European Commission

Scientific support for growth, jobs and sustainability: the example of eco-industries

Brussels, 15 May 2012

Conference report

Joint Research Centre

European Commission

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JRC76026
ISBN 978-92-79-26857-1 (pdf)
ISBN 978-92-79-26858-8 (print)
doi: 10.2788/54159 (pdf)

Luxembourg: Publications Office of the European Union, 2012.

Printed in Belgium

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Scientific support for growth, jobs and sustainability: the example of the eco-industries

15 May 2012, Brussels

Eco-industries provide technologies, products and services that reduce environmental risk and minimise pollution and the consumption of resources.

The Europe 2020 Strategy identifies environmental protection, the promotion and diffusion of eco-innovations and environmental technologies as an important pillar of current and future European policy and stresses their potential for economic growth and employment.

Eco-industries include activities in the sectors of water, air quality, waste, energy efficiency and renewable energy. With their potential for innovation and technological development, the eco-industries create economic growth and jobs at local level. Already, they account for more than 3.4 million direct jobs in the EU. It has been estimated that recycling 70% of key materials in the EU by 2025 could create over 500,000 jobs. In the area of renewable energy, employment in the EU has grown by around 15% annually between 2000 and 2008.

European eco-industries have a turnover of more than €300 billion (2.5% of GDP). The annual growth rate of the EU eco-industry market was about 6% on average between 2004 and 2008 in real terms.

The aim of the conference was to identify where scientific support was needed to strengthen Europe's eco-industries as a source of growth and jobs.

The two key questions the conference set out to address were:

1) Where will new scientific support be needed?
Scientific support, new research and investment are required to develop critical technologies. There are huge needs for basic and applied scientific research by industry, universities and public research organisations. While renewable energy has been

The JRC Conference on "Scientific support for growth, jobs and sustainability: the example of the Eco-Industries" took place in Brussels on 15 May.

the subject of significant research, other areas have been less favoured, such as energy efficiency, food waste and water leakages. There are also needs for more research to better understand the potential of the eco-industries and to improve the quality of data, assess the cost-benefit of different options and understand the important inter-linkages between sectors. Finally there needs to be more research into understanding consumer behaviour, to help facilitate the social innovation needed to power green growth.

2) Where will new standards be needed?
Identifying opportunities for EU standards to become global standards will help EU-based industries. At the same time, it will be important to understand the key changes needed in the regulatory regime for eco-industries in the single market.

Following the conference a cross-cutting foresight study was to be launched, re-grouping water treatment and supply, energy efficiency, solid waste management and recycling, air quality and renewables. The study would take a holistic view, seeking to identify opportunities for new research to boost innovation, growth and jobs from the identification of complementarities between competitiveness and sustainability goals.

Opening session

Opening session

Mr Dominique Ristori, Director General of the JRC, opened the conference by emphasising that the time had now come to decide on action for jobs and growth. The key to this would be finding ways of fully exploiting the potential of industry, while balancing competitiveness with sustainability. The role of science and innovation would be central in this effort, as the required technologies were not yet mature.

Dominique Ristori, JRC Director-General

The JRC, with its function of providing scientific support, was increasingly concentrating on the importance of focused innovation, targeting the most relevant sectors and fixing precise objectives.

In accelerating the shift to a low-carbon, resource-efficient European economy, the eco-industries would be one of the most important sectors. Promoting innovation in the greening of industry would lead to great rewards in terms of growth and job creation. Furthermore, this could be achieved without the risk of 'delocalisation', since the EU was a net eco-industrial exporter and was responsible for more than 50% of global eco-industry trade.

The focus of the day's conference would be on where scientific support was most needed to strengthen Europe's eco-industries as a source of growth and jobs at all levels.

Máire Geoghegan-Quinn, the European Commissioner for Research, Innovation and Science, stressed the enormous challenge facing Europe, with its need for growth and job creation at a time when planetary limits and the fragility of the environment had to be taken into account.

Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science

With the global population set to rise to 9.3 billion by 2050, and 70% of that population forecast to be concentrated in urban areas, there was increasing pressure on resources. At the same time, new sources of raw materials and energy were needed.

But this challenge also brought opportunities. The EU was a major producer and exporter of eco-industry applications, and in many cases a world leader. Together, the eco-industries in Europe had a combined turnover of more than €300 billion, provided some 3.5 million jobs and had global market shares ranging between 30% and 50%. The eco-industries offered a way of boosting European competitiveness and economic development.

But these industries faced global competition – making it vital to invest more in research, science and technology.

- **Water**
  Supplies of clean, plentiful water could no longer be taken for granted. The EU water sector was a major economic player, with turnover of more than €100 billion and 5% growth per year. But much water was still lost through leakage – 60% in some European cities. Desalination offered a way of improving supplies, but it was energy-intensive and needed new technology to make it economically viable. If nothing was done, the world faced a global freshwater deficit of 40% by 2030.
- **Waste management and recycling**
  Europe throws away some 3 billion tonnes of waste every year, with only 40% of solid waste being recycled. This was a scandalous waste – of raw materials, energy and the land needed for landfill. Investment was needed to turn costly waste into profitable new products. The recently launched EU Bioeconomy Strategy contained measures to help with this. 500,000 jobs could be created in Europe by 2025 if 70% of key materials were recycled efficiently.
- **Renewable energy and energy efficiency**
  Renewable energy accounted for 11.7% of EU energy consumption in 2009, and the EU was committed to reaching 20% by 2020. But scientific support was needed to help deliver better technologies in wind turbines, biomass, solar power and biofuels. In energy efficiency, existing buildings offered a major opportunity. Since 90% of today's building would still exist in 2050, upgrading those buildings would generate important savings as well as jobs.
- **Air**
  It was shocking that 40 million people in the 115 largest EU cities were exposed to air that failed to meet WHO quality standards. Technological innovation in transport and the use of renewable energy had a direct impact on air quality. Meeting the EU target of deriving 20% of its energy from renewable sources would help the environment, improve air quality, and could create more than 600,000 jobs in the EU by 2020.

The EU was taking practical steps to support the eco-industries. The Europe 2020 strategy identified these sectors as key contributors to sustainable growth. Innovation Union, launched by Ms Geoghegan-Quinn in 2010, would also play a role, and Ms Geoghegan-Quinn stressed her personal commitment to removing the obstacles preventing innovators from transforming Europe's excellent basic research into products and services that could be successful in world markets. Key requirements for this included faster standard-setting, cheaper and easier patenting, more public procurement of innovative goods and services, and better access to venture capital.

Horizon 2020 and the JRC would also play important roles in supporting the continued investment in science and technology needed to develop Europe's vital eco-industries.

Hannes Swoboda, President of the Group of the Progressive Alliance of Socialists and Democrats in the European Parliament, spoke of the need for a new kind of growth policy for Europe. It was extremely good timing, he said, that this conference was taking place just as Europe was starting to talk about the need for growth.

Hannes Swoboda, President of the Group of the Progressive Alliance of Socialists and Democrats in the European Parliament

Austerity alone would not solve the economic crisis. It was important to combine savings efforts with a genuine growth policy. Why should investment into R&D, and into areas like the eco-industries, be treated in the same way as public salaries and pensions? Of course, salaries and pensions had to be paid, but one form of expenditure was creating jobs and wealth while the other was spending it.
To create the right kind of growth, a key requirement was public investment. This could not be just any

investment, for example into roads that were not needed. It had to be directed into necessary areas such as research and development, or into initiatives like renovating Europe's massive housing stock – a project which would add value both by reducing energy consumption and by creating jobs. Private investment was also needed. Companies needed capital, and they needed banks which would provide it.

This should all take place within the framework of a new industrial policy. Europe had long had a competition policy, but had forgotten about having an industrial policy. This did not mean 'creating industries', but providing a framework within which industry could operate. It was no use, for example, promoting solar energy if most production was coming from China and the net effect was to subsidise Chinese industry. Not enough attention had been paid to the fact that we had to produce the right products here in Europe.

Investing in education and training was important, to help businesses provide not just products but the fully integrated, comprehensive services that customers wanted. While Europe did have high quality people, it was a weakness that so many of the immigrant population did not make it into higher education.

Above all, said Mr Swoboda, high aims were not enough, as Lisbon had shown. Implementation was vital. The danger was that the EU could develop a comprehensive growth policy, and have excellent 2020 aims, supported by all – 'but implemented by very few'.

In the area of energy saving and renewable energy, for example, it was hard to convince Member States that the targets were anything more than a headline since there were no obligations attached. Why did we impose obligations in budgetary discipline but not in energy patterns? The example of the REACH regulations in the chemical industry indicated that imposing obligations could lead to success. Despite initial objections, the European chemical industry had in fact become much more profitable and was now calling for even stricter standards, because REACH compliance had become a source of competitive advantage.

Recycling was another area which contributed directly to competitiveness. An example was the need to recycle rare earth elements. If Europe wanted to be more competitive it had to do much more recycling, even if that led to short-term increases in costs. E-mobility and water management were other examples where more needed to be done.

