Green Energy-Green Business:

New Financial and Policy Instruments for Sustainable Growth in the EU

Arash Duero and Sandu-Daniel Kopp

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European Centre for Energy and Resource Security

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Foreword

The study "Green Energy—Green Business: New Financial and Policy Instruments for Sustainable Growth in the EU" investigates the current status quo of the European eco-industry along with its future prospects. It goes back to the beginning of a European policy on renewables in order to trace the evolution of Europe's transformation towards a green economy.

Most importantly, the study acknowledges that Europe's green economies are still highly dependent on public subsidies, which is why an increase in private investments and venture capital is considered crucial for the development of economically viable industries. Further, the authors point out that Europe's green industry is facing growing international competition from the United States, China and other Asian countries. These competitors have increased their investments in renewable technologies, benefit from growing domestic markets and are posing a challenge to Europe's leadership in green industries in the medium to long-term.

Against this backdrop, the study outlines the progress the EU has made towards achieving its '2020' goals and highlights the most important political and economic obstacles for their realisation, such as the challenge of phasing out renewable subsidies while maintaining a competitive green industry. It investigates existing policy and financial instruments for the promotion of green energy and business, identifies shortcomings and formulates policy implications including the need for new investment forms, sustainable financial products and more transparency in the eco-industry.

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Tomi Huhtanen Director, the Centre for European Studies (CES), Brussels.

Executive Summary

This study examines the current state of renewable energy in the European Union (EU). It outlines the evolution of the EU's renewable energy policy, assesses the current status of renewables within Europe's transformation toward a green economy, analyses the challenges that the Union currently faces in this effort and, finally, formulates policy implications.

A European policy on renewable energy dates back to the 1997 White Paper, Energy for the Future: Renewable Sources of Energy. But it was not until 2009 that the EU adopted legally binding targets in the form of the current '2020' goals (20% renewable energy, 20% increase in energy efficiency, 20% reduction of greenhouse gas emissions, all by 2020). This study finds that Europe has been progressing towards these goals but that many challenges still lie ahead; the EU needs to do its homework now and to readjust its policies to keep the 2020 goals within reach.

Given strong international competition, a great deal of volatility in the relatively young renewables sector and the fact that most alternative energy technologies have not yet achieved price parity vis-à-vis conventional forms of energy production, the EU needs to generate and maintain the general framework conditions under which the eco-industry can grow sustainably. The authors identify the need to mobilise adequate amounts of private investment capital as the most pressing current challenge to this endeavour. New investment forms, sustainable financial products along with greater transparency on the part of the eco-industry are necessary to make available more venture capital, which the industry requires in order to maintain the necessary technological edge. Further, public investment,

especially in the R&D sector, remains necessary until green technologies become economically viable on their own. Subsidies and public incentives have helped get the young eco-industry off the ground and should not be discontinued before renewable technologies have achieved price parity. Instead, this study recommends starting with the phase out of fossil fuel subsidies now. Nonetheless, the planning for a definite phase out of subsidies for renewables should also be undertaken and written into law in tandem with the phase out of fossil subsidies to help ensure that all energy technologies compete against each other on a level playing field as soon as possible. This, ultimately, will bring the greatest benefits to consumers, states as well as the environment in the long term.

Key words
Renewable energy – Green business – Green technology – Green economy – The EU's 2020 strategy – Start-ups – Young enterprises – Global competition – Financing green technologies – Public incentives – Subsidies – Phasing out public financing – Private investment – R&D – Germany's solar industry

1. Introduction

The EU was an early proponent of the shift toward alternative forms of energy and sustainable development. It has undertaken impressive efforts to promote green business and environmental reform across the continent, which plays a central role in its current '2020 growth strategy'. Today, Europe is a global leader in green industries and has committed itself to some of the most ambitious policy goals in this field around the world.

But where does the EU stand today in its efforts to transition to a new, sustainable economic model built on green business? What challenges does Europe face, and what can policymakers and business leaders do to safeguard the transition to a green economy?

