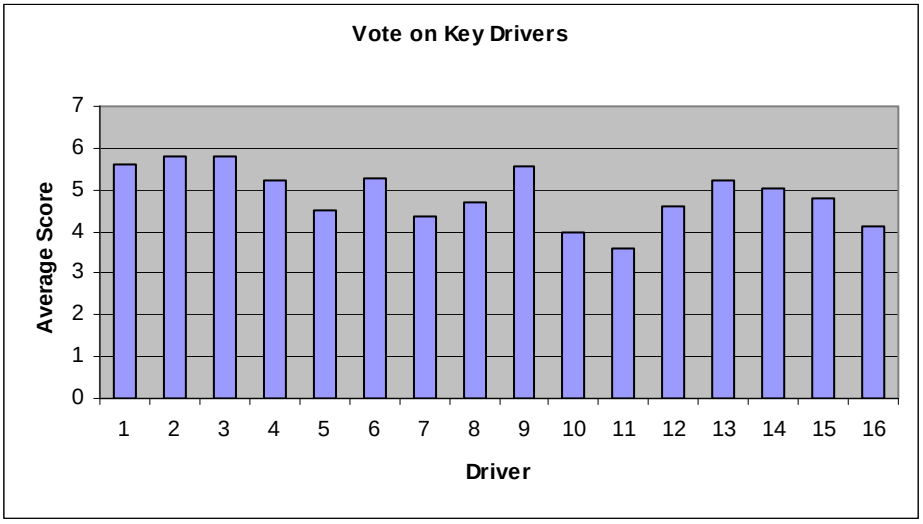
A list of invitees is given in Annex 6.

Responses were received from 37 of the 50 invited to participate. The drivers were ranked by taking the mean of the scores awarded to each driver.

5.3.2. Results

The results of the survey are shown graphically in Figure 1. There were no 'runaway' winners. Overall there was a steady gradation in scores from top to bottom. The environment, government interventions and renewable energy technologies were considered most important. At the other end of the scale, fossil fuel technologies and nuclear energy were considered the least important. The ranking is shown in Table 3 in Section 6.

Figure 1: Results of final voting exercise on key drivers



Key to the drivers (x-axis of Figure 1)	
1. Environment	9. Renewable Energy Technologies
2. Government Incentives	10. Fossil Fuel Technologies
3. Government Controls	11. Nuclear Energy
4. Public Opinion	12. Electricity Distribution, Storage and Use
5. Public Behaviour	13. Energy Efficiency Improvements
6. Economic Growth	14. Growth in Waste Management and Recycling
7. International Issues	15. Other Technologies
8. Energy Security Issues	16. Demographics and the Workforce

The results of this survey will be taken forward to Phase 3 where they will be considered alongside information obtained in Phase 2 on key technologies, to assist in the construction of scenarios.

5.4. Towards phase 2 – Preliminary indicators of technology

The identification and selection of technologies for consideration is the subject of Phase 2 of this project, but inevitably the research and consultation on contextual drivers produced a lot of comment on technologies. The key areas that were mentioned were:

- Renewable energy technologies
- Fossil fuel technologies
- Electricity generation and storage
- Nuclear energy
- Other technologies (including nanotechnologies, biotechnologies, green chemistry and sustainable manufacturing technologies)

More details on these areas are given in Annex 8.

In addition to these technologies, the following industry sectors were identified as important:

- Agriculture
- Transport
- Rail
- Waste and Recycling
- Manufacturing
- Retail
- Construction
- Service Sector

6. Conclusions

Phase 1 of this project analysed 69 drivers of change and from these identified sixteen priority drivers. The priority drivers were ranked through a web-based survey in terms of their importance to the creation of a green economy in Europe by 2020. The ranking of the drivers is shown in Table 3.

Table 3: Ranking of drivers after voting exercise

Ranking	Driver	Mean Score	Ranking	Driver	Mean Score
1=	Government Controls	5.81	**9**	Other Technologies	4.81
1=	Government Incentives	5.81	**10**	Energy Security Issues	4.70
3	Environment	5.62	**11**	Electricity Distribution, Storage and Use	4.62
4	Renewable Energy Technologies	5.54	**12**	Public Behaviour	4.51
5	Economic Growth	5.27	**13**	International Issues	4.35
6=	Energy Efficiency Improvements	5.21	**14**	Demographics and the Workforce	4.15
6=	Public Opinion	5.21	**15**	Fossil Fuel Technologies	3.97
8	Growth in Waste Management and Recycling	5.03	**16**	Nuclear Energy	3.59

During this process we have collected via interviews valuable opinions from a range of individuals with interests in different aspects of environmental, economic and health and safety disciplines. These have been collated and recorded in the project 'workbook', which will provide valuable information in subsequent stages of the project. A brief summary of the main thrust of the responses to each question was given in Section 5.2.1.3, with further details in Annexe 4.

Useful information on a range of technologies and their potential health and safety risks has been obtained and will be used in Phase 2 of the project.

During Phase 1 reference was made, for example, to: people close to moving machinery (e.g. while maintaining wind turbines and recycling waste); potentially hazardous chemicals (e.g. in photovoltaic arrays and composite materials); explosion hazards (e.g. in hydrogen filling stations and biogas digesters); pollution hazards (e.g. from CO_2 pipelines and bio-active processes); and hazards from working at height (e.g. in rooftop energy systems and wind farms). The nature of many of these hazards is understood by the OSH community, but the environments in which they are encountered in green jobs and the workforce exposed to them will in many cases be different.

A number of key uncertainties surrounding the creation of green jobs also arose from the interviews and include:

- The pace and direction of a change to a low-carbon economy – which technologies will succeed and what will be the energy mix by 2020?
- The effect that political and social attitudes will have – will governments rise to the challenge and take the appropriate steps?
- What will future market conditions and funding models be as the world climbs out of recession?

- How will the increasing influence of emerging economies affect Europe?
- How will all the previous points affect working conditions and will a truly sustainable economy be achieved, i.e. where decent, healthy and safe working conditions are provided for the diverse workforce?"

In Phase 3 of the project we will use the data from Phase 1 and the ranked key contextual drivers to develop a set (up to five) "outline" scenarios for the period from now to 2020.The outline scenarios will represent a range of possible views of the context in Europe for occupational safety and health associated with green jobs. These outline scenarios will be used for a series of workshops to generate the alternative technology development pathways for the technologies identified in Phase 2 and the associated new and emerging occupational safety and health risks associated with these in order to form the final scenarios.

Foresight is important, as over the next ten years new organisations and people with new skills will be working in new environments dealing with new and emerging risks associated with new technologies in green jobs. Phase 1 has generated data across all these issues, which will provide valuable inputs into the scenarios and the work of Phases 2 and 3.

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8. Annexes

Annex 1: Literature sources for drivers of green jobs and potential health and safety risks of green jobs

	Organisation	Title	pp	Authors	Date	URL	Notes	Region
1	Institute for Public Policy Research	The Future's Green: Jobs and the UK low-carbon transition plan	71	Jenny Bird and Kate Lawton	Oct-09	http://www.ippr.org.uk/publicationsandreports/publication.asp?id=712	Identifies 'smart government intervention' as crucial. Prioritising in low-C, incentives - supply side 'push' and demand side 'pull', develop the workforce - STEM education, Skills. Useful discussion on 'what are green jobs?' Chapters 4 and 5 give more detail on incentives and skills measures.	UK
2	Institute for Public Policy Research (with Greenpeace)	Green Jobs: Prospects for creating jobs from offshore wind in the UK	58	Jenny Bird	Apr-09	http://www.ippr.org.uk/publicationsandreports/publication.asp?id=658	Considers prospects for offshore wind in UK. Considers drivers as: stable and sizeable domestic market; industrial activism - tax incentives, feed-in tariffs, favourable duties, R&D; skills base; job creation opportunities.	UK
3	Universidad Rey Juan Carlos	Study of the effects on employment of public aid to renewable energy sources	53	Raquel Merino Jara and Juan Ramón Rallo Julián	Mar-09	http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf	Analysis of heavy government investment in renewables jobs. Claims that for every green Megawatt, between 4.27 and 8.99 jobs lost in other areas. Identified cheap credit as a driver. Spanish 'photovoltaic bubble'.	ES
4	House of Commons Environmental Audit Committee	Pre-Budget Report 2008: Green fiscal policy in a recession	111		Mar-09	http://www.publications.parliament.uk/pa/cm200809/cmselect/cmenvaud/202/202.pdf	Identifies the following drivers: green fiscal stimulus - opportunity afforded by recession, Treasury influence in banks - investigate environmental criteria for investment strategies, green tax - shift from 'goods' to 'bads', aviation taxes - regrets backtrack from per passenger to pr plane duty, motoring taxes and scrappage (since done).	UK
5	Institute for Energy Research	Green Jobs: Fact or Fiction? An Assessment of the Literature	21	Robert Michaels and Robert Murphy	Jan-09	http://www.instituteforenergyresearch.org/wp-content/uploads/2009/01/IER Study - Green Jobs.pdf	US report dismissive of green jobs initiatives saying many reports based on incomplete economic analysis and overstate benefits. Some good points on definition of green jobs.	USA
6	University of Illinois	Green Jobs Myths	97	Andrew P Morriss, William T Bogart, Andrew Dorchak and Roger E Meiners	2009	http://www.instituteforenergyresearch.org/wp-content/uploads/2009/03/morriss-green-jobs-myths.pdf	Report critical of green jobs movement. Subsidies could lead to description of jobs as green when they aren't. Green jobs include clerical and admin jobs - shouldn't. Examines 7 'myths'.	USA