The combination of industry, politics and ecology was a big chance for Europe, which we should not miss, Mr Swoboda concluded. It was an opportunity to create a growth policy which would have a dual benefit – creating jobs AND a better environment, in Europe and worldwide.

The world's growing demands – environmental, social and economic – and the tensions these caused, meant that we were going to have to re-think our development models, said the final speaker of the opening session, **Dr Marion Guillou**, President and CEO of the French National Institute for Agricultural Research (INRA).

Marion Guillou, President of the French National Institute for Agricultural Research (INRA)

Looking at the role of the eco-industries, it was right to see their purpose as being the correction and repair of the damage caused to natural resources such as water, soil and air. But it was important to recognise that they had an additional, more positive role to play in guaranteeing better use of, and productivity from, those resources – in other words, providing a form of environmental added-value.

Reflecting the new definition of the eco-industries as not only repairing damage but also providing new, value-adding goods and services, the key aspects of the eco-industries could be defined as:

- managing natural resources sustainably
- reducing dependence on non-renewable resources such as fossil fuels
- mitigating and adapting to climate changelimiting waste (e.g. 30-50% of farm

- products around the world were lost or wasted)
- ensuring food and non-food production efficiency

The vital theme underlying all of these aspects was the need, at the same time, to create jobs and maintain European competitiveness. Sustainability was not achievable without economic and social sustainability.

Within this broad description of the bioeconomy, the key challenges were:

- renewable energy sources and biomass
- air pollution, in particular the nitrogen cycle
- energy efficiency
- eco-construction , including the use of new and renewed materials
- waste reduction, management and recycling
- water management – in particular reducing the large amount lost through leakage
- understanding consumer behaviour

The last point was extremely important, since no amount of technological innovation would succeed if there was social opposition. Any innovations needed to be well-perceived and accepted.

In addressing all of these challenges, there was a major potential for research and innovation. Europe certainly had a competitive edge in all the established sectors of the eco-industries, whether it was water, energy or farming and food production. But there was strong international competition to be faced and more innovation would be vital for Europe to maintain its advantage.

One specific example where innovation was required was soil management. Large quantities of soil were lost every year because of urbanisation, erosion and salinity. Soil remediation was a key requirement – but we needed the necessary know-how to achieve it.

Another area was sustainable food production. The world was at a ceiling in terms of cereal production, and yet food needs were growing. Innovation was needed to maintain or improve yield levels.

Renewable carbon was a further example. In France, a recently established project was researching the use of 'white biotechnologies' – using enzymes and microbes to manufacture biofuels. For example, yeast was being used to produce biokerosene.

In the drive to innovation, research and development, Europe of course had a major role to play, guided by the targets set in Horizon 2020. Important in this would be the creation of the necessary infrastructures and databases, the modelling and anticipating of future trends, joint research programmes, and platforms to enable innovation and dissemination. Multinational organisations would also have an important role to play.

Above all, said Dr Guillou, close cooperation would be key, with all stakeholders working together to anticipate, innovate, and create initiatives that were positive not only for the environment but also for the economy.

Science for clean water

Session 1

Science for clean water

According to a recent study by the Water Resources Group, the world could face a global freshwater supply shortage of 40% by the year 2030, said **David Wilkinson**, Director of Scientific Policy and Stakeholder Relations at the JRC and the Moderator of Session 1. The efficient use of water was both a global challenge and an EU one. Many freshwater sources within Europe were at risk of not reaching the 'good ecological status' objective set by the EU Water Framework Directive.

David Wilkinson, JRC Director of Scientific Policy and Stakeholder Relations

In Europe, water management was an important sector for job creation and growth, accounting for around one third of the global water market. It accounted for 600,000 jobs in Europe and was growing at 5% per year. European companies were world leaders, but other parts of the world were making significant efforts to enter this growing market and catch up.

Science could be key to providing effective water management solutions, said Dr Wilkinson. For its part, the JRC was prioritising three focus areas: water saving, water treatment, and the desalination of sea water.

The first speaker of the session, **Mr Patrick Lavarde**, Director General of the French National Agency for Water and Aquatic Environments (ONEMA), focused his comments on the issue of water quantity, rather than quality.

Mr Patrick Lavarde, Director General of the French National Agency for Water and Aquatic Environments (ONEMA)

The world was in a fragile position. Only now were we discovering that water was a limited resource. It was not even clear how much water we had. Rainfall was unpredictable and demand was changing as a result of changing demographies and lifestyles. Already in Europe, one third of the territory was in chronic water shortage, and drought levels across Europe had doubled in the last 15 years.

Water scarcity produced friction between competing users and ways had to be found of prioritising these claims. Clearly, a minimum level of water had to be guaranteed for the basic requirements of life. This was why, in 2010, the UN Assembly had recognised food and water as fundamental human rights.

As water supply was not limitless, we had to manage demand. For that, the overwhelming priority was saving water. Many countries, including France, were now coming up with quite drastic water saving plans. We had to be more efficient in our use of water, and that meant decoupling economic growth from pressures on natural resources.

The strong message to have come out of the recent World Water Forum was that the number one priority for water-saving had to be agriculture – the sector that consumed the most water. With the world's food needs increasing, it was clear that more needed to be done with less.

But it was not only agriculture. The need for efficiency and savings applied across the board. Industry had an important role to play. And if we looked at urban water use, water losses between the water utility and the tap were considerable. To tackle this, France had recently introduced legislation requiring no more than 15% loss through such leakage, and doubling the tax on taking water out of aquifers.

Financial instruments would be an important lever for encouraging efficiency. Household users paid 100% of the cost of their water whereas others, such as agricultural users, only paid two thirds. More integrated policy-making would also be required, since water policy could not be separated from energy or farming policy, as evidenced by increasing recognition of the 'water-food-energy nexus'.

To address this fragile situation, several key areas required more research and innovation. These included:

- climate change and its effects on the water cycle and on variability within the cycle
- ways to reduce water consumption in agriculture
- ways to reduce water consumption in industry
- ways of re-using water
- desalination
- optimal management of urban water resources
- techniques for the detection and tracking of water reserves (e.g. by radar and satellite)
- new techniques for water storage.

To enable this to happen, a great deal of support was needed in Europe for research, development and innovation, to help the industry face growing international competition. This was a key message that had emerged from a session that ONEMA had chaired at the World Water Forum.

It was also important to involve all stakeholders in the process, and to establish the correct arrangements for sharing the risks linked to innovation, for example helping public authorities by adapting public procurement codes and providing financial incentives for sharing risk.

Finally, it was important to link up initiatives at all levels – European, national and regional. The newly launched European Innovation Partnership for water would be an important tool to help with this.

The next speaker, **Gernot Klotz**, Executive Director of Research and Innovation of the European Chemical Industry Council (Cefic), addressed the theme 'Sustainable Water Management in Europe'. To illustrate the current state of water management in Europe, Dr Klotz began by noting that:

Gernot Klotz, Executive Director of Research and Innovation of the European Chemical Industry Council (Cefic)

- Brussels had only recently started treating most of its waste water
- 740 bathtubs of water were needed to make a single new car
- For 2030, an increase of 15% was expected in irrigation water requirements
- 33% of fresh water was lost in London through leaks in the supply pipes – and in some Italian cities the proportion was as high as 70%.

The present situation was a challenge but not yet a crisis. There was still time to take action to tackle the challenges. These were:

- the scarcity of fresh water
- increasing demands
- unsustainable systems
- energy use in the water industry
- unsustainable dependence on water.

In order to achieve a sustainable and competitive Europe, the 'water objectives' were clear.

- No European citizen should lack clean water and sanitation
- No economic activity should be disturbed by water problems
- No water should be affected by human activity.

While innovation required investment, it was mainly about mindset change. The water challenge went beyond the water sector alone, but there was a danger of Europe remaining rooted in old silos and patterns of behaviour. If we did not link up we would not be able to use the strengths of Europe. While we were still thinking about innovation, other parts of the world, like China or the US, were moving ahead.

In Europe today, industrial, agricultural and urban water usage were isolated from each other. A more symbiotic approach was needed, driven by bio-based technologies, to maximise the potential for waste water treatment, materials recovery and water re-use. Every drop of water counted and we had to use it several times. There would be no bio-economy if we did not solve the water recycling problem.

The chemical industry's potential to contribute to innovation was huge. It included developing corrosion-resistant and antibacterial materials to aid water quality, along with new processes for removing salts, pollutants and microorganisms. In terms of water quantity, the industry was focused on designing new, less water-dependent industrial processes and cooling systems, along with new biomimetic methods for seawater desalination. Meanwhile, the design of closed-loop industrial processes such as energy extraction and re-use would boost energy efficiency.

The potential impact was significant. Using modern piping materials and techniques could save 40% of the water used for irrigation. Reducing leakages in supply systems through corrosion-resistant materials, smart meters and real-time monitoring could achieve 50% savings. And nano-membranes for water treatment could save the energy generated by four nuclear reactors.