This paper addresses these and other questions surrounding Europe's quest to enter the age of sustainability. It outlines the history and current status of EU policy in the energy and environmental field, highlights the opportunities for green technologies and business and examines the main challenges ahead. Particular attention is paid to the role of subsidies in enabling young industries to prosper and to the question of phasing out public financing. The availability of and access to private forms of investment capital is identified as one of the most crucial challenges for the still-young industries on their way to maturing and maintaining a competitive edge in the face of rising international competition. A case study focusing on solar power in Germany illustrates some of the practical challenges faced by green industries. Finally, the report provides conclusions and recommendations that should prove insightful for decision-makers from the public and private sector alike.

1.1 The Beginning of an EU Renewables Policy and the 2010 Goals

The issue of renewable energy officially entered mainstream EU politics in the mid-1990s when the Community began to develop a comprehensive policy to promote alternative energy sources and technologies. The most prominent document—and thus for many the official launch for renewables at the Community level—was the White Paper produced in November 1997 by the EU Commission entitled *Energy for the Future: Renewable Sources of Energy*.[1] It followed a general White Paper[2] on energy from 1995 in which the Commission had already alerted Europeans to the significance of a coherent European energy strategy for the twenty-first century and had among other things explicitly called for the promotion of renewables.

Most importantly, the 1997 White Paper laid the groundwork for the '2010 goals', which marked the first phase of a concerted push for renewables at the European Community level and allowed the topic of alternative energy to assume centre stage within EU politics. Specifically, the Commission called on Europe (i.e., the EU-15) to double the share of renewables in gross energy consumption from under 6% to 12% by 2010. This objective, however, was 'a political, and not a legally binding tool'.[3]

[1] European Commission, *Energy for the Future: Renewable Sources of Energy*, White Paper, COM(97) 599 final (26 November 1997), accessed at http://ec.europa.eu/energy/library/599fi_en.pdf on 18 January 2012.

[2] European Commission, *An Energy Policy for the European Union*, White Paper, COM(95) 682 final (13 December 1995), accessed at http://europa.eu/documentation/official-docs/white-papers/pdf/energy_white_paper_com_95_682.pdf on 18 January 2012.

[3] European Commission, *Energy for the Future: Renewable Sources of Energy*, White Paper, COM(97) 599 final (26 November 1997), 10, accessed at http://ec.europa.eu/energy/library/599fi_en.pdf on 18 January 2012.

Besides committing itself to a specific renewables target, in 1997 the EU also explicitly embraced 'the principle of sustainable development' within the amendments to the Treaty of the European Union made at the summit in Amsterdam—only weeks before the preparation of the Kyoto Protocol in December that same year—where the Europeans found themselves among the strongest advocates for an ambitious plan to reduce global greenhouse gas emissions.

The motivation for promoting renewable energy remains the same today as during the 1990s and consists of three main components: (1) renewables are seen as a central resource in the quest for *energy security*, particularly in terms of the diversification of energy sources and the lowering of dependency on imports (mainly oil and gas); (2) renewables are considered a key tool in meeting environmental challenges, particularly in mitigating the effects of climate change; and (3) renewable energy sources promise various *economic benefits*, such as keeping energy affordable in the long-term, contributing to job creation, developing new export potential through green technology and expertise and enabling sustainable development.

The EU's goal of 12% renewables by 2010 was further amended with the passage of two directives in the early 2000s; both contained non-binding, indicative targets for 2010. The 2001 Green Electricity Directive[4] reaffirmed the overall 12% renewables goal and projected that for this to be achieved a share of 22.1% renewables in electricity consumption across the EU-15 by 2010 would be

[4] European Commission, *Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the Promotion of Electricity Produced from Renewable Energy Sources in the Internal Electricity Market, Directive 2001/77/EC* (27 September 2001), accessed at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:283:0033:0033:EN:PDF on 19 January 2012.

necessary.[5] Two years later, the 2003 Biofuels Directive[6] was adopted, aiming at replacing 5.75% of all fossil fuels used for transport EU-wide with biofuels (or other renewable fuels) by 2010.