	Organisation	Title	pp	Authors	Date	URL	Notes	Region
7	United Nations Environment Programme	Green Jobs: Towards decent work in a sustainable, low carbon world	376	Micjael Renner, Sean Sweeney and Jill Kubit	Sep-08	http://www.unep.org/labour_environment/PDFs/Greenjobs/UNEP-Green-Jobs-Report.pdf	Comprehensive study with worldwide scope. Looks at definition of green jobs and measurement of them. Section on Green Policies and Business Practices, including Policy Toolbox. The Policy Toolbox includes: Financial and Fiscal Shifts - Subsidy Shifts, i.e. between fossil and renewable energy sources, removal of 'perverse subsidies'; Rethinking R&D Priorities Stern recommends doubling efforts on energy R&D; International Development Assistance (away from hydropower); Carbon Trading and Finance; Ecological Tax Reform; Mandates - Extended Producer Responsibility; Eco-labelling; Energy Targets and Mandates; Promotion of Energy Alternatives. The bulk of the report looks at the main sectors for green jobs in some detail. Likely to be useful in Phase 2.	Global
8	United Nations Environment Programme	Green Jobs: Towards decent work in a sustainable, low carbon world: Policy messages and main findings for decision makers	36		2008	http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---webdev/documents/publication/wcms_098487.pdf	Summary of full UNEP report.	Global
9	United Nations Environment Programme	Global Green New Deal: Policy Brief	40		2009	http://www.unep.org/pdf/A_Global_Green_New_Deal_Policy_Brief.pdf	Study based on the premise that the financial crisis is an opportunity to green the world. Use 1% of GDP to achieve Millennium Development Goals.	Global
10	United Nations Environment Programme	Background Paper on Green Jobs	20		2008	http://www.unep.org/labour_environment/PDFs/Green-Jobs-Background-paper-18-01-08.pdf	A short summary of the main UN Report but without the sectoral summaries. One page on drivers of green jobs - growth in investment, business benefits, employment benefits. Policies for green jobs - the need for government action; green investment strategy; green R&D and technology transfer; international cooperation and aid; job training	Global
11	World Wildlife Fund	Low Carbon Jobs for Europe Executive Summary	8	Meera Ghani-Eneland	2009	http://assets.panda.org/downloads/low_carbon_jobs_summary_final.pdf	Recession offers opportunity to use stimulus packages to green economies. Disappointing that only 9% of EU money going to climate change goals. Includes statistics and projections to 2020 for jobs in various sectors in EU.	EU
12	World Wildlife Fund	Low Carbon Jobs for Europe	36	Meera Ghani-Eneland	2009	http://assets.panda.org/downloads/low_carbon_jobs_final.pdf	Recession offers opportunity to use stimulus packages to green economies. Disappointing that only 9% of EU money going to climate change goals. Includes statistics and projections to 2020 for jobs in various sectors in EU.	EU
13	European Trade Union Confederation	Speeches and slides from Climate Change and Employment meeting 20 and 21 Feb 2007	-		2007	http://www.etuc.org/a/3161	Speeches and slides from Climate Change (CC) and Employment meeting 20 and 21 Feb 2007. Sessions covering impact of CC on employment, links between employment and CC policy in energy, transport, building and industry. Slides alone not very easy to follow.	EU

	Organisation	Title	pp	Authors	Date	URL	Notes	Region
14	Global Climate Network	Low-Carbon Jobs in an Inter-connected World - Summary	6		2009	http://www.ippr.org.uk/members/download.asp?f=/ecomm/files/gcn_low_carbon_summary.pdf&a=skip	Looks at low-carbon job creation in a range of countries, focusing on targets as a key driver. In summary offers the following conclusions: Clear, consistent and targeted government policy will help boost jobs numbers; Finance is critical to the creation of low-carbon economic opportunities; Training is critical to the development of low-carbon sectors; Adjustment policies should also form part of the strategy.	Global
15	Pew Centre for Global Climate Change	Review of Green Jobs Studies	8		2009	http://www.pewclimate.org/review-greenjobs	Set of literature references with short summaries, mostly US.	USA
16	Economic Policy Institute	Green Investments and the Labor Market: How many jobs could be generated and what type?	12	Josh Bivens, John Irons and Ethan Pollack	2009	http://epi.3cdn.net/3ede40f054b5406d66_q6m6b9ne5.pdf	Calls for government stimulus to counter the recession as an opportunity to boost green jobs, over and above Obama's cap-and-trade policy. Contains analysis of the numbers of jobs that could be created by sector (US).	USA
17	European Commission	Commission Staff Working Document - Summary report on the analysis of the debate on the green paper "A European Strategy for Sustainable, Competitive and Secure Energy"	60		2006	http://ec.europa.eu/energy/strategies/2006/doc/sec_2006_1500.pdf	Identifies six priority areas to meet policy objectives of energy sustainability, security of supply and competitiveness. Not specifically dealing with green jobs. Includes results of on-line poll on favoured energy sources. Results perhaps surprising in that Carbon Capture and Storage came only seventh.	EU
18	ILO	The social and decent work dimensions of a new Agreement on Climate Change	40	Ana Belen Sanchez and Peter Poschen	2009	http://www.ilo.org/wcmsp5/groups/public/---dgreports/---integration/documents/briefingnote/wcms_107814.pdf	Looks at impacts of CC on work, but focusing more on adaptation rather than mitigation. Drivers/areas for action - skills developments, climate change investment, special needs of SMEs, enabling technology transfer, mapping skill requirements.	Global
19	ILO	Green jobs: Facts and Figures	2		2008	http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_098484.pdf	Short leaflet with key worldwide figures. Green jobs will be in at least four types - additional jobs - as in the manufacturing of pollution controlled devices added to existing production equipment; substitution - as in shifting from fossil to renewable energy, from land fill to recycling; elimination without direct replacement - as in reduction or banning of packaging materials and their production; many existing professions such as plumbers, electricians, metal workers and construction workers will be transformed and redefined as day-today skills sets, work methods and profiles are greened.	Global
20	DG Environment	Links between the environment, economy and jobs	132	GHK, Cambridge Econometrics and Institute for European Environmental Policy	2007	http://ec.europa.eu/environment/enveco/industry_employment/pdf/ghk_study_wider_links_report.pdf	Considers three categories of Environmental jobs - where environment is a primary natural resource, activities concerned with protection and management of environment, activities dependent on environmental quality. Sub-divides these into ten second-level environment-economy linkages. Useful five top-level drivers for environment related economic activities. Very useful paper. Also looks at future drivers (Chapter 8). See also related annexes below.	EU