The chemical industry was fully committed to innovation in Europe. But research alone was not innovation. It was important to bridge the gap between research and markets, turning the results of research into value-added products and services.

In addition, cooperation along the value chain was essential. The chemical industry could provide innovative materials, but there needed to be demand for them.

Academia, industry and policy-makers could not do it alone either. There needed to be strong commitment and frameworks, not just 'visions'.

Areas in which science could provide important support were:

- studies on the impact of integrated water management across Europe
- scenarios for optimal use of water in various sectors (e.g. not using drinking quality water for irrigation)
- harmonised standards and methods across Europe
- predictive tools for material quality – since innovative materials did not have long histories of established use

Dr Klotz concluded with a quotation from the 18th century German philosopher Georg Christoph Lichtenberg: 'I do not know if what I propose is enough, but I know that things have to change to get better.'

The final speaker of the session, **Dr Nick Hankins**, Director of the Centre for Sustainable Water Engineering at the University of Oxford in the UK, highlighted the current priorities driving the technological research needed to ensure clean water supplies.

Dr Nick Hankins, Director of the Centre for Sustainable Water Engineering at the University of Oxford

The fact was that there was plenty of water on the planet, said Dr Hankins. The problem was that most of it was salty, or in the wrong place, or available at the wrong time. The result was that we had to use what water we had in a better way. Technology therefore had to focus not only on ways of providing clean water, but also on ways to enable more efficient use of water.

There were several clean water challenges confronting the world:

- 1.1 billion people had no access to safe drinking water, and 2.6 billion had no proper sanitation
- 2.2. million deaths a year were related to issues of water, hygiene and sanitation, many of them young children
- 97% of the world's water was in the ocean and the world's fastest growing cities were within 100km of the coast. With water shortages set to limit economic growth and food production, we would have to turn to the ocean for our water supplies, even if there were sustainability challenges in that
- even though water resources were under pressure, new reservoirs, wells, pipelines and river transfers were not sustainable economically, socially or environmentally
- a new range of contaminants and pollutants was emerging as EC regulations were tightened
- lower-energy, sustainable technologies were urgently needed for desalination and wastewater treatment
- water-stressed regions had to rely increasingly on brackish underground water, sea water, or water recycling and re-use.

In response to these challenges, the priorities for scientific research relating to water could be grouped under three headings.

Sustainability and new technology
While many in industry and academia saw sustainability largely in terms of efficiency, it was important also to recognise the needs of the environment and of equity – in the form of social justice both today and in the future.

A key focus was the need both to develop existing processes and to devise new ones for the treatment of raw drinking water and the desalination of ground water and sea water. These processes had to be low cost, with a low environmental and carbon footprint. Two research areas showing great promise were nanotechnology and membrane separation technology, with both indicating clear potential for significant energy savings over existing methods.

Waste water and industrial usage
The emphasis here was on reclaiming, reusing and recycling water. We had to change our mindset and start seeing waste as a resource, providing raw materials and energy. Membrane bio-reactors were a potential great leap forward, able to treat water in the same way as existing technologies, while also providing drinkable water as part of the process.

Other priorities for research focused on finding ways to remove contaminants. These included micro-contaminants such as endocrine disrupting compounds, trace heavy metals, or the potentially toxic or carcinogenic by-products of disinfectant use, as well as contaminants such as nitrates and phosphates from agricultural run-off.

Water as a resource
With the climate changing and water resources shrinking, key focus areas for research included the recharging and remediation of ground water, and new technologies for leak detection and real-time quality monitoring in water distribution systems.

The key driver of clean water research, concluded Dr Hankins, was increasing demand for a finite resource. Clean water technology was a priority for the 21st century, with membrane processes and nanotechnology offering the greatest potential for sustainable progress.

Bringing the session to a conclusion, **Dr Wilkinson** noted that a key point emphasised by all of the speakers had been the fact that water was not a problem that could be solved on its own. It had to be seen in a single, coherent perspective which embraced all resources, in particular energy. The speakers had also made it clear that the issue of water resources was one of the key challenges for the 21st century. The fact that 97% of the world's water was still not usable because it was in the sea was a problem that had to be tackled. Finally, Dr Wilkinson said, there was considerable potential for 'joined-up thinking' between the renewable energy sector and the water sector.

Science to improve air quality

Session 2

Science to improve air quality

Opening the session on air quality, the Moderator, **Professor Leen Hordijk**, Principal Adviser to the Director General of the JRC, noted that activities in this sector amounted to less than 3% of the total turnover generated by the eco-industries. Why was it so small? Referring to an OECD study some two years earlier, which had listed the characteristics of environmental policy which were likely to induce innovation, Professor Hordijk highlighted three of the five factors the report had identified:

1. the stringency of the policy and the requirements it made of the industry:
2. the predictability and stability of the policy:
3. the extent to which policies encouraged innovators to look across a wide area for a diversity of possible solutions.

Professor Leen Hordijk, Principal Adviser to the Director General of the JRC

The first speaker, **Gunnar Söderholm**, Head of the Environment and Health Administration of the City of Stockholm, addressed the topic of smart cities.

Stockholm was proud to have been the first Green Capital of Europe in 2010, said Mr Söderholm. Stockholm was also a growing city, with expected growth of some 25% in the next 20 years. This growth created challenges, making the city denser and home to more businesses. But its experience showed that a denser city could also be a sustainable city.

Gunnar Söderholm, Head of the Environment and Health Administration of the City of Stockholm

Crucially, public support was strong. In a recent survey, around 90% of Stockholmers said it was 'very good' that Stockholm pursued an active environmental programme. Even more importantly, as well as voicing general support, they were also strongly in favour of the city making greater demands on citizens to live in an environmentally friendly way.

Stockholm was not entirely without problems. Concentrations of PM10 particles still exceeded EU limits on occasions. In the case of Stockholm, the use of studded winter tyres was the dominant source of PM10. The city was considering ways of addressing the problem – and its performance in terms of numbers of days per year exceeding EU permitted average levels was improving. A similar picture – of occasionally raised levels but an overall year-on-year improvement – was true of nitrogen dioxide levels.

The single biggest reason for the improvement in Stockholm's air quality, said Mr Söderholm, was the extension of district heating and the co-generation of heat and power, fuelled in large part by biofuels and waste. 80% of homes were now connected to district heating. As a result, emissions had been reduced by 99% compared to 1960 levels.

Other factors which had played a part in improving air quality in Stockholm included the introduction of congestion charging to the inner city in 2006. This had led to a 20% decrease in traffic and a 10-14% decrease in emissions. Most notably, initial strong opposition, with 80% of Stockholmers being against the charge before its introduction, had turned into a 67% majority in favour today.

A rise in the number of clean vehicles had also played an important role. As a result of a 20-year programme, some 40% of Stockholm's vehicles now qualified as 'clean' and the city was now aiming towards the introduction of 'super-clean' vehicles, with a plan to introduce electrical and biogas-powered models. Volvo was planning to introduce a plug-in hybrid vehicle in 2013. In the public transport arena, Stockholm already had the world's largest ethanol bus fleet in the world, and it was working to achieve fully fossil-free public transport by 2022.

Overall, Stockholm had seen a 100-fold improvement in air quality since 1960. This effort had not started as a 'green' movement. It had begun more as a social movement, based on engineering and rational thinking, with broad support across the entire political spectrum. And its success was clear, with surveys showing the citizens of Stockholm providing increasingly positive assessments of the quality of the environment of their city.

As a graphic illustration of the progress Stockholm has made, Mr Söderholm displayed a graph showing daily emissions during 2011. A dramatic spike in levels appeared for one day – a day on which a single road in the city had hosted a vintage car race featuring cars from the 1960s and 1970s. In those decades, Mr Söderholm stressed, every day on the graph had looked like that. Children in Stockholm today were breathing much better air today than had been the case then.

The second speaker of the session was **Dr Irene Feige**, Director of the Institute for Mobility Research (ifmo), a research establishment of the BMW group. Speaking on the subject of the future of mobility, Dr Feige said that, with 70% of the world's population forecast to be living in cities by 2050, urban mobility was the key issue.

Dr Irene Feige, Director of the Institute for Mobility Research (ifmo)

But cities were all very different and would require different approaches to mobility. For example, although 'mega-cities', with more than 10 million people, tended to be talked about the most, in fact the largest share of urban population was in cities of up to 500,000 people. And major growth was occurring in cities of up to 5 million inhabitants.

It was also important to understand the linkage between air quality, carbon emissions and wealth. As wealth increased, urban air quality initially declined as industrial activity and transport expanded. But air quality then improved as better technologies emerged. The same was not true of carbon emissions, however. Carbon was not decoupled from wealth but continued to increase along with wealth levels.