While the EU had set the overall goal of 12% renewables by 2010 alongside sectoral targets for power generation and biofuels, the implementation of the new energy policy was primarily the task of individual Member States. The EU has provided a basic framework by setting national targets, offering support in the R&D field (such as ALTENER, STEER and SAVE), encouraging 'the sharing and transfer of successful technological and market experiences' and generally continuing to develop and manage the internal market, but as of today it has still refrained from creating a harmonised promotion system at the Community level. Instead, Member States independently determine their own individual energy policies 'according to their own potential'.[7] Most importantly, the defined objectives remain indicative targets that have no binding character.

[5] This figure was later amended to 21% for the EU-27, following the 2004 and 2007 enlargement rounds.
European Commission, *Directive 2006/108/EC of the European Council of 20 November 2006 Adapting Directives 90/377/EEC and 2001/77/EC in the Field of Energy, by Reason of the Accession of Bulgaria and Romania*, Directive 2006/108/EC (20 November 2006), accessed at http://eur-lex.europa.eu/Notice.do?mode=dbl&lang=en&ihmlang=en&lng1=en,de&lng2=bg,cs,da,de,el,en,es,et,fi,fr,hu,it,lt,lv,nl,pl,pt,ro,sk,sl,sv,&val=438005:cs&page= on 19 January 2012.

[6] European Commission, *Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the Promotion of the Use of Biofuels or Other Renewable Fuels for Transport*, Directive 2003/30/EC (08 May 2003), accessed at http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:123:0042:0042:EN:PDF on 19 January 2012.

[7] European Commission, *Energy for the Future: Renewable Sources of Energy*, White Paper, COM(97) 599 final (26 November 1997), 10, accessed at http://ec.europa.eu/energy/library/599fi_en.pdf on 19 January 2012.

1.2 With the Future of the 2010 Targets Uncertain, the EU Shifts Focus to 2020 and beyond

Europe's hopes for an international agreement on the global promotion of renewable energy sources with specific objectives and fixed timetables were dashed at the 2002 Earth Summit in Johannesburg. Together with other pioneers in renewables, Europe then formed the Johannesburg Renewable Energy Coalition (JREC) in order to accomplish at the national and regional level what seemed out of reach internationally. At the January 2004 European Renewable Energy Conference in Berlin—organised within the framework of the JREC—the participants' primary conclusion was that Europeans needed to set clear and ambitious goals for themselves beyond 2010. The proposed new target was that by 2020 at least 20% of Europe's energy should come from renewables. At the time it seemed increasingly likely that Europe would fall short of the initial targets set for 2010.[8] But, regardless of the eventual outcome,[9] clear medium and long-term goals were deemed essential in order to provide stable and predictable conditions for private sector investments.

The '20% renewables by 2020' target subsequently gained widespread acceptance within the EU's leadership

[8] As electricity consumption from renewables exceeded 18% by 2010, according to a Commission memo from early 2011 (EU Commission 2011), Europe ultimately came reasonably close to reaching the 21% target in the power sector. This is largely attributed to onshore wind projects, which began to soar in the mid-2000s.
European Commission, Commission Communication on Renewable Energy, MEMO/11/54 (2011) accessed at http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/54&format=HTML&aged=0&language=EN&guiLanguage=en on 15 January 2012.

[9] The European Wind Energy Association recently published the results of their own calculation according to which 21.2% of electricity consumption in the EU-27 came from renewable sources by the end of 2010, thus exceeding the targeted 21% in this sector (EWEA 2012).
European Wind Energy Association, *'EU MetIts 2010 Renewable Electricity Target - Ambitious 2030 Target Needed'*, (12 January 2012) accessed at http://ewea.org/index.php?id=60&no_cache=1&tx_ttnews[tt_news]=1928&tx_ttnews[backPid]=1&cHash=4b7e762152ac15e75a14d10ccd960778 on 17 January 2012.