	Organisation	Title	pp	Authors	Date	URL	Notes	Region
21	DG Environment	Links between the environment, economy and jobs: Annexes	125	GHK, Cambridge Econometrics and Institute for European Environmental Policy	2007	Unpublished. Obtained from DG Environment Library	Annexes to previous document. Excellent annex B linking five high level drivers to environmental activity areas	EU
22	European Commission	The Impacts of Climate Change on European Employment and Skills in the Short to Medium-Term: Company Case Studies Final Report (Volume 1)	156	Adarsh Varma (GHK)	2009	http://ec.europa.eu/social/main.jsp?catId=88&langId=en&eventsId=172	Set of 15 case studies of company responses to climate change. Chapter 2 is a very useful synthesis of the overall findings. The main drivers to date relate to policies rather than the physical effects of CC or immediate competitive pressures. Regulation has been more important than corporate social responsibility policies except for airlines. The main drivers were: CSR and reputation; Competitiveness; Regulation; Physical (e.g. water shortages). Dominant drivers for particular sectors also identified.	EU
23	European Commission	The Impacts of Climate Change on European Employment and Skills in the Short to Medium-Term: A Review of the Literature Final Report (Volume 2)	48	James Medhurst (GHK)	2009	http://ec.europa.eu/social/main.jsp?catId=88&langId=en&eventsId=172	Literature review linked to above report. Identifies three main forms of climate change regulation - 'traditional (standards etc), carbon pricing, innovation policy. Future policy drivers - three main types continue. Quotes McKinsey - four types of regulation required - traditional, carbon pricing, innovation support, measures to ensure potential of forestry and agriculture is addressed (mainly developing countries). Table 32 lists 32 refs and employment estimates extracted from them.	EU
24	European Commission	Commission Working Document - Consultation on the Future "EU 2020" Strategy	12		2009	http://ec.europa.eu/eu2020/pdf/eu2020_en.pdf	Conserving energy, natural resources and raw materials, using them more efficiently and increasing productivity will be key driver for future competitiveness of industry and economies. EC aim for Europe to lead, compete and prosper as a knowledge-based, connected, greener and more inclusive economy. Key drivers of EU2020 should be: Creating value by basing growth on knowledge; Empowering people in inclusive societies - skills innovation, entrepreneurship etc; Creating a competitive, connected and greener economy - lower and efficient energy consumption etc. Targeted regulation, emission trading, tax reform, grants, subsidies and loans, public investment and procurement policies, targeting research and innovation budgets.	EU
25	European Commission	Facts and Figures - the links between EU's economy and environment	14		2007	http://ec.europa.eu/environment/enveco/pdf/facts.pdf	Short pamphlet with various numbers and charts - EU Eco-industry, employment, polluter pays, cost of inaction, environmental policy, international competitiveness and eco-innovation.	EU
26	ILO	Green Economy and Green Jobs: Myth or Reality?	28	David Kucera (presentation at EC Sustainable development meeting)	2009	http://ec.europa.eu/research/sd/conference/2009/presentations/13/david_kucera_-_green_economy_and_green_jobs_-_myth_or_reality.ppt	A good summary of the prospects for green economies in four countries - US, EU27, Germany and UK. Conclusions - a reality for all except UK. References to four 'high quality' studies - US Green Recovery - PERI; EU - Links between environment, economy and jobs (GHK); Germany - Renewable Energy: Employment Effects; UK - Building a Low Carbon Economy. EU 27 core definition of environment related jobs: organic farming, sustainable forestry, renewable energy, water supply and environment related tourism.	EU

	Organisation	Title	pp	Authors	Date	URL	Notes	Region
27	American Council for an Energy-Efficient Economy	The Size of the US Energy Efficiency Market: Generating a more complete picture	58	Karen Ehrhardt-Martinez and John A 'Skip' Laitner	2008	http://www.aceee.org/pubs/e083.htm	Facts and figures on the potential for energy savings and the number of related jobs in the US.	USA
28	American Solar Energy Society and Management Information Services Inc.	Defining, Estimating and Forecasting the Renewable Energy and Energy Efficiency Industries in the US and in Colorado	207		2008	http://www.ases.org/images/stories/ASES/pdfs/CO_Jobs_Final_Report_December2008.pdf	Discusses definitions of green jobs and green industries with examples. Stats on US markets. Three 'scenarios' to 2030, a base case and two others - the moderate and advanced scenarios - based on assumptions that could be translated into drivers.	USA
29	Apollo Alliance	Green Collar Jobs in America's Cities	24		2008	http://www.apolloalliance.org/downloads/greencollarjobs.pdf	A report aimed at communities, talks of 'green collar' i.e. decent green jobs. Create demand by: Public sector investment policies - energy efficiency in buildings, renewable energy in public buildings, green standards in public buildings, build transit infrastructure, convert official vehicles to alternative fuels, plat trees, create green space. Incentives or requirements to drive private sector investment - tax incentives, rebates, streamlined permissions for energy efficiency, renewable energy or green building, technical assistance or innovative financing; green building codes; land use and infrastructure policies to support green manufacturing.	USA
30	European Parliament Policy Department Economic and Scientific Policy	Burden Sharing: Impact of Climate Change mitigation policies on growth and jobs	44	Samuela Bassi and Jason Anderson IEEP and Onno Kuik IVM	2008	http://www.europarl.europa.eu/activities/committees/studies/download.do?file=20894	Literature search plus sector-by-sector analysis of current situation and trends. Good reference section with summaries.	EU
31	European Commission	Investing in the Development of Low Carbon Technologies (SET-Plan) A Technology Roadmap Commission Staff Working Document	56		2009	http://ec.europa.eu/energy/technology/set_plan/doc/2009_comm_investing_development_low_carbon_technologies_roadmap.pdf	Lists main sectoral targets for EU and roadmaps for each. Relevant ones recorded	EU
32	Institution of Environmental Sciences	Environmental Scientist: The Uptake of Emerging Science into Strategic Planning	52	Martin Duckworth, Mark Everard, Joe Ravetz, John Reynolds, Sarah Bardsley, Jennifer de Lurio, Sarah Webb, John Seager and Kathryn Monk	Jul-09	http://www.ies-uk.org.uk/resources/journalarch/envsci2009/env_sci_jul_09.pdf	Global drivers of change for the future, some related to green jobs and new technologies. Relevant ones recorded.	UK
33	UK Commission for Employment and Skills (UKCES)	Scenarios for Skills in 2020, Drivers	24	SAMI (In Confidence)	2009		List of drivers of change, some relevant to green jobs, recorded.	UK
34	Natural England	Global Drivers of Change to 2060 Natural England Commissioned Report NECR030	49		2009	http://www.jmt.org/assets/johnmuir_award/global_drivers_of_change_to_2060.pdf	List of Global drivers of change out to 2060, ones relevant to project recorded.	UK

	Organisation	Title	pp	Authors	Date	URL	Notes	Region
35	Political Economy Research Institute	Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy	38	Robert Pollin, Heidi Garrett-Peltier, James Heintz and Helen Scharber	2008	http://www.peri.umass.edu/green_recovery/	Report describes benefits of a low-carbon economy - widespread employment gains, lower unemployment, renewed construction and manufacturing work, more stable oil prices, self-financing energy efficiency. Defines green jobs as Direct, Indirect and Induced. Gives estimates of job creation figures. Annexes describe the methodology used for estimation.	USA
36	European Commission	Renewable Energy Country Profiles	168	Rogier Coenraads, Gemma Reece, Corinna Klebmann, Mario Resch, Anne Held, Gustav Resch, Christian Panzer, Inga Konstantinaviciute, Tomas Chadim	2008	http://isi.fraunhofer.de/isi/publ/download/isi08b33/progress-renewable-energy-countryprofiles.pdf?pathAlias=/publ/downloads/isi08b33/progress-renewable-energy-countryprofiles.pdf	A detailed EC paper describing the renewable energy profiles of a number of EC countries. Includes national commitments, government investments and incentives and a breakdown of the technologies used in each country.	EU
37	European Commission	Investing in the Development of Low Carbon Technologies (SET-Plan) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions	14		2009	http://ec.europa.eu/energy/technology/set_plan/doc/2009_comm_investing_development_low_carbon_technologies_en.pdf	See 31 above.	EU
38	Technology Review	Solar Energy: New Technologies in Spain	8		2007	http://www.technologyreview.com/microsites/spain/solar/docs/TR_Spain_solar.pdf	Article on the history and future of all forms of solar energy in Spain, includes solar concentrators.	ES
39	Technology Review	Desalination: New Technologies in Spain	8		2007	http://www.technologyreview.com/microsites/spain/water/docs/Spain_desalination.pdf	Article on the history, technology and futures of desalination in Spain.	ES
40	Technology Review	Wind Power: New Technologies in Spain	8		2008	http://www.technologyreview.com/microsites/spain/wind/docs/spain_wind_brochure.pdf	Article on the history and futures of wind energy technology in Spain. A good example of how government incentives can stimulate a rapid expansion in renewables. In this case by Government Decrees.	ES
41	European Commission	Adapting to climate change: Towards a European framework for action. White Paper	16		2009	http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52009DC0147:EN:NOT	Strategy paper on coping with climate change. Section on 'instruments' focuses mainly on financing and insurance but not specifically related to job creation. Reference to European Economic Recovery Plan (EERP).	EU
42	Journal of the American Medical Association (JAMA)	Expansion of Renewable Energy Industries and Implications for Occupational Health	3	Steven A. Sumner and Peter M. Layde	2009	JAMA, August 19, 2009, Vol 302, No.7. pp797-789	A large number of renewable energy technologies are safer in the fact that they reduce or remove the fuel extraction phase. Although this is not the case with biomass. Electrical issues are likely to provide the greatest risk. Other H&S risks of renewables are discussed.	USA