A recent study of 42 cities around the world, conducted by ifmo, had shown that, at relatively low levels of GDP, cities fell into one of two categories – either 'non-motorised' or 'paratransit' (where motorised transport took the form of mostly illegal taxis). As GDP rose and cities went through a period of mass motorisation, they became 'traffic saturated' – with a high level of private vehicles but no alternatives in the form of good public transport.

What was of crucial importance for the mobility of the future was the development phase that cities entered after mass motorisation, said Dr Feige. The ifmo study had shown three possible scenarios, closely linked to levels of population density:

- **Transit**
  The 'transit' city was a city of high

population density, very much oriented towards public transport – e.g. Tokyo.

- **Auto**
  Cities of very low density with a heavy reliance on private motoring – e.g. Atlanta.

- **Hybrid**
  Cities with high density at their centre but with less dense suburbs – e.g. most European and some US cities.

Each of these city types would require different solutions, which would in turn determine the potential contribution to be made by the eco-industries.

In traffic saturated cities, the main challenges were the need to improve air quality and make best use of infrastructure capacity. The requirements were for clean vehicle technologies, intelligent transport system (ITS) technologies, and improvements in public transport.

In hybrid and auto cities, air quality levels were typically much better than in traffic saturated cities, but carbon dioxide emissions and energy use needed to be reduced. The needs here were more centred on efficient vehicle development, alternative engines, ITS technologies, and – in auto cities – improvements in public transport.

In the light of the above, and turning to the key question of the conference, the areas in which scientific support and research were most needed were:

- the interlinkage between the energy and transport sectors
- how to improve the linkages between different modes of transport in order to achieve a more multimodal approach to mobility
- social science research to understand the different mobility needs between cities and geographical regions
- studies in consumer behaviour

In conclusion, said Dr Feige, there was significant potential for the eco-industries in urban areas, where 80% of global GDP was generated, and where 60-80% of global carbon dioxide emissions occurred. That potential would be the greatest in traffic saturated cities, hybrid cities and auto cities.

The final speaker of the session, **David Fowler**, Senior Scientist at the Centre for Ecology and Hydrology in the UK, outlined the need for basic and applied science research to improve air quality. With EU Air Quality policy undergoing a review, and many cities in Europe exceeding permitted limits, this was a good time to discuss scientific research needs.

David Fowler, Senior Scientist at the UK Centre for Ecology and Hydrology

Basic and applied research was vital for the understanding of the factors affecting air quality, and to be able to quantify the consequences of policy intervention before decisions were made. Three examples would help to demonstrate this – one in which good research had underpinned a policy success, resulting in controls that were effective, and two examples where policy had been less effective

Acid rain
Air quality was not a new problem. The London smog of 1952, resulting in 12,000 excess deaths, had led to the first air quality legislation – the removal of the power stations which were the source of the pollution from cities to the countryside. The same example had been followed in other European countries. This had led, however, to acid rainfall in Sweden – a discovery which triggered a process of strongly science-led research into the phenomenon of trans-boundary air pollution issues.

In time, the research led to the UN Convention on Long-Range Transboundary Air Pollution, signed in 1979. The result had been reductions of up to 95% in sulphur emissions around Europe, and a major decline in ecosystems still deemed vulnerable to acidification. Acid rain had broadly been a policy success story, underpinned by high-quality science.

Ground level ozone
Ground level ozone, however, remained a major problem. It was responsible for some 20,000 premature deaths in the EU, 20 million hospital days due to respiratory problems, and €6.7 billion of arable crop loss. With forestry showing similar sensitivity to ozone levels, there was also an impact on carbon sequestration and therefore on climate change.

The ozone problem continued despite the fact that Europe had approximately halved the levels of the two pollutants responsible – VOC's and NOX – since the 1970s, and also achieved a decline in peak ozone levels of around 30%. Despite these achievements, mean ozone values had been steadily increasing for the last 30 years.

The reason for the increase was that Europe was not alone in the northern hemisphere in producing the ozone-creating pollutants. Ozone was able to travel long distances from sources outside Europe. Policy controls therefore needed to be agreed and implemented at hemispheric level.

Particulate matter
Although progress was being made in tackling the issue of reduced life expectancy due to fine particles in the air, there was still a problem. While we knew a lot about particles, there was still a lot that was unknown – for example, which chemical species in particulate matter were responsible for the health effects. The policy response was therefore limited to reducing the overall mass of particulate matter.

Issues which needed further research, and which would feed into the current EU Air Quality review, included identifying which size of PM was most important for regulation, the link between aerosol composition and health effects, the most important sources to control, and whether PM hot spots or general background levels should be the priority for control.

Looking to the future, concluded Dr Fowler, many scientific challenges remained for areas such as ozone and PM. There was also a need for policies on air quality and climate change to be complementary. The two issues were very closely linked – yet the tendency was for the people working on these issues to be separated in different institutions and ministries.

Bringing the session to a close, **Professor Hordijk** remarked that the important role of the social sciences was a point that emerged very clearly from the session, as shown by the need to understand consumer preferences regarding transport, or the attitude of Stockholm's citizens to congestion charging. As well as the challenge to develop better technologies, there was also the challenge of understanding public attitudes. While pricing was one factor, the issue was clearly more complicated than just that.

Waste management

Session 3

Waste management

Opening the session, the Moderator, **John Bensted-Smith**, Director of the JRC's Institute of Prospective Technological Studies, said that some of the statistics relating to waste management were astonishing. In the EU alone, 3 billion tonnes of waste were generated every year, with only 40% of solid waste being recycled. It was also a growing industry, with the OECD forecasting that the world would be creating 45% more waste in 2020 compared to 1995 levels.

John Bensted-Smith, Director of the JRC's Institute of Prospective Technological Studies

Not only was it a 'sunrise' industry, it was also one in which Europe was at the forefront, with a 50% share of world markets. Waste management was clearly a central point for our attention if we were going to achieve anything in the eco-industry sector.

The first speaker of the session was **Peter Kurth**, President of the European Federation of Waste Management and Environmental Services (FEAD), whose members include the national waste management federations of 20 EU countries, representing 3,000 companies involved in all forms of waste management.

Mr Kurth stressed the valuable contribution the private waste management industry could make to Europe, and outlined the conditions that were necessary to achieve the best results.

Peter Kurth, President of the European Federation of Waste Management and Environmental Services (FEAD)

The industry had the expertise and competitive skills to play a key role in helping the EU to realise the ambitious target it had set of turning Europe into a 'recycling society'. Already, it had enabled Europe to have the highest recycling rates in the world, the most efficient waste processing, and the highest environmental standards.

Innovation was vitally important to the waste management industry. FEAD had financed numerous research and innovation initiatives, such as the recycling of copper, indium, gallium and selenide from solar cells. Some members were now assessing the potential of landfill mining, with closed landfill sites in Germany alone estimated to contain some 40 million tonnes of different metals.

The potential offered to Europe by the waste management industry was enormous. On average in the 27 EU member states, 16 tonnes of materials were used per person per year. Of these, 6 tonnes went to waste, of which half went to landfill. Between 20% and 30% of these resources had to be imported, and €5.25 billion of recyclables such as paper, glass, aluminium and steel were disposed of every year.

If these materials were recycled, the equivalent of 148 million tonnes of CO_2 emissions would be avoided. And 500,000 new jobs would be created if 70% of waste were recycled across the EU.

The recycling industry was a source of valuable materials to manufacturing, supplying 50% of paper, 43% of glass and 40% of non-ferrous metals.

Reflecting the emphasis placed on green growth in its Horizon 2020 strategy, the EU was in a position to provide a major push to the research and innovation that was necessary. Particular areas where future scientific support for innovation was required included technologies for rare earths recycling, photovoltaic panels and landfill mining.

Also needed were changes in the regulatory regime for eco-industries in the single market. These included:

- fair legislation on public procurement, removing special privileges for cooperative ventures between public authorities
- uniform VAT rates between public and private sector companies
- stricter implementation of existing legislation across all EU member states. This was currently very patchy, with some countries still landfilling the vast majority of their waste. EC proposals to link future funding for waste management projects to better compliance was a welcome step.

FEAD also supported initiatives to establish better standards – for example stricter inspection standards to combat illegal waste shipments, high quality recycling standards, and minimum treatment standards.

In conclusion, said Mr Kurth, the waste management industry was able to make an important contribution to jobs, growth and sustainability in Europe. But to achieve this, it needed innovative technologies, the right framework conditions and common standards. For this reason FEAD welcomed the conclusions of the European Parliament's recent Report on a Resource Efficient Europe. These conclusions included an emphasis on the role of the private sector, asking the European Commission and the Member States to boost research and innovation in recycling and waste management, and called for support for investments in new techniques and new business models.

FEAD looked forward to contributing significantly to an innovative European 'recycling society', and helping to make Europe the most resource-efficient continent in the world.

The second speaker of the session was **Ross Bartley**, Director of Environment and Technical Affairs of the Bureau of International Recycling (BIR).