and institutions and was reaffirmed on multiple occasions, notably in the Commission Communication *Renewable Energy Road Map* of January 2007.[10] The road map laid the foundation for the 2007 Spring European Council, where the European heads of state and government endorsed a new EU energy policy, the 'European Energy Action Plan'.[11] To the 20% overall renewables goal (including 10% biofuels in the transport sector, overall as well as in each Member State), the Action Plan added the twin goals of a 20% reduction in greenhouse gas emissions (relative to 1990 levels) and a 20% improvement in overall energy efficiency. Together, the three 20% targets constitute the EU's current 2020 goals.[12]

The 2020 goals officially became part of EU legislation with the enactment of the 2009 Renewable Energy Directive,[13] which replaced the previous directives on renewable electricity and biofuels. The act constituted a landmark decision as it marked the first time that the EU had issued legally binding renewables targets for its Member States. The 2020 targets have since been incorporated into the broader 'Europe 2020' growth strategy[14] formally adopted by the European Council in June 2010.

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[10] European Commission, *Renewable Energy Road Map. Renewable Energies in the 21st Century: Building a More Sustainable Future*, COM(2006) 848 final (10 January 2007), accessed at http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0848:FIN:EN:PDF on 19 January 2012.

[11] Germany 2007 – Presidency of the European Union, *The Spring European Council: Integrated Climate Protection and Energy Policy, Progress on the Lisbon Strategy,* 12 March 2007, accessed at http://www.eu2007.de/en/News/Press_Releases/March/0312AAER.html on 21 February 2012.

[12] Also referred to as the '20-20-20' goal.

[13] European Commission, *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC,* Directive 2009/28/EC (13 April 2009), accessed at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF on 20 January 2012.

[14] European Commission, *Communication from the Commission "Europe 2020– A strategy for smart, sustainable and inclusive growth"*, COM (2010) 2020 final (03 March 2010), accessed at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF on 20 February 2012.

1.3 Member States' Obligations and Support Measures (EU and National)

The 2009 Renewable Energy Directive contains specific, binding national targets that each Member State has to meet in order for the EU to reach the overall 2020 goals. Member States had to submit national renewable energy action plans to the Commission by June 2010, detailing how they plan to meet their individual renewables targets by the end of the decade. Every two years they have to submit follow-up reports, in which they need to show whether they are following the indicative trajectory laid out in the action plan and are thus on track towards meeting the 2020 goals. The EU continually monitors Member States' progress and provides guidance to those countries that are falling behind on their individual goals. The directive also contains the possibility of a 'statistical transfer', by which a country exceeding its targets can transfer a share of its surplus to a lagging Member State. States that fail to meet their target can under certain conditions also buy energy produced from renewables from a third, non-member country in order to meet their obligations.

The bulk of the cost for the technological investments and changes is to be borne by the Member States. Yet the EU does provide a number of financial and non-financial channels through which it may contribute to the promotion of renewables. Beginning with the former: the largest share of financial support available from the EU comes from its funds, especially the European Regional and Development Fund (ERDF) and the Cohesion Fund (CF), as well as the two European banks, the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD). Funding from these sources mainly goes toward large-scale investment projects. Besides this, a substantial

amount of EU finances goes toward scientific programmes, especially in the research and technology development field, but also toward analysis and policy research, for example, through the 'Intelligent Energy for Europe' programme. The main aim of these measures is to support innovation, which in turn influences the market for renewables.

The EU has, moreover, a number of non-financial direct and indirect mechanisms to support Member States in their efforts to promote renewables and meet their 2020 obligations. The Renewable Energy Directive explicitly foresees the possibility of and encourages cooperation between Member States through joint programmes with other Member States as well as third country partners. The main reason behind this is the general conviction held by EU policymakers that, ultimately, the full potential of renewables can be achieved only in a truly regional energy market in which economies of scale can be achieved. In addition, the EU in general performs an advisory role vis-à-vis Member States; on the basis of its continuous monitoring, it tries to foster cooperation and aims at promoting best practices and innovative measures. As mandated by the 2009 Renewable Energy Directive, the EU hosts the Transparency Platform[15] on its website, where Member States' action plans and progress reports as well as EU documentation can be accessed, in order to provide greater openness and stimulate exchange in the policy, business and research communities as well as within the general population. Finally, there is a large amount of related EU legislation dealing with energy and sustainability, the internal market or both which indirectly impacts the fate of renewables.