	Organisation	Title	pp	Authors	Date	URL	Notes	Region
43	United Federation of Danish Wokers and the Ecological Council	Green Jobs: Examples of energy and climate initiatives that generate employment	48	Christian Ege, Trine Bang Hansen, Jeppe Juul and Vibeke Ero Hansen	2009	http://ecocouncil.dk/index.php?option=com_content&view=section&layout=blog&id=32&Itemid=177	Paper that outlines a number of proposals to combat the economic and environmental crisis in Denmark. It describes renewable technologies to be embraced, how to change the transport system and energy savings that can be made.	DK
44	Energy Policy	Renewable Energy and Employment in Germany	8	Ulrike Lehr, Joachim Nitsch, Marlene Kratzat, Christian Lutz and Dietmar Edler	2008	Energy Policy. Vol 36. 2008. pp108-117	A paper that outlines the results of a study that models the impact of policies for an increasing share of renewable energy on the labour market in Germany. The net effects of 2 policy scenarios for Germany were calculated to 2030.	DE
45	Journal of Cleaner Production	The Quantitative and Qualitative Impacts of Clean Technologies on Employment	24	M. Getzner	2002	Journal of Cleaner Production. Vol 10. 2002. pp305-319	An Austrian paper that describes the results of a survey of companies in 5 European countries on the impact of clean technologies on all aspects of employment.	EU
46	International Journal of Technology Management	Cleaner Production, Employment Effects and Socio-economic Development	21	Michael Getzner	1999	International Journal of Technology Management. Vol 17. No. 5. 1999. pp522-543	An Austrian study of the employment effects of clean technologies	CH
47	Trade Unions as Environmental Actors: The UK Transport and Workers' Union	Capitalism Nature Socialism	31	Michael Mason and Nigel Morter	1998	Capitalism Nature Socialism. Vol 9. Issue 2. 1998. pp 3-34	Essay which aims to establish the role of British Trade Unionism in extending ecological regulation and in expanding the public discourse of ecological politics. Britain's 2nd largest Union, the Transport and General Worker's Union (T&G) is studied closely in relation to its involvement in environmental issues.	UK
48	Global Climate Network	Low-carbon Jobs in an Interconnected World: Literature Review	14		2009	http://www.globalclimatenetwork.info/uploadedFiles/globalclimatenetwork/low_carbon_jobs_lit_review.pdf	See ref 14 above.	Global
49	DG Environment	Environment and labour force skills	77	Allister Slingenberger et al. ECORYS	2008	http://ec.europa.eu/social/main.jsp?catId=370&langId=en&featuresId=63&furtherFeatures=yes	Report on the potential for environment-related employment in the EU 25, looking at skills requirements and how they will change as jobs change. Identifies the risk of a shift to low skills work associated with new jobs favoured by climate policies.	EU

Annex 2: Drivers for green jobs and potential health and safety risks in green jobs

SOCIETAL		
Demographics		
1	Increasing population	Increasing population, worldwide as well as in Europe, is likely to increase the use of energy and natural resources. Thus population increase drives the need for ever more efforts to improve energy efficiency, sustainable development, recycling and the environmental impact of human activity.
2	Ageing population and workforce	Increasing numbers of older people in the general population and in the workforce will have an impact on energy use and the potential for health and safety issues. Older people tend to use more energy in the home, but less on transport. Older workers may be more susceptible to new technologies and substances in the workplace.
3	Baby-boomer retirement bulge 2010-2020	As many post-war baby-boomers reach retirement there may be a loss of essential skills in the workplace and a resulting threat to health and safety in work generally, including green jobs.
4	More women in the workforce	There may be gender issues associated with new substances and new work processes in green jobs.
5	Increasing urbanisation	Increasing urbanisation of populations may impact on energy use, use of natural resources, pollution etc., driving the need for mitigation measures such as energy efficiency, renewable energy, recycling etc.
6	Increasing single living, driven by family breakdown, lifestyle choices, increasing longevity	Single households are likely to be less energy efficient than multiple occupancy houses, driving the need for mitigation measures such as energy efficiency, renewable energy etc.
7	Increasing levels of obesity	Health and safety risks attributable to obesity in general will apply to green jobs and may be particularly relevant in certain jobs, for example in susceptibility to the effects of new or substitute chemicals.
8	Migration	Shortage of the skills necessary in some green jobs means that migrant labour is being used to fill vacancies. Migrant workers can be at greater risk of accidents and work-related ill health than local staff owing to language and cultural issues. They are also typically more often employed in more risky jobs and in more precarious conditions, benefit less training, etc. and are therefore more at risk. Climate change might modify migration patterns (e.g. owing to scarcity of water in some regions of the world, etc.) and new populations of migrant workers with different characteristics might be found in the EU; or the migration flow might also be modified.
Public Opinion		
9	Increasing consumer and investor concerns about energy and other industry sectors' responsibility.	Public opinion and competitiveness issues could drive Corporate Social Responsibility programmes leading to companies making efforts to operate more efficiently and sustainably. Public opinion, pressure groups, campaigns etc will influence governments.

10	Growing intolerance of risk	The general public's growing intolerance of risk, coupled with their inability to properly assess risk, may lead to a reluctance to adopt new (green) technologies. On the other hand they may favour newer renewable and sustainable technologies over older, dirtier technology. Improved risk communication might affect people's attitudes.
11	People's reaction to climate change and the extent to which they regard human activity as responsible.	If people believe that CO_2 emissions play a major part in global warming, then they will be increasingly likely to support low-carbon energy sources. Climate change deniers will take a different view. Companies and government will be influenced by these views.
12	Public opinion on environmental protection generally.	Public opinion on environmental protection and opposition to activities that damage the environment could drive green jobs in protection. However, shortages of essential natural resources could eventually result in conflict between our material needs and protection of the environment.
13	Generational Attitudes	Social scientists define different cohorts in society – Baby Boomers and Generations X, Y and Z. Each group has different attitudes to and approaches to communication ('digital migrants' compared to 'digital natives'), learning, engagement with politics etc. The younger groups may be more questioning and challenging. They will have different attitudes to environmental issues.
14	Increasing demand for organic food	Increasing demand for organic food is likely to generate more jobs in the production of organic food.
15	Increasing demand for low-carbon and environmentally friendly products and services	Increasing demand for such items and services will driver increases in jobs involved in their production and delivery.
TECHNOLOGICAL		
Technologies for Climate Change Mitigation		
16	Carbon Capture and Sequestration (CCS)	Successful testing and development of this technology will result in increasing numbers of jobs in this sector, although numbers by 2020 may not be great. Although this qualifies as green in that it reduces carbon emissions to the atmosphere, it could be argued that it is not a long-term sustainable solution.
17	Clean Coal Technologies	Successful testing and development of this technology will result in increasing numbers of jobs in this sector, although numbers by 2020 may not be great. Although this qualifies as green in that it reduces pollutant emissions to the atmosphere, it could be argued that it is not a long-term sustainable solution.
18	Renewable Energy Technologies	Developments in renewable energy technologies and/or expansion in these areas would create jobs. The technologies include: wind, wave, solar PV, solar heating, geothermal energy, air exchange method, small-scale hydroelectricity, biofuels, biomass.
19	Other emerging energy technologies	Developments and expansion in novel energy solutions will lead to jobs in those areas. For example, combined heat and power, microgeneration, hydrogen, energy storage technologies, including batteries.

20	Nuclear energy	The extent to which nuclear energy contributes to the future energy supplies will affect the demand for energy from other sources, including green energy sources.
21	Smart Grid Technologies	Development of smart grid technology, resulting in more efficient use of power, would lead to green jobs. Development of a smart grid will require corresponding development of Information and Communications Technologies (ICT) (see below) to control the grid.
22	Development of energy efficient transport.	Increasing development and production of greener transport technologies, for example electric, hybrid and hydrogen (fuel cell or internal combustion) vehicles.
Technologies for Climate Change Adaptation		
23	Coastal defences, Reinforcing buildings, Water management, Harvesting, Adaptation in agriculture - agroforestry.	Efforts to make the most efficient use of land could lead to increased food production and green jobs.
24	Geoengineering	Developments in technologies such as ambient air CCS and ocean seeding, designed to remove carbon from the wider atmosphere as opposed to capture at source, or management or exploitation of methane gas hydrates would create jobs in these areas. Unlikely to be large numbers by 2020. Although these qualifies as green in that they reduce carbon dioxide levels in the atmosphere, it could be argued that they are not long-term sustainable solutions.
Other Environmentally Relevant Technologies		
25	Growth in Waste Management and Recycling	Growth in waste management and recycling activities, driven by declining natural resources, environmental legislation and public opinion. Recycling is a dangerous sector in which to work.
26	Developments in Information and Communications Technologies (ICT)	Increasing use of computers will require more energy. Much software contains redundant code reducing the efficiency of the computers. More energy efficient computers, in terms of both hardware and better software will reduce the inevitable increase in energy use in this area. Computers will be essential for control of, for example smart grid technology and smart appliances, optimisation of energy use in buildings and transport.
27	Development of smart appliances	Alongside a smart grid we will need smart appliances – appliances that can communicate with energy suppliers and take their own decisions about when to switch on and off in order to use electricity at the best price. In an industrial situation there could be risks associated with autonomous machines switching themselves on and off.
28	Developments in robotics and automation.	Robots will increasingly be used to replace humans in dangerous jobs. They may also replace humans in green jobs. For example, use of computerised tractors in farming is already with us. ‘Precision farming’ uses global positioning technology and satellite images to make the best use of land.