Ross Bartley, Director of Environment and Technical Affairs of the Bureau of International Recycling (BIR)

Mr Bartley outlined the substantial part played by recycling in providing raw materials to manufacturers, saving resources including energy, and creating jobs and sustainable growth. He then went on to identify key areas where further research and innovation were needed.

Worldwide, the recycling industry employed more than 1.6 million people, processed 800 million tonnes of commodities, and had an annual turnover of more than 200 billion US dollars.

Of total world steel production of 1.3 billion tonnes, 520 million tonnes was produced from recycled scrap metal. Scrap metals provided almost 45% of global stainless steel production, 40% of copper, 30% of zinc and 25% of aluminium. Looking at other commodities, 50% of worldwide paper production came from recovered paper and board, and 90% of collected textiles were reused or recycled.

The energy savings achieved through recycling could be dramatic. Using recycled materials to produce aluminium resulted in energy savings of 95%. For plastics the figure was 80%, and for paper, 64%. Altogether, recycling saved over 500 million tonnes of CO_2 emissions.

Innovation in the recycling industry was driven by legislation. In Europe, the Waste Framework Directive, Waste Shipment Regulations and End-of-Waste Regulations were the primary drivers. The main Directives relating to the specific materials entering the recycling industry were those on End-of-Life Vehicles, Waste Electrical and Electronic Equipment, Batteries and Accumulators, and Packaging and Packaging Waste.

Mr Bartley welcomed the fact that the important role of recycling had been endorsed in the 2011 EEA report, which had stated that:

- recycling created more jobs at higher income levels than landfilling or incinerating
- the booming Asian economies and EU Directives had boosted European recycling
- there was a need to improve product design to make recycling easier
- the growing recycling industry helped to generate 'green jobs'.

Taking the car industry as an example, Mr Bartley described the recycling process, which included depolluting the end-of-life vehicle (removing batteries, fluids and lead where possible), before the vehicle was sent to the shredder to be turned into scrap metal. It was the shredder that offered particular potential for further innovation. More sophisticated sensing and sorting machinery was now starting to allow better extraction of different materials which otherwise would go to landfill.

But it was not just technological innovation that was needed. Innovation was needed in several areas, including:

- *Collection*
  consumer behaviour needed to change, so that more items entered the recycling process, like old mobile phones. Consumers also needed to do more separation of materials
- *Pre-treatment*
  goods had to be designed with more focus on facilitating the separation of materials
- *Markets for recycled materials*
  there needed to be markets for items like leaded glass from old cathode ray tube computer monitors, and other 'difficult materials'
- *Legislation and technologies to support implementation*
  for example, ways of distinguishing more effectively between goods for re-use and end-of-life goods under the Waste Shipment Regulations – perhaps by RFID tagging
- *Innovation in recovery facilities*
  such as the use of less aggressive chemicals in hydro-metallurgical operations

Other areas requiring innovation included sorting and processing, trading, and EU-level financial instruments.

Having outlined the significant role already played by recycling, Mr Bartley concluded with a graphic illustration of how much potential still remained – an image of the Periodic Table on which no fewer than 34 metals were coloured in red. The red indicated those elements for which average end-of-life recycling was still below 1%.

The final speaker, **Luis Delgado Sanchez**, Head of the JRC's Sustainable Production and Consumption Unit, focused on the role of applied science and research in supporting policy-making to enhance the effectiveness of waste management in a changing technological, economic and social landscape.

Luis Delgado Sanchez, Head of the JRC's Sustainable Production and Consumption Unit

The four main drivers of progress in waste management were environmental concerns, market forces, legislation and technological and scientific development. It was important to understand the interactions between these factors.

Although waste management brought environmental benefits, it still produced greenhouse gases – accounting for 3.2% of the EU-27 total. Economic growth had not yet been decoupled from the environment. But encouraging progress was being made.

The municipal solid waste sector had been steadily reducing its emissions and was on track to become GHG neutral, and potentially even GHG negative.

This reduction in emissions had been largely generated by pioneering EU Directives in the 1990s and early 2000s. But the regulations had been created at a time when the key aim was to divert waste from landfill. The high net costs of collecting and recycling had not been the focus. Those costs were significant – but there was also an ever greater potential for revenue generation, as treatment technologies and markets for waste materials developed. For an increasing number of waste streams it was becoming possible to at least break even, or even make a profit.

This situation created the context in which further research and policy had to be considered.

In a situation far more complicated today than in the early days of waste management, one key topic for research had to be the frameworks and incentives necessary to generate the maximum benefits of recycling. More data and analysis was needed to answer questions such as:

- how can deregulation (such as end-of-waste) make recycling markets work better?
- where in product life-cycles and the recycling chain are incentives most effective?
- what role can product eco-design requirements play?
- what is the most efficient role for producers, households, waste collectors, processors and recyclers?
- how effective can consumer-oriented measure be in reducing waste?
- how should the costs of treatment be shared?
- how should the benefits of recycling be distributed?

Further research was also need to define when approaches like Life Cycle Thinking justified a departure from the established waste hierarchy. Depending on specific circumstances, Life Cycle Thinking might deliver the 'best overall environmental outcome' outlined in the new Waste Framework Directive, but there was no clear understanding yet of how those circumstances should be defined.

Applied scientific research was needed in areas such as end-of-waste. This was an important concept which could stimulate recycling markets by releasing valuable resources from waste status. But more science was required, for example in setting acceptable pollutant limits based on standard measurement values, and in determining the suitability of input materials and the treatment technologies employed.

A final key area requiring scientific research concerned the 'critical raw materials' referred to in a European Commission report of 2010. Including elements such as gallium, indium, germanium and cobalt, many of these were critical raw materials for important emerging technologies, such as fibre optics and photovoltaics, and their scarcity could jeopardise the EU's future technological and economic development. Yet, as the previous speaker had shown, less than 1% of these materials were currently recycled.

In conclusion, waste management had an important part to play in decoupling economic growth from the environment. Technological development and policy development went hand-in-hand; each supported and stimulated the other. And both needed to be supported by applied science and research.

Renewables

Session 4

Renewables

Opening the session on renewables, the Moderator, **Paul Rübig**, a member of the European Parliament and a member of its Committee on Industry, Research and Energy, said that, given the EU's 2020 targets for both renewable energy usage and CO_2 reduction, and a background of rising future demand for energy, efficiency was going to be paramount. Efficiency of production would play an important role, but another priority area would be the development of eco-efficient transport. With the global population rising rapidly, ensuring both security of energy supply and freedom of movement were important goals. But it was not just transport. Energy usage in areas such as industry and housing would also need to be examined closely. The job of the European Parliament was to help set a strategy with the right targets and standards, with renewables playing a key role in overall energy policy, in order to ensure that energy was as cheap as possible, as efficient as possible, and as sustainable as possible.

Paul Rübig,
Member of the European Parliament and member of the Committee on Industry, Research and Energy

Arthouros Zervos, President of the European Renewable Energy Council (EREC), issued a call for a more ambitious renewable energy target for Europe, supported by the necessary efforts in science and research. Without this, it would be difficult for Europe to achieve energy sustainability.

Arthouros Zervos,
President of the European Renewable Energy Council (EREC)

With EU unemployment at record levels, the economic outlook gloomy, and emissions on the rise, it was high time to emphasise the role of the eco-industries in boosting growth, creating jobs and reducing greenhouse gases.

Plans already in place, at both EU and Member State levels, to achieve the EU 2020 target of reducing CO_2 by 20% compared to 1990 volumes showed that renewables would play an important role. The projected use of renewable energy would reduce energy-related CO_2 levels by 40%.

There was currently a debate over whether Europe should unilaterally move beyond the 20% GHG reduction target. EREC believed an increase to 30% was urgently needed.

In 2009, the European Parliament and the European Council had endorsed the need to achieve a reduction in greenhouse gases of 80-95% of 1990 levels by 2050. Current policies, however, would achieve only a 40% reduction. Further action was needed beyond 2020. This was important to bear in mind when considering the role of scientific support and research. New efforts and investments would be needed, not only to roll out current technologies to meet the 2020 targets, but also to develop advanced technologies as we moved towards 2050.

2050 was only one investment cycle away, and we could not rely on technologies that were approaching maturity today. A stable and predictable investment environment for renewable energy, and a clear research agenda, were needed now. This would not only help Europe to meet its environmental targets. It would also stimulate innovation, create jobs, unlock private investment, and maintain Europe's first-mover advantage in renewable energy technologies. Investors needed the right signals today to make Europe a resource-efficient, renewable energy economy by 2050.

For these reasons, EREC was calling for a binding renewable energy target of 45% by 2030, accompanied by a full and dedicated implementation both of the existing SET-Plan, and also of a further SET II to address those technologies which were currently ignored.

Without addressing the heating and cooling sector, without accelerating the development of 2nd generation biofuels, and without scientific support for things like ocean energy, it would be difficult to get Europe on a sustainable energy pathway and realise the additional benefits of job creation and economic recovery.