[15] See European Commission, *Renewable Energy Transparency Platform*, accessed at http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm on 21 January 2012.

For example, the Ecodesign Directive[16] introduced binding ecological requirements for products using energy (e.g., light bulbs, electronics or appliances). A regulation of this kind pushes the market toward developing and producing more environmentally friendly products and improves energy efficiency across the EU, which in turn makes it easier for Member States to meet their renewables targets. The EU sees the tandem of ecological standards, along with measures aimed at greater liberalisation of the European energy market—particularly through the removal of trade barriers—as one of its core contributions to facilitating the promotion of renewable energy.

But the majority of the publicly financed support has to come from the Member States. As the EU has not developed a harmonised support system, each Member State can independently decide which type of support scheme[17] it favours to promote renewables based on its individual situation. The main types of support schemes employed by Member States are, according to the EU, (1) feed-in tariffs, (2) premiums, (3) quota/certificate schemes, (4) fiscal incentives and (5) tenders.[18]

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[16] European Commission, *Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 Establishing a Framework for the Setting of Ecodesign Requirements for Energy-Using Products and Amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council,* Directive 2005/32/EC (06 July 2005), accessed at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0029:0029:EN:PDF on 21 January 2012.

[17] According to the 2009 Renewable Energy Directive, the term 'support scheme' refers to 'any instrument, scheme or mechanism applied by a Member State or a group of Member States, that promotes the use of energy from renewable sources by reducing the cost of that energy, increasing the price at which it can be sold, or increasing, by means of a renewable energy obligation or otherwise, the volume of such energy purchased.'

[18] European Commission, *Commission Communication on Renewable Energy*, MEMO 11/54 (31 January 2011), accessed at http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/54 on 22 January 2012.

1.4 The Current Status of and Outlook for Renewables in the EU

According to recent estimates, most Member States are currently on track towards at least meeting their individual renewables goals for 2020.[19] A handful of countries, notably Italy and Luxembourg, have fallen behind somewhat, but this is partly due to the latest financial crisis and subsequent economic downturn. Also, a significant number of countries will likely exceed their commitments. Thus the overall goals at the Community level do not seem to be in jeopardy.

However, it is important to point out that the final outcome hinges on many different variables, which may also impact each other. Of fundamental importance are the future prices of conventional energy sources, notably crude oil prices. But also the future economic climate, the weather, gains in energy efficiency, technological developments and many other factors that cannot be known at this point; therefore, the reliability of current forecasts hinges on estimates that may be more or less accurate.

Given that attainment of the 2020 goals seems more and more likely, a trend has developed towards shifting attention more in the direction of 2030 and even 2050 as the next medium and long-term reference points.

In the area of promotion policies, the EU expects a gradual convergence of support schemes in the long term, claiming that a 'convergence of financing, such as feed-in tariffs, will be necessary in the medium or long term, when a truly European market is created. This can include

[19] European Commission, *Communication from the Commission to the European Parliament and the Council 'Renewable Energy: Progressing towards the 2020 Target'*, COM(2011) 31 final (31 January 2011) accessed at http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0031:FIN:EN:PDF on 24 February 2012.

greater cooperation in setting tariffs, technology bands, tariff lifetimes, etc. It could also include completely joining the support schemes (such as planned by Norway and Sweden)'.[20]

2. Challenges for the EU

2.1 Goals and Targets for the EU's Green Economy

The dynamic green businesses of the European eco-industry have great potential for fostering economic growth and thereby contributing to the achievement of the EU's ambitious green economy goals and targets as stipulated in the 2020 strategy (Europe 2020).