29	Nanotechnology	It is likely that nanotechnologies will contribute to green issues in various ways, for example changes in manufacturing resulting in saving of natural resources, novel materials, desalination, changes in food production, carbon nanotubes in new battery designs. New materials and nanoparticles may bring health and safety risks as well as environmental risks.
30	Biotechnologies	Use of Synthetic Biology and genetic modification techniques to generate desired traits in crops and animals may have health and safety implications. Genetic testing could be used to identify those at particular risk from toxic substances.
31	Green Chemistry	Substitution of chemicals for environmental purposes may inadvertently result in changes in health and safety risks.
32	Sustainable Manufacturing	Manufacturing making use of low-carbon technologies, renewable and non-toxic materials, recycling, low waste has strong green credentials, but new methods and new or substitute substances may bring changes in health and safety risks.
	Wildcard:[*] Major incident involving renewable technology	
ECONOMIC		
33	European economic growth to 2020	The state of European economies will have a significant effect on the availability of resources with which to tackle environmental issues. Will the European economy grow? Has the recession ended? Will another global financial crisis occur? Will the European economy be favourable to investment in green technologies?
34	Decreasing oil availability and increasing and more volatile oil prices.	As easy to reach oil resources decline and demand increases, there will be increasing pressure to improve fuel efficiency and to seek alternative, renewable fuel sources. In addition to its transport and heating uses, oil is a feedstock for many industrial processes and so shortage and increasing prices will drive efficiency improvements and use of alternative sources, such as biomass.
35	Decreasing availability of gas and increasing and more volatile gas prices	As easy to reach gas resources decline and demand increases, there will be increasing pressure to improve fuel efficiency, energy efficiency in buildings and to seek alternative, renewable fuel sources. In addition methane from biomass and novel natural sources, e.g. gas hydrates may be introduced.
36	Decreasing price of renewable energy	As the cost of energy from renewable sources decreases, whether as a result of technological innovation or as a result of subsidies and incentives, its popularity and rate/extent of adoption will increase.
37	Shortages and increasing prices of natural resources (other than energy)	Increasing competition for natural resources from emerging economies and increasing use at home will lead to increased efforts in areas such as recycling, more efficient production and reduction of waste. Companies adopting more sustainable business practices to hold down costs by reducing waste.
38	Global Recession	Governments are seeing the need for financial stimulus to deal with the recession as an ideal opportunity to green their economies.

[*] Wildcards are low frequency, high impact events.

39	Globalisation	Globalisation leads to increasing movement of goods and people, contributing to global energy use and therefore driving the need for efficiency. In addition, competition from emerging economies drives cost cutting in Europe resulting in greater efficiency. Increasingly demanding climate change regulations affecting multinational businesses could also drive efficiency gains.
40	Trade liberalism versus protectionism	The current global economy has been enabled by, amongst other factors, increasingly liberal trade conditions. Continuation or re-emergence of recession could drive a return to protectionism. This could affect prices and availability of natural resources, including energy.
41	Shifts in World Economic Power	Emerging economies such as China and India are growing more quickly than OECD countries and their economic influence will increase accordingly. This could lead to increasing political influence, for example China's ability to affect decisions on carbon targets at the Copenhagen conference in 2009.
42	Employment - need to create jobs	Green jobs tend to be more labour intensive. However, some argue that green policies cause a net loss of jobs overall. Others argue that the environmental crisis that could occur as a result of climate change will threaten more jobs than environmental policies. Every green job contributes to greening of jobs in other parts of the economy.
43	The attitudes of insurance companies to developing green technologies.	Businesses need to be able to get cover for speculative ventures.
44	Creation of a suitable financial climate to enable investment in green technologies.	Businesses need to be able to raise capital to invest in green technologies. Many companies involved in this area are SMEs. Legislation to remove investment uncertainty and the availability of credit are essential drivers. Recognition by Venture capital firms that green technology development can give significant business opportunities. Many companies driving renewable energy solutions are SMEs. More established companies can use green technologies to stay at the cutting edge, expand sales and exploit new export markets.
45	Availability of capital for investment	Government action to encourage banks and venture capitalists to back green projects. Government to underwrite borrowing.
46	Market opportunities offered by environmental products	Global market for environmental products and services (efficiency, recycling, water sanitation and efficiency and sustainable transport) is currently €1000 billion, and could reach €2200 billion by 2020.
47	Growth of the EU	Potentially bigger markets for green technology.
48	The need for food security	Increasing energy costs could drive decreasing transport of food and increasing local food production.
49	The need to replace ageing infrastructure.	Ageing infrastructure and networks need replacement over the coming decade, e.g. Electricity grids, New forms of energy generation require new infrastructure. Massive amount of activity required will affect size and shape of EU workforce. ‘Smart’ infrastructure requires manufacture, installation and maintenance.

50	Availability of a sizeable domestic market for green products and services and a requirement for local content	A ready domestic market and a need for local input will make developments more attractive to potential investors.
	Wildcards: New global financial crisis.	
ENVIRONMENTAL		
51	Global Climate Change Initiatives	UN Initiatives - Kyoto, Copenhagen etc
52	EU Initiatives	European Directives and Regulations, including; Directive on the Promotion of the Use of Energy from Renewable Sources (2008); the Biofuels Directive (2003); Directive on the Energy Performance of Buildings (2003); Regulation on CO2 Emissions of Passenger Cars and the Eco-design Directive.
53	National Initiatives	The extent to which individual member states comply with EU initiatives.
54	Increasing responsibility on producers	Extended producer responsibility' laws (requiring companies to take back products at the end of their useful life) for all types of products and the requirement for eco-labels for all consumer products to ensure that consumers have access to information needed to make responsible purchases will encourage manufacturers to design and market more eco-friendly products.
Physical Effects of Climate Change		
55	Increasing frequency of natural disasters and/or freak weather	Increasingly extreme weather will drive public opinion on climate change, strengthening the position of pressure groups and potentially influencing government policies.
56	Increasing need to manage water supplies	Climate change may lead to water shortages in parts of the world, e.g. southern Spain. Activities to store water and to use less water will become increasingly important. Desalination might become more important.
57	Food security	Climate change may drive the need for more efficient and/or more local food production. This could lead to an increase or decrease in jobs, depending on the solutions adopted.
58	Increasing importance of ‘uplands’.	As climate change affects lower lying areas, higher ground might become more important in farming and forestry, possibly bringing new challenges.
	Wildcards: Release of climate change e-mails Increase in natural disasters/freak weather	
POLITICAL		
Government Interventions		
60	Actions to develop education and training to develop the necessary skills.	Many observers fear that a shortage of skills will hamper the development of green activities and therefore green jobs. Action to encourage education in science, technology, engineering and mathematics, to identify the skills gaps and to provide relevant training will promote the creation of green jobs. Skill levels are important to health and safety.