As European Commission President José Manuel Barroso had stated, Europe needed a job-creation strategy to tackle its unacceptable level of unemployment. The green economy was one of three sectors identified by Mr Barroso, along with health and ICT, which would create more than 20 million jobs in the years to come.

There was common agreement that the goals of security of energy supply and environmental sustainability should be achieved without sacrificing the economy. The renewable energy sector offered a variety of high quality jobs in a range of different technologies. Today, it employed more than 600,000 people in areas ranging from research to production, installation, operation and maintenance.

If the 45% by 2030 target for renewable energy usage were achieved, it would lead to gross employment of 4.4 million in the renewable energy sector.

If scientific support, research and development, and a binding 2030 target went hand-in-hand, Europe could deliver the employment, prosperity, sustainability and international competitiveness that it needed at this time of economic crisis.

The second speaker, **Heinz Ossenbrink**, Head of the JRC's Renewable Energy Unit, focused on photovoltaics. Dr Ossenbrink outlined Europe's traditionally strong position but also highlighted the serious threat now emerging from China.

Heinz Ossenbrink, Head of the JRC's Renewable Energy Unit

Unlike other eco-industries, phovoltaics (PV) was a complex mix of many industries and technologies, running from chemicals to display technologies, civil engineering and the building industry. European expenditure on PV research and development averaged around €400 million per year. Although this was a small sum relative to the total cashflow of the electricity industry, the PV sector had developed successfully because there was a market that drove it, in large part based on the Renewable Energy Directive.

Most PV innovation in Europe went into manufacturing. Product prices naturally fell as output size increased – but the key was to achieve prices low enough at start-up to enable businesses to enter the market in the first place. This had been aided by a very innovative research landscape in Europe and cross-fertilisation with other industries. Incentives such as feed-in tariffs had also helped, although direct subsidies had not been a success.

In terms of global grid-connected PV installation, Europe led the world with 75% of the total. When it came to production, however, Europe had only a modest market share while Asia, led by China, was the dominant producer with 72%, according to 2010 figures. The two continents were thus mirror images of each other, with Asia being high in production and low in installation, while Europe was high in installation but low in production. In terms of total value, Europe currently had about 55% of the global market.

Europe was committed to the further development and competitiveness of PV. For this, it relied on the R&D roadmaps set out within the SET-Plan. Key areas included innovation in low-cost, high efficiency silicon cells, in organic devices and nano-photonic materials. 'Very intelligent' grid connection would also be crucial, with remote control of demand and supply and the capability to store electricity locally for up to 3 hours.

But competition from China was growing and posing a challenge to Europe's global 55% market share. There were a number of factors to this including:

- production costs in China were 8% lower than in Europe – most notably in much lower costs of capital
- there was a worrying 'brain drain' of European researchers to highly paid jobs in Asian companies
- China had set a clear industry focus as far back as 2006, with PV identified as one of six key technologies. China was expecting a decline in European markets and was building up its domestic market
- Asia, and China in particular, had short, effective decision trees, making them very fast-moving
- It was not only China. Japan, Taiwan and South Korea were also part of the challenge, with companies such as Sharp, LDK, LG and Samsung.

Given the huge size of China's population relative to Europe's, Europe needed to position itself as a partner in this growth. To achieve this, the European PV industry had to be market-driven, with a short route to innovation. As with other eco-industries, a stable policy framework was crucial, and access to capital was an increasing bottleneck which needed to be addressed.

Success in the PV sector would produce a major reward for Europe in terms of growth and employment. And there was exciting export potential. But the threat was clear. Global competition was becoming tougher, not only in manufacturing, but also in innovation.

The final speaker, **Kati Ihamäki**, Vice President, Sustainable Development at Finnair, focused on biofuels in aviation and the contribution the aviation industry could make to sustainability and the eco-industries. Finnair was one of the first airlines in the world to operate commercial passenger flights using biofuels, with a flight from Amsterdam to Helsinki in June 2011.

Kati Ihamäki, Vice President, Sustainable Development at Finnair

Although new aircraft types and operational improvements would have a role to play, the success or otherwise of biofuels would be overwhelmingly the key determining factor in enabling the move towards sustainable aviation.

Like much of the aviation industry, Finnair had a four-pillar strategy for sustainable development:

Technology – the new generation of aircraft would cut emissions by 20%. But this transition took both time and significant investment

Infrastructure – shortening routes and using resources effectively would aid sustainable development. Having three runways at Helsinki, for example, allowed aircraft to carry out continuous descent, thereby reducing both emissions and noise

Operations – flying more slowly was a way of reducing fuel consumption and emissions. Finnair also had a focus on reducing the weight of its flights, with a 'Weight Watchers' programme for everything except passengers

Economic instruments – these were just becoming important for the aviation industry with the introduction of Emissions Trading.

However, biofuels were by far the most important potential contributor to aviation sustainability. The main drivers towards the adoption of biofuels included the increasing oil price and the need to reduce oil dependency, the need to address the problems of climate change and environmental damage, and increasing aviation traffic volumes. Other drivers included the Emissions Trading Scheme, and the fact that, compared with other travel modes, when it came to aviation there were fewer alternatives available to passengers.

In addition, since they were lighter than conventional fuels in relation to their energy output, biofuels potentially made it possible for aircraft to extend their flying range.
Currently, biofuels were made mainly from vegetable oils, but in the future it was hoped to use algae, biowax and microbial oils as well.

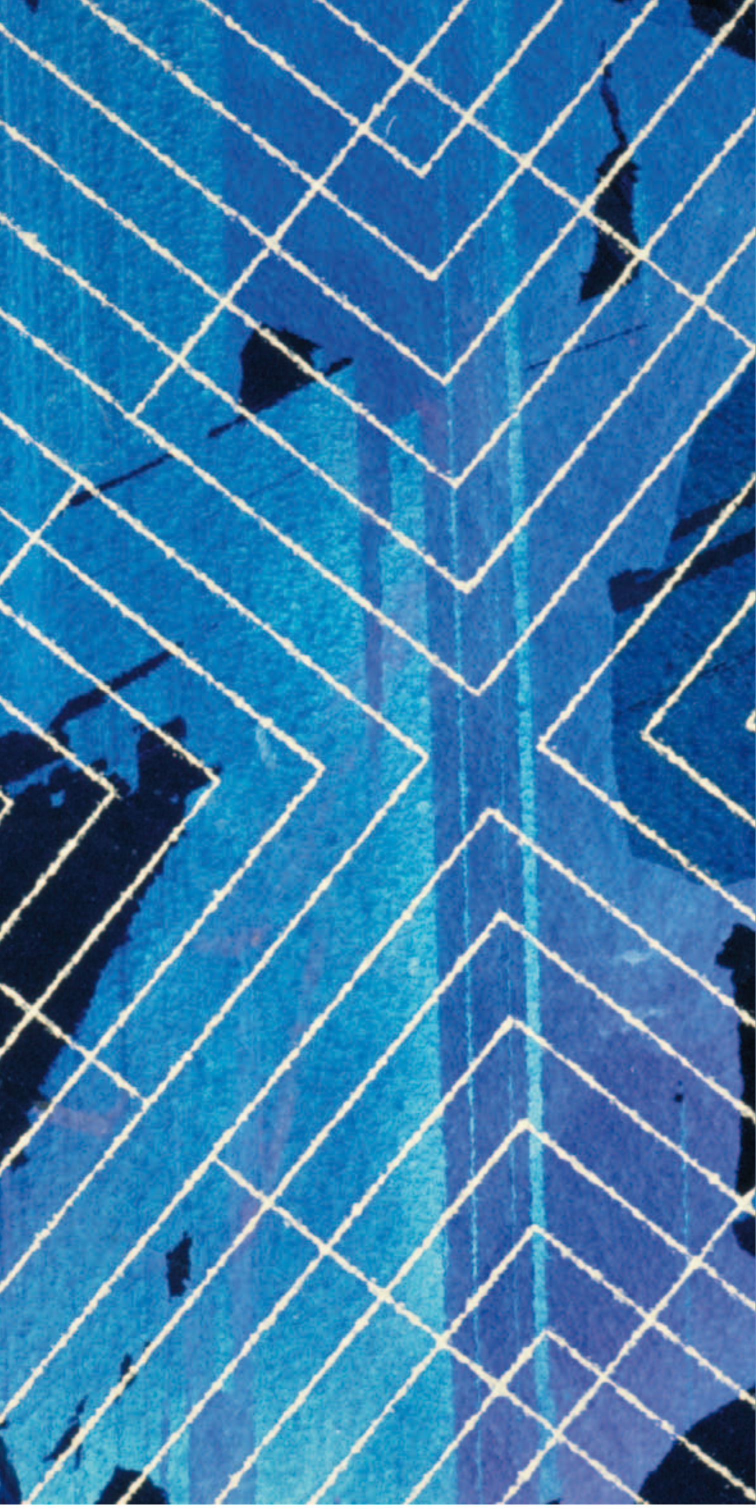
But there was still a long way to go before biofuels were a practical option. The most important obstacle at present was cost, with biofuels approaching three times the cost of normal fuel. Since fuel already made up 25% of total costs for an airline, it was not yet economically sustainable to use biofuels.