61	Action to ensure that regulation enables rather than stifles development of green jobs. Removal of the barriers to the creation of green jobs.	Ensuring that the regulatory regime is used in the drive to develop greener technologies, products, and services and thus green jobs. For example, faster and easier permissioning procedures for green projects, including land use policies and planning permission, building codes, energy efficiency standards (for appliances, vehicles, etc.), targets for producing renewable energy and proportionate health and safety legislation.
62	A favourable tax regime for environmental activities	Tax incentives for green activities, favourable customs duties. Taxation of high carbon and polluting activities, e.g. aviation and motoring, removal of 'perverse' subsidies on fossil fuel activities in some cases. Shifting of tax from 'goods' to 'bads'.
63	Financial incentives	Grants, subsidies and loans, for renewable and low carbon energy projects, car scrappage schemes, feed-in tariffs.
64	Governments to target recession busting financial stimulus	Many governments are seeing the need to boost their economies in the wake of the global recession as an opportunity to green their economies by targeting environmentally sound activities. In addition to the availability of finance, it may be that costs of major engineering projects will be lower over the next few years as contractors compete for business in a reduced market.
65	Carbon Markets	Carbon Markets: Fixing the current shortcomings inherent in carbon trading and Kyoto Protocol related innovations such as the Clean Development Mechanism so that they can become reliable and adequate sources of funding for green projects and employment. Carbon pricing via EU's Emissions Trading Scheme (EU-ETS).
66	Public sector investment policies	The public sector should lead on energy efficiency by retrofitting energy efficiency measures to public buildings, using renewable energy systems on public buildings and ensuring that new public buildings are built to green standards. It should undertake initiatives to boost public transport and energy efficient vehicles to convert local government fleets to alternative vehicles or fuels. Procurement policies should favour green products and services from local providers.
67	Tax incentives, rebates, reduced fees or streamlined permitting for private building owners that invest in energy efficiency, renewable energy, or green building.	Technical assistance or innovative financing for private investment in renewable energy, efficiency, green building, alternative vehicles or green space. Green building codes, energy conservation ordinances, or other requirements for new green buildings or retrofits of existing buildings. Land use and infrastructure policies to support green manufacturing companies.
68	Existence of adjustment policies	Where jobs may be lost as a result of the creation of green jobs, action to retrain and redeploy displaced staff may reduce the risk of opposition to green job creation.
69	Increased house building to cope with demand	Requirements for new housing to be energy efficient or even 'carbon neutral' will increase the number of green jobs in construction.
	Wildcards: Global instability disrupts supplies of energy and other resources. Terrorism.	

Annex 3: Participants in the interview programme

Professor Øle Busck	Aarlborg University, Denmark
Dr F Jesus Alvarez	European Commission, DG EMPL.F.4, EU Member of EU-OSHA's European Risk Observatory Advisory Group (EROAG)
Dr Andrea Okun	NIOSH, USA
Olivier Salvi	Ineris, France
Professor Sergio Iavicoli	National Institute for Occupational Safety and Prevention, Italy
Professor Jorma Rantanen	Formerly Finnish Institute of Occupational Health
Kären Clayton	Health and Safety Executive, UK
Ian McCluskey	Shell Gas Ltd, UK
Steven Marshall	Scottish Power, UK
Fruzsina Kemenes[5]	Renewable-UK, UK
Dr Michael Sturm	E.ON Climate and Renewables GmbH, Germany
Dr Stefano Carosio	D'Appolonia S.p.A., Italy
Professor Edward Barbier	University of Wyoming, USA
Michael Renner	Worldwatch Institute
Ana Belen Sánchez	ILO
Bo Diczfalusy	International Energy Agency
Anabella Rosemberg	International Trade Union Confederation
Ian Pearson	Futurizon, UK
Jennifer Stack	Inasmet-Tecnalia, Spain
Dr Ivan Ivanov	World Health Organisation
Dr Janet Asherson	International Organisation of Employers Nominated by EU-OSHA's EROAG employers' representatives
Dr Totti Konnola	European Commission, Joint Research Centre - Institute for Prospective Technological Studies, EU
Aida Ponce	European Trade Union Institute, EU Nominated by EU-OSHA's EROAG workers' representatives
Klass Soens	Federation of Enterprises, Belgium
Professor Dietmar Reinert	Institute of Occupational Safety and Health of the German Social Accident Insurance (IFA)

[5] Chris Streatfeild responded for Renewable-UK in the WP 1.3 voting exercise.

Annex 4: Selected extracts from the interviews

The workbook created from the responses to the interviews conducted in WP 1.2 comprised a great deal of information and opinion, far too much for inclusion in this report. A brief summary of the main thrust of the responses to each question was given in Section 5.2.1.3. A few further selected points taken from the workbook are arranged under appropriate headings below, to give a flavour of the material obtained. These are opinions of the interviewees and do not necessarily reflect the views of the project team.

Green Jobs

- Environmentalism and health and safety sit well together.
- Not all green jobs are necessarily safe jobs (although some would say that safety is a prerequisite for recognition as green).
- Green can sometimes mean more risks. For example, waste recycling and treatment are green activities, but jobs in that area are not necessarily nice. In other situations, green activities can reduce risks – for example in coal mining.
- There is a trade off between reduction of risks and environmental protection against innovation and economic growth.

Quote – 'I see a lot of activities that I would call 'sham green'. I would like to see more 'real green' in ten years' time.'

Public opinion

Quote 'Any change comes largely through public opinion – as voters the public are driving the politicians in front of them. For me, public opinion will be most important in coming years. It affects not only politicians but also company leaders – people that are sometimes as influential or even more influential than politicians.'

- Public attitudes are fickle and there is a danger of 'greenwashing', i.e. manufacturers using the green label excessively, sometimes with no justification.
- Some 'bad science' in the climate arena has led to public suspicion of science.
- Disasters will be drivers through public opinion and government response.

Health and safety

- Need to consider OSH by design when developing green technologies.
- Worker Health and Safety should be built in to jobs and processes.
- H&S at work has been a great success and is now part of the culture.
- History is full of [H&S] failures where we look only after things have happened.

Quote ' You might think you know the risk, but technologies often evolve and are put to new uses – new risks can be unforeseen.'

Risks/Technologies

- Risks from moving things near people (wind turbines; marine energy sources; waste sorting; robots).

- Distributed energy production is a very different H&S environment from centralised power stations.
- Carbon Capture and Storage is a big uncertainty.
- Green construction can generate increased risks (fires in passive solar houses could be quite a hazard; asbestos is a big threat retrofitting buildings in Eastern Europe).
- These are not new risks. Science works to a longer timescale than 10 years.
- Rising temperatures lead to new diseases in Europe (e.g. malaria and tick-borne disease).
- Questions over Environmental Sciences (Oceans, clouds, solar activity etc).
- Wind technology has big OSH issues, and solar may be important too.

Quote 'There was a story recently on Belgian TV about a fire in a passive solar house. The fire brigade had real difficulty putting the fire out because the PV panels on the roof could not be broken into like roof tiles, and very thick insulation held the heat and made it difficult for the water to penetrate.'

Politics

- Political initiatives need to be well signalled and with long-term commitments.
- Government must invest in research (e.g. proving whether CCS works).
- Government support must be credible and stable to justify green investments by business.
- Companies are waiting for political decisions to be made before investing heavily in some energy technologies.
- Key question: did politicians dare to introduce strong enough measures to generate change (e.g. carbon taxes etc.)?
- Regulatory powers are often driven by events.

Quote 'Taxes, fiscal cuts and impacts on public services have downstream impacts that are not well understood – and how these affect environmental issues, policies, investment policies and businesses that may provide green jobs, is also not well understood. There is a big unknown there. This will have a significant influence on the speed of green job creation.'

Economics

- Economic growth is a key driver of the future and a major uncertainty.
- High oil prices are making green investments a lot easier at the moment.
- Will green business pay: by being profitable in its own right; because CSR makes good business sense; or through overt or hidden subsidies?

Quote 'Investment needs to go into quality development, not just for a fast buck. There is a real risk of another DeLorean in this area.'

Quote 'I am worried about the economic pressure on green business, which will have an impact on the safety of green workers, resulting in 'lean, mean and green' working practices.'

Quote 'The tension between economics and competitiveness versus corporate social responsibility and branding. That's a moving target. Depending on how well off you are you'll be prepared to buy green. The state of the economy in a recession will impact on this. This is precluding a major disaster, a real game-changer that affects the whole world, that is undeniably caused by climate change.'

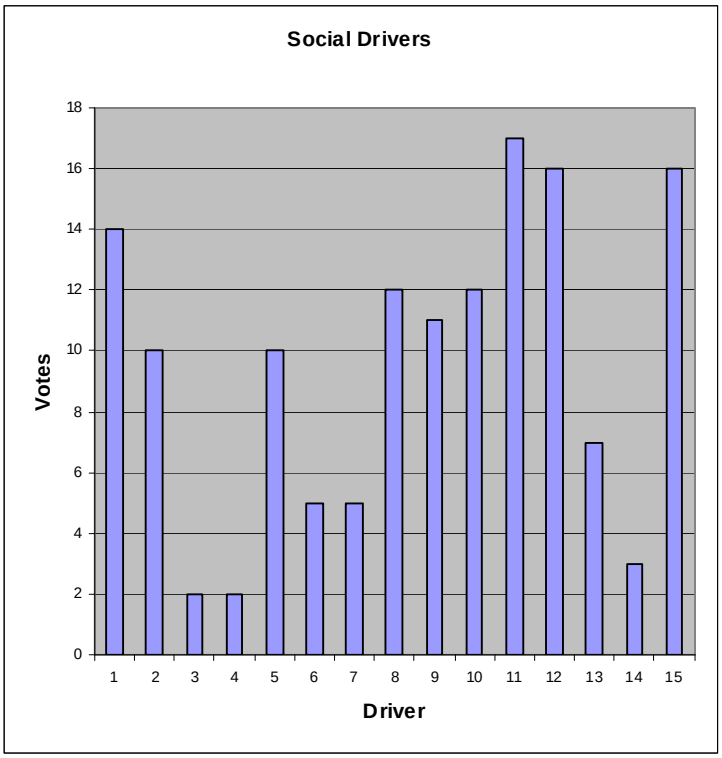
International Issues

- Global sharing of knowledge and technology and globalised standards and values.
- Issues of regulating subcontractors and global supply chains. Technology supply chains will make a huge difference to health and safety risks; for example, will turbine blades be made in Denmark or China?
- We live in a multi-polar world.
- Different priorities between developed and developing countries.
- Companies are delocalizing.
- Europe is being left behind by the rest of the world.

Quote 'We were not able to foresee the enormous boom in subcontracting in our area, which can have a significant impact on degrading and jeopardising conditions.'

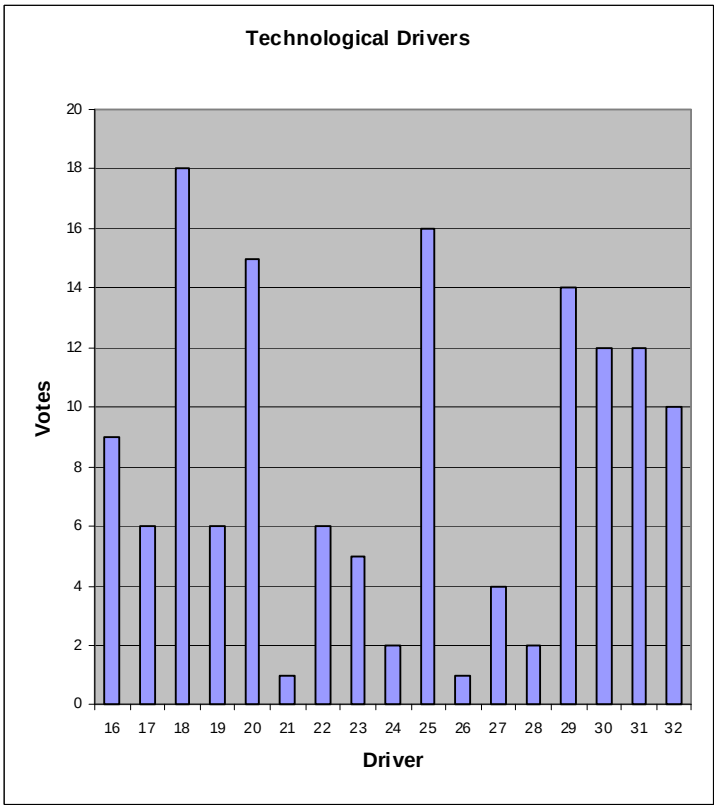
Annex 5: Web WP 1.2 survey results

Figure 2: Results of WP 1.2 voting on social drivers



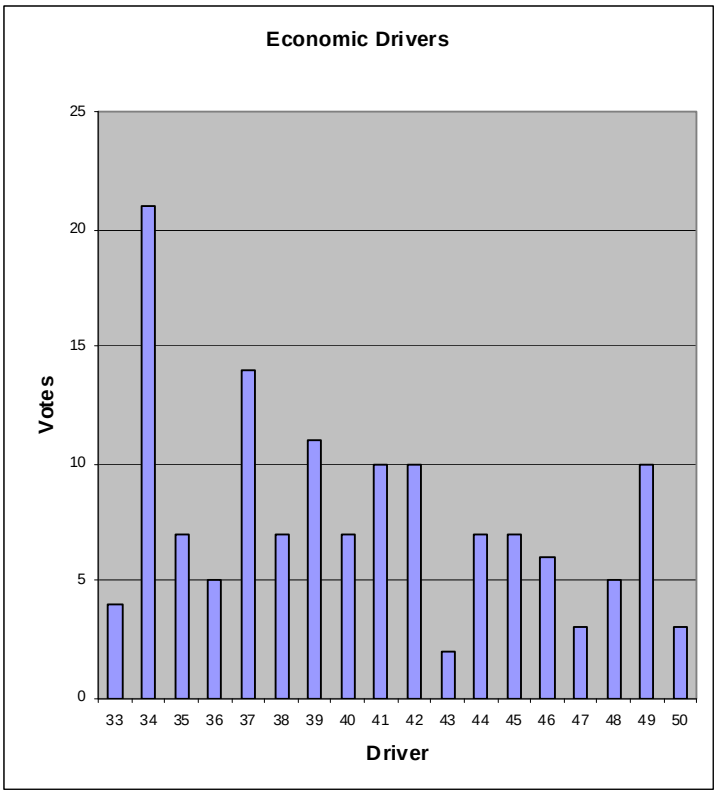
SOCIETAL DRIVERS	
Demographics	
1	Increasing population
2	Ageing population and workforce
3	Baby-boomer retirement bulge 2010-2020
4	More women in the workforce
5	Increasing urbanisation
6	Increasing single living, driven by family breakdown, lifestyle choices, increasing longevity.
7	Increasing levels of obesity
8	Migration
	Public Opinion
9	Increasing consumer and investor concerns about energy and other industry sectors' responsibility.
10	Growing intolerance of risk
11	People's reaction to climate change and the extent to which they regard human activity as responsible.
12	Public opinion on environmental protection generally.
13	Generational Attitudes
14	Increasing demand for organic food
15	Increasing demand for low-carbon and environmentally friendly products and services

Figure 3: Results of WP 1.2 voting on technological drivers



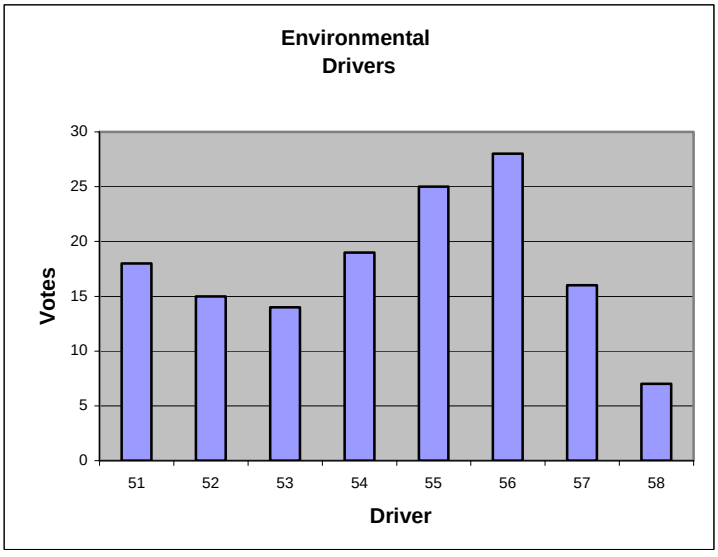
TECHNOLOGICAL DRIVERS	
Technologies for climate change mitigation	
16	Carbon Capture and Sequestration (CCS)
17	Clean Coal Technologies
18	Renewable Energy Technologies
19	Other emerging energy technologies
20	Nuclear energy
21	Smart Grid Technologies
22	Development of energy efficient transport.
	Technologies for Climate Change Adaptation
23	Coastal defences, Reinforcing buildings, Water management, Harvesting, Adaptation in agriculture - agroforestry.
24	Geoengineering
	Other Environmentally Relevant Technologies
25	Growth in Waste Management and Recycling
26	Developments in Information and Communications Technologies (ICT)
27	Development of smart appliances
28	Developments in robotics and automation.
29	Nanotechnology
30	Biotechnologies
31	Green Chemistry
32	Sustainable Manufacturing