The supply chain was a further important issue that needed to be tackled, since supplies of biofuel needed to be in place near airports. It was also important to resolve the 'food vs. fuel' debate in a sustainable way that would make it possible to have both food and fuel.

The fuel for Finnair's first biofuel-powered flights had been brought across from Houston, but this was clearly not a sustainable option. For the future, Finnair was focused on finding local, sustainable feedstocks, most likely based on wood.

Eventually, it was to be expected that economies of scale would resolve the biofuel cost problem. But it was also an issue which called for public-private cooperation – a concept which was already gaining traction in the US.

Finnair's targets, concluded Ms Ihamäki, were ambitious but realistic – to reduce emissions by 24% per seat between 2009 and 2017. This would need aircraft technology innovation – but also biofuels.



Energy efficiency

Session 5

Energy efficiency

Energy efficiency was the most important challenge facing the EU if it wanted growth, jobs and sustainability, said the Moderator, **Daniel Calleja Crespo**, Director General of the EC's DG Enterprise and Industry. It was necessary to reconcile two challenges – first, to create economic growth, and second, to do this in a resource-efficient, low-carbon manner. Energy efficiency was critical for European competitiveness, because it reduced costs and promoted opportunities.

Daniel Calleja Crespo, Director General of the European Commission's Directorate-General for Enterprise and Industry

Industry would play a decisive role in achieving energy efficiency for three reasons:

- industry could improve its own energy efficiency levels
- it could develop new sustainable energy technologies
- it could provide energy-efficient products and services.

SMEs' would have an important part to play, in an integrated value chain with larger companies and other players. Sectors such as construction and transport clearly had huge potential to deliver energy efficiency. But other considerations had to be addressed as well. Links between research and industry would need to be strengthened, and agreement on standardisation would also be vital.

The Secretary General of the European Automobile Manufacturers' Association (ACEA), **Ivan Hodac**, stressed the economic importance of the automobile industry to Europe and made a call for it to be more strongly supported. This support needed to come both through European trade policy (too many free trade agreements opened Europe's borders, without providing reciprocal access to other countries' markets) and through increased R&D investment.

Ivan Hodac, Secretary General of the European Automobile Manufacturers' Association (ACEA)

Although the European auto industry was facing tough times, it was still an important strategic industry for Europe. It was the largest private investor in R&D, it accounted for 10% of EU GDP, and it created roughly 15 million jobs, direct and indirect.

For the industry to continue investing in smart, fuel-efficient vehicles, we had to keep manufacturing in Europe. If we did not, we would lose this investment and other countries like China and Korea would take away one of the few advantages we still had, namely our innovation and technological edge.

The research needs and challenges facing the auto industry fell into four areas:

Fuels and powertrains

The challenges here were clear – limited resources, growing populations and urbanisation, and CO_2 emissions and air pollution. The auto industry's research in this area was focused on the development of greener, more fuel-efficient vehicles. But it was important to stress that this did not only mean electric vehicles. Improving the internal combustion engine was a key priority. Other research priorities included hybrid electric vehicles, battery electric vehicles, fuel cell electric vehicles, and greener fuels.

Integrated safety
The EU's target of halving fatalities between 2010 and 2020 was a key challenge for the industry, along with increasing customer demands for vehicle safety. These challenges were reinforced by the targets set out by the European Road Transport Research Advisory Council (ERTRAC) to reduce fatalities and severe injuries by 60% by 2030. Research priorities here included improving ways of designing vehicles to achieve integrated safety, anticipating the safety aspects of new vehicle concepts, and finding ways to incorporate vehicle-to-vehicle communication into safety design, as well as understanding and improving driver behaviour.

Materials and manufacturing
The auto industry faced the challenge of reducing consumption and emissions, meeting customer and regulatory demands – and at the same time making affordable products. New materials for weight reduction were a top priority. Other research priorities included developing lighter and more compact interiors, digital manufacturing for integrated product and process development, and finding affordable ways of manufacturing green vehicles, which still tended to be expensive.

Mobility and transport
The pressures of population changes, rising economic and societal demands, environmental concerns and policy expectations all came together to pose a major challenge for future mobility and transport. It would be important to balance private and public transport systems, and to achieve 'co-modality', integrating all forms of transport. Key areas for research included new mobility concepts, optimised vehicles, intelligent transport systems (ITS), and advanced logistics.

The European auto industry would continue to support R&D initiatives in priority areas such as Green Cars, ITS for mobility, advanced powertrains and fuels, heavy duty vehicles and green corridors. It also supported Public-Private Partnerships as a model for proposed initiatives such as a European Green Vehicles Initiative.

But for the industry to meet all of the challenges just outlined, it would be necessary to at least maintain the proposed €80 billion budget for Horizon 2020 and ensure an increased budget for future EU pre-competitive automotive R&D. Unfortunately, at present, the industry did not feel that what it was getting reflected the true importance of the automotive industry to the European economy.

Speaking on the topic of smart cities and what was needed to make them a reality, **Jean-Paul Peers**, Vice-President for EU Energy and Climate Policy at Siemens AG, argued that, in the face of numerous challenges, solutions were possible – but changes were needed in the way Europe approached the issue.

Jean-Paul Peers, Vice-President for EU Energy and Climate Policy at Siemens AG

The challenges included:

- ***increasing urbanisation*** – two hundred years ago, London was the first city to exceed 1 million inhabitants. Today, there were 400 such cities
- ***climate change*** – we had the highest concentrations of CO_2 in the atmosphere for 350,000 years
- ***economics*** – Europe spent €700 billion a year on energy imports. These imports could be reduced by the use of renewable energy, but our grids were destabilised when large amounts of renewable energy were introduced. Stabilising the grids and reducing outages was expensive.

On the positive side, studies had shown what cities could achieve. London, for example, could reduce CO_2

emissions from 45 million tonnes to 29 million by 2025. Two thirds of this reduction would pay for itself, while the other one third would cost just GBP300 per inhabitant. 19% of global electricity was used for lighting, which could be cut by 50%. Building management systems could reduce energy consumption by 30%.

In total, Siemens had achieved 317 million tonnes of CO_2 reductions for clients in 2011. The question was: how could we multiply these results?

Key points to address included:

- the EU had a great deal of expertise and understanding of the issues – but it had 8 Commissioners and 8 different DGs, all with a little bit of responsibility for energy and climate policy. It was important to move away from this silo thinking towards a single strategy

- in research, it was to be hoped that Horizon 2020 would move towards less complexity and more grand challenges, or 'Lighthouse Projects', such as Smart Grid, eCar or High Performance Buildings

- decision-making needed to be much faster

- the trust base needed addressing. Under FP7, every euro spent on innovation was matched by another euro spent on application-writing, reporting and controlling. The process could be more efficient than that.

In addition to R&D, deployment was a crucial but often overlooked issue. The costs of moving from development to full deployment were huge. Siemens had recently invested 10 years and €500 million in the roll-out of the world's most efficient combined cycle power plant. If the new technology were globally implemented in all fossil-fuel power plants, it would reduce emissions by 2.5 Giga-tonnes, more than half the EU total. If the SET Plan had been available to help with the roll-out and testing, it would have accelerated the process by several years.

Here, funding was a major problem. Money which had supposedly been earmarked for the SET Plan in 2011 had not yet materialised and Mr Peers issued a direct appeal to the European Commission to ensure the funding was provided. The SET Plan referred to many promising technologies, such as the Smart Grid, but funding was almost non-existent. As Mr Hodac had noted, to give another example, funding for electric vehicles was too low. Whereas the US had foreseen €3 billion for the development of electric vehicles, in Europe the SET Plan had originally provided for €300 million – of which today only €30 million was actually available.

We were now living in the urban millennium. The battle for our future would be won or lost in the cities. Technologies to achieve a 30% efficiency improvement were available, but these were not enough. Studies showed there was an investment need of €2 trillion per year to make the necessary progress. Strong alliances were required, bringing together the JRC, the European Commission and all stakeholders beyond, to ensure that we were all pulling on the same side.

The final speaker of the session, **Helmfried Meinel**, Director General of the Ministry for the Environment, Climate and Energy of the State of Baden-Württemberg, outlined the energy efficiency policies, targets and priorities adopted by Baden-Württemberg and described the type of research that was most urgently needed. In particular, there was a need to move away from single-discipline specialisation to a more inter-disciplinary and trans-disciplinary approach.

Helmfried Meinel, Director General of the Ministry for the Environment, Climate and Energy of the State of Baden-Württemberg

The state of Baden-Württemberg had been involved in environmental research for around 30 years. The research had come a long way in that time, and businesses and civil society now played an increasingly active role. But the range of concerns had also changed. While energy and energy efficiency had been an important topic for many years, now they were at the very heart of Baden-Württemberg's research activities.