Figure 4: Results of WP 1.2 voting on economic drivers



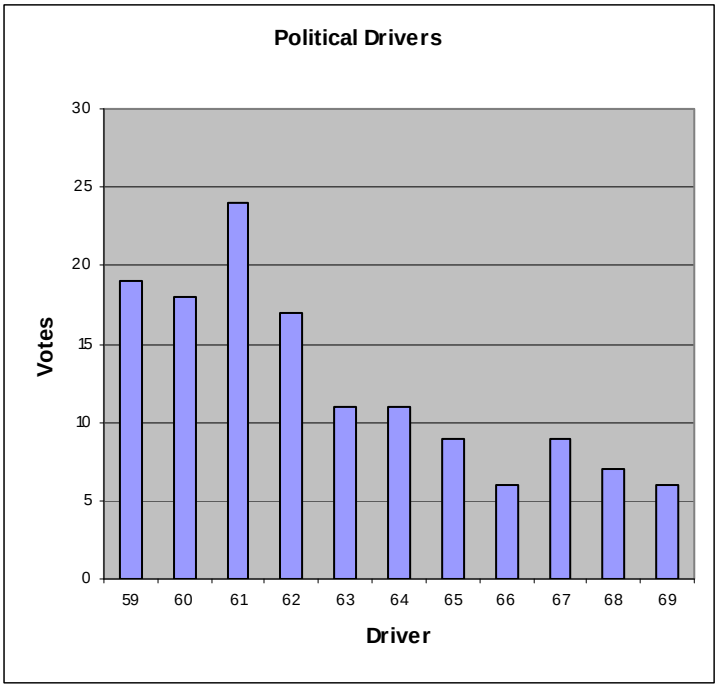
ECONOMIC DRIVERS	
33	European economic growth to 2020
34	Decreasing oil availability and increasing and more volatile oil prices.
35	Decreasing availability of gas and increasing and more volatile gas prices
36	Decreasing price of renewable energy
37	Shortages and increasing prices of natural resources (other than energy)
38	Global Recession
39	Globalisation
40	Trade liberalism versus protectionism
41	Shifts in World Economic Power
42	Employment - need to create jobs
43	The attitudes of insurance companies to developing green technologies.
44	Creation of a suitable financial climate to enable investment in green technologies.
45	Availability of capital for investment
46	Market opportunities offered by environmental products
47	Growth of the EU
48	The need for food security
49	The need to replace ageing infrastructure.
50	Availability of a sizeable domestic market for green products and services and a requirement for local content

Figure 5: Results of WP 1.2 voting on environmental drivers



ENVIRONMENTAL DRIVERS	
51	Global Climate Change Initiatives
52	EU Initiatives
53	National Initiatives
54	Increasing responsibility on producers
	Physical Effects of Climate Change
55	Increasing frequency of natural disasters and/or freak weather
56	Increasing need to manage water supplies
57	Food security
58	Increasing importance of ‘uplands’.

Figure 6: Results of WP 1.2 voting on political drivers



POLITICAL DRIVERS	
Government Interventions	
59	Actions to encourage research and development
60	Actions to develop education and training to develop the necessary skills.
61	Action to ensure that regulation enables rather than stifles development of green jobs. Removal of the barriers to the creation of green jobs.
62	A favourable tax regime for environmental activities
63	Financial incentives
64	Governments to target recession busting financial stimulus
65	Carbon Markets
66	Public sector investment policies
67	Tax incentives, rebates, reduced fees or streamlined permitting for private building owners that invest in energy efficiency, renewable energy, or green building.
68	Existence of adjustment policies
69	Increased house building to cope with demand

Analysis of Respondents

Country	Number
Australia	1
Bangladesh	1
Cameroon	1
Finland	1
France	2
Germany	3
Greece	1
Ireland	1
Italy	2
Latvia	2
Malta	1
Norway	1
Portugal	1
Romania	2
Spain	5
Switzerland	1
UK	17
USA	2
Not Stated	4
Total	49

Sector	Number
Government/Public	19
Private	18
Research/Academic	3
Trade Union	2
Voluntary	1
Not Stated	6
Total	49

Interest	Number
Health & Safety	25
Environment	1
R&D	6
Manager	11
Not Stated	6
Total	49

Annex 6: Invitees in WP 1.3 voting exercise

Fifty people were invited to take part in the voting exercise of WP 1.3. In addition to the 25 interviewees listed in Annex 3, the following were invited:

From EU-OSHA's European Risk Observatory's Advisory Group (EROAG)

Daniel Podgórski	Central Institute for Labour Protection - National Research Institute, Poland Member of EU-OSHA's EROAG
Viktor Kempa	European Trade Union Confederation, EU Member of EU-OSHA's EROAG
Rebekah Smith	Business Europe, EU Member of EU-OSHA's EROAG
Laurent Vogel	European Trade Union Confederation, EU Member of EU-OSHA's EROAG
Erkki Yrjänheikki	Ministry of Social Affairs and Health, Finland Member of EU-OSHA's EROAG
André Pelegrin	Belgian General Constructors, Belgium Member of EU-OSHA's EROAG

From EU-OSHA

Jukka Takala	EU-OSHA Director, EU
Emmanuelle Brun	EU-OSHA, Project Manager, EU

From the Project Team

Dr Peter Ellwood	HSL, UK
Dr Sam Bradbrook	HSL, UK
John Reynolds	SAMI Consulting, UK
Martin Duckworth	SAMI Consulting, UK
Michal Miedzinski	Technopolis, Belgium

Web survey participants from the following organisations

Regional Government of Andalusia, Spain
State Environmental Service, Latvia
European Process Safety Centre, UK
INRS, France
European Commission, JRC-IPTS, EU
Sociedad de Prevencion de FREMAP, Spain
INCDOM - The National Research & Development Institute on Occupational Safety, Bucharest, Romania
French Development Agency
ALP Norway Ltd
Skanska Construction Ltd, UK
National Research Council of Italy
Ministry for Foreign Affairs, Finland

Annex 7: Consolidated driver short descriptions

Environment – carbon dioxide emissions and the physical effects of climate change, including natural disasters and the shortage of natural resources other than energy (for example water) and the need to manage them better, which may drive public opinion and influence government policies.

Government Incentives – having clear and stable energy policies to encourage investment, simplifying planning controls, promoting R&D and offering grants, subsidies, loans, technical assistance and other inducements to promote green activities.

Government Controls – taxes, carbon pricing, removal of subsidies on fossil fuels, legislation and other instruments to penalise polluting activities.

Public Opinion – the public's awareness and views on climate change and the extent to which they believe human activity is responsible, views on other environmental matters and attitudes to risk.

Public Behaviour – the extent to which the public acts to protect the environment with energy efficient practices, with increasing demand for low-carbon and environmentally friendly products and services and by supporting recycling schemes.

Economic Growth – the state of European economies will affect the availability of resources with which to tackle environmental issues and to invest in new technologies.

International Issues – globalisation and the extent to which it grows or possibly recedes in the wake of the recession will affect competition for scarce natural resources, driving the need for green activities.

Energy Security Issues – the need for energy security and the desire to reduce dependency on imported energy will drive energy efficiency and the growth of renewable energy sources.

Renewable Energy Technologies – progress in the development of and the availability of renewable energy technologies.

Fossil Fuel Technologies – the development and availability of technologies to allow continued use of fossil fuels.

Nuclear Energy – whether or not nuclear energy is regarded as green, the extent of its availability will affect the creation of green jobs.

Electricity Distribution, Storage and Use – the development and availability of technology to cope with increased use of electricity in buildings and vehicles, with distributed generation and with the variability of output from renewable sources.

Energy Efficiency Improvements – the construction of energy efficient buildings, the retrofitting of insulation in older buildings and the promotion of public transport use and less energy-demanding manufacturing.

Growth in waste management and recycling - driven by declining natural resources, environmental legislation and public opinion this sector is likely to continue to grow. This is a dangerous sector in which to work.

Other Technologies – technologies other than energy technologies that may offer environmental advantages may also bring H&S risks, for example nanotechnologies, biotechnologies, green chemistry, sustainable manufacturing.

Demographics and the Workforce – increasing population and changing lifestyles, for example increasing urbanisation will drive the need for energy and therefore the need for green activities. Ageing of the population may result in loss of skills with a resulting increase in risk.

Annex 8: Technologies identified in the interviews

Renewable Energy Technologies
Wind
Wave
Solar
Biofuels
Wood-burning

Fossil Fuel technologies
Coal
Clean Coal
Clean Energy
Carbon Capture and Storage
Offshore Rigs
Drilling
Peat

Electricity Distribution and Storage
Distributed Generation
Grid
Smart Grid
Battery Technology
Electric Cars
Hydrogen

Nuclear Energy
Nuclear Fusion

Other Technologies
Air Conditioning
Biotechnology
Biomass
Nanotechnology
Information and Communications technologies
Genetic Modification
Low Carbon technology
Materials Management
Robotics/Artificial Intelligence

Not mentioned – geothermal energy, geoengineering, green chemistry.