In the face of growing global demand for energy in coming decades, it was not possible to continue relying on fossil fuels. There was a need for huge progress in energy efficiency, and there was a need to develop expertise in the field of energy efficiency as an important aspect of the eco-industries. This would also help to create growth and jobs.

What kind of research was needed to achieve this?

1. More inter-disciplinary projects were needed. It was important to overcome the growing conflict between specialist and inter-disciplinary views of research, and to move away from the idea that specialisation was the only source of excellence. Social, cultural, economic and legal aspects had to be considered as well as scientific and technical ones, since these were key to the application of the research.
2. There was a need for a more trans-disciplinary approach. This would mean involving key players and stakeholders in society as participants in research projects, including the initial design and the final implementation and delivery of the results.
3. Outstanding inter-disciplinary and trans-disciplinary expertise had to earn more respect than isolated specialist excellence.

While not denouncing specialisation, which had an important role to play, it was an unfortunate fact that it was becoming increasingly difficult to find people working in specialised scientific fields for Baden-Württemberg's inter-disciplinary topics. Businesses and NGO's were reporting the same difficulty.

Turning specifically to the eco-industries, there was a need for research and development in the fields of energy transformation, energy distribution and energy use.

Germany had opted to phase out nuclear power and launch an energy transition programme. In Baden-Württemberg the long-term aim was to obtain all energy from renewable sources, with an interim goal of 38% to be achieved by 2020 – mainly on the back of growth in solar and wind energy since water and biomass were already well-established and therefore had less growth potential. To support the transition, Baden-Württemberg had also set up a research programme into energy storage technology.

Recognising the indispensable role of energy efficiency, Baden-Württemberg planned to reduce energy consumption by 20% by 2020 and by 50% by 2050. But energy efficiency would not solve all the problems. Despite huge gains in efficiency in recent years, overall consumption had still risen. It would therefore be important to do more to encourage energy saving still further and increase the share of renewable energies. This was an area where a trans-disciplinary approach could make a significant contribution.

Finally, more research was needed to reduce consumption of the scarce material resources necessary for many of the new technologies, most notably rare earths. This was a challenge for Europe's eco-industries, but one which offered major opportunities for growth, employment and research.

Concluding the session, the Moderator, **Daniel Calleja Crespo**, noted that the speakers had shown that energy efficiency could be a key driver for sustainable development. The challenges were huge, but so was the potential. If we developed a strategy and a roadmap, if we were innovative, if we attracted young people, if we succeeded in getting away from silo thinking, if we achieved standardisation and adopted a European approach in which we all worked together, we could succeed.

Conclusions and next steps

Conclusions and next steps

Malcolm Harbour, Member of the European Parliament and Chairman of its Internal Market and Consumer Protection Committee, focused on the challenges of turning innovative ideas into successful products and services, and in particular on the role politicians could play to assist this process.

Malcolm Harbour, Member of the European Parliament and Chairman of its Internal Market and Consumer Protection Committee

A recent visit to a group of 'angel' investors in the UK, witnessing companies making pitches for funding, had revealed some of the issues that had to be contended with. Two of these were the time and the money needed to turn ideas into viable products. Almost always, more of both was needed than originally predicted.

A third issue was the need for the right people. Alongside the technical and scientific expertise of innovators and inventors, there was a need for people with the right management and financial skills. That partnership between ideas and management would be crucial for an eco-efficient future built on science. The Joint Technology Platforms had been a great success in this regard, helping to establish vital partnerships between inventors, investors, and those who would ultimately make use of the new technologies. The Joint Platform on photonics was one example that had been very successful, raising both public and private financing and offering a model of what needed to be encouraged in other technologies as well.

Turning more specifically to the work of the Internal Market and Consumer Protection Committee, it was important to make the internal market work even better. It had been a success, but there were still far too many inconsistencies. Energy efficient building products, for example, were still being subjected to too many local testing requirements, or duplicated testing. European standards were not being applied consistently and this resulted in waste and inefficiency which could not be allowed to continue. Reforms to the standards regulations were currently on the table which would allow the European Commission to be more active in tackling this problem.

Global standards were needed as well. A positive development here was an agreement the JRC had recently reached with the US National Standards Authority on common standards for technologies including smart grids and electric vehicles.

The single market also needed to work better for service providers, to encourage firms specialising in areas such as energy efficiency consultancy to operate more freely across the EU.

A final area to be addressed was the failure to use the public sector to encourage innovation. The eco-industries and energy efficiency were prime markets where this could happen. Customers in the public sector had to be encouraged to work with inventors and new technology suppliers by setting them challenges requiring radical new solutions, for example around smart mobility in cities, and inviting them to pitch solutions. The public customer would then choose the best one or two and participate in their further development to the point where they could be deployed. This model of procurement' was found commonly in the private sector but not in the public sector. One of the dossiers on the table in the Internal

Market and Consumer Protection Committee was the complete reform of public procurement, including measures which would enable public customers to operate this type of procurement method and so drive innovation.

Finding major public sector customers for new technologies early in the development process would also help inventors and suppliers when they looked for investors.

In conclusion, Mr Harbour noted that public procurement was usually very cautious. Nobody wanted to take a risk on new science and technology. In the case of climate change and energy efficiency, however, the reverse was happening. The public was expecting better solutions. Eco-efficiency and green products were an area where we could encourage our politicians to take bolder action in the future, knowing that public support was strong.

Closing the conference, JRC Director General **Dominique Ristori** focused on two key points: the need for action and the unique role of science and innovation.

There was broad political consensus on the need for sustainable growth in Europe. This growth had to be linked with a shift to a new, low-carbon economy. The eco-industries were the best example of this, combining sustainability and competitiveness at all levels, local, regional, national, European and global, and generating turnover of more than €300 billion, together with 3.5 million jobs.

However, it was still necessary to define new models of production and the challenge was to combine growth with the protection of the environment and the efficient use of non-renewable resources. In this context, the role of science and innovation would be crucial.

A cross-cutting, interdisciplinary approach, bringing together policy makers, academia and industry, was absolutely fundamental. The sectors discussed during the day were all closely inter-related, and it was necessary for the EU to foster links between higher education, basic and applied research, and both public and private research, while also taking account of the needs of business and of public opinion and behaviours.

As the only service of the EC in charge of direct research, the JRC would ensure more and more scientific support to focused innovation, targeting the most relevant sectors and fixing clear objectives. This would be done in close cooperation with all key partners, including European institutions, Member States, the scientific community, industry and NGOs.

The JRC would also work towards achieving the standardisation that was so important to fully exploit the benefits both of the internal European market and of the global market – as evidenced by the recent agreement with the US on standards for smart grids and electromobility.

Turning to the specific sectors discussed during the day:

Water was a challenge that would not be solved on its own. All resources, including water and energy, needed to be tackled together within a single, coherent perspective. Future processes needed to be energy- and chemicals-efficient, with low cost and low environmental footprint. Methods for water saving, water treatment and desalination needed to be developed further.

Air quality was an issue concentrated in the urban areas, which were set to grow rapidly. The eco-industries had major potential, especially in the context of clean transport and smart cities, and the JRC would provide significant scientific support in these areas.

Waste management was a sector where policy had stimulated the development of both technologies and markets. But technological development was needed to optimise the supply of new materials from waste and the potential of policy instruments to enable this needed to be carefully considered.

For ***renewables*** the key issues were offshore wind energy, establishing links with the grid, photo-voltaics, biomass and biofuels. Investors needed the right signals today to make possible the European targets on CO_2 reductions, and there needed to be accelerated R&D to increase the use of renewable energies and to broaden the renewable energy portfolio. This century should become the century of renewables.

Energy efficiency would be critical to making Europe more competitive. Sectors such as clean cars, smart cities and insulating existing buildings offered huge potential, opening the way to jobs and growth across all of Europe. It was important to keep manufacturing in Europe, and here again standardisation would be key.

The conference had been useful in helping to define the needs of the eco-industries in terms of scientific support. The JRC was already working with DG Enterprise to reinforce the links between science and industry, and a cross-cutting foresight study on the eco-industries was to be launched to identify new opportunities for research to boost innovation, growth and jobs. Today was only a start – but it had been a promising one.

European Commission

Title: Conference proceedings report for 'Scientific support for growth, jobs and sustainability: the example of eco-industries' conference.

Editor: Geraldine Barry

Luxembourg: Publications Office of the European Union, 2012.
2012 – 36 pp. – 21 x 29.7 cm

ISBN 978-92-79-26857-1 (pdf)
ISBN 978-92-79-26858-8 (print)
doi: 10.2788/54159 (pdf)

Abstract
This report summarises the proceeedings of the JRC-organised conference 'Scientific support for growth, jobs and sustainability: the example of eco-industries' that took place in Brussels on 15th May 2012.

LB-31-12210-EN-N

JRC MISSION

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security, including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

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ISBN 978-92-79-26857-1

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