The strategy focuses on five central objectives: employment, innovation, education, social inclusion as well as climate and energy. Concretely, it stipulates that 75% of the 20 to 64-year-olds are to be employed and 3% of the Union's GDP (public and private combined) is to be invested in R&D and innovation by 2020. It seeks to reduce greenhouse gas emissions by at least 20% compared to 1990 levels (or even by 30% if conditions allow), to increase the proportion of renewable energy in Europe's final energy consumption to 20% and to achieve a 20% increase in energy efficiency. Brussels, moreover, plans to reduce the number of early school dropouts in Europe from 15% currently to 10% and to increase the share of the

[20] European Commission, *Commission Communication on Renewable Energy*, MEMO 11/54 (31 January 2011), accessed at http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/54 on 22 January 2012.

population aged 30–40 with tertiary education from 31% to at least 40%. Overall, Europe 2020 is a growth strategy. It is designed to reduce the number of Europeans living below national poverty lines by at least 20 million people.[21]

In 2010, the EU presented seven flagship initiatives that are intended to contribute to the achievement of these objectives:[22]

Smart growth:

- A digital agenda for Europe
- An 'Innovation Union'
- Youth on the move

Sustainable growth:

- A resource-efficient Europe
- An industry policy for the globalisation era

Inclusive growth:

- An agenda for new skills and jobs
- A European platform against poverty

The flagship initiatives within the realm of 'sustainable growth' are of particular interest for the achievement of Europe's goals and targets for a green economy. According to the European Commission, sustainable growth and a green economy require the following:[23]

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[21] European Commission, *Europe 2020 Targets*, accessed at http://ec.europa.eu/europe2020/reaching-the-goals/targets/index_en.htm on 10 January 2012.

[22] European Commission, *Flagship Initiatives*, accessed at http://ec.europa.eu/europe2020/reaching-the-goals/flagship-initiatives/index_en.htm on 12 January 2012.

[23] European Commission, *Sustainable Growth – For a Resource Efficient, Greener and More Competitive Economy* (2011), accessed at http://ec.europa.eu/europe2020/priorities/sustainable-growth/index_en.htm on 12 January 2012.

- the establishment of a competitive and efficient low-carbon economy,
- emission reduction and the prevention of biodiversity loss in order to protect the environment,
- the development of new green technologies and production methods,
- the introduction of efficient smart grids,
- the provision of networks all over Europe to create additional competitive advantages (especially for SMEs),
- the improvement of the business environment (especially for SMEs) and
- customer support to help in the making of well-informed choices.

The objectives are clear. However, the question of which concrete courses of action to take to achieve these aims was debated many times in recent years, both at the EU and Member State level. These debates resulted in the European Commission's launch of a new Eco-Innovation Action Plan (EcoAP) in mid-December 2011. This new plan is part of the commitments of the Innovation Union Flagship Initiative and builds on the 2004 Environmental Technologies Action Plan (ETAP). It consists of supplements for existing policies on innovation and resource efficiency as well as an outline of measures aimed at meeting the challenges for green jobs and sustainable economic growth.[24]

EcoAP is supposed to provide a broad concept of eco-innovation, including new actions to face specific challenges and to achieve innovation. It aims to take new

[24] European Commission, *EcoAP* (2011), accessed at http://ec.europa.eu/environment/etap/inaction/ecoAp_launched_en.html on 10 January 2012.

measures in the areas of regulatory incentives as well as private and public procurement and standards. Moreover, the mobilisation of support for SMEs and the improvement of investment readiness and networking opportunities are central aspects of the action plan. A top priority is the improvement of competitiveness and the creation of new jobs. For this purpose, the key aspects of the plan, according to the European Commission, include the following:[25]

- using environmental policy and legislation to promote eco-innovation;
- supporting demonstration projects and partnering to bring promising, smart and ambitious operational technologies to market;
- developing new standards to boost eco-innovation;
- mobilising financial instruments and support services for SMEs;
- promoting international cooperation;
- supporting the development of emerging skills and jobs and related training programmes to match labour market needs; and
- promoting eco-innovation through European Innovation Partnerships.

Partnerships between stakeholders from the private *and* public sector will assume shared responsibility for the implementation of the plan.[26]

[25] European Commission, *EcoAP* (2011), accessed at http://ec.europa.eu/environment/etap/inaction/ecoAp_launched_en.html on 10 January 2012.

[26] European Commission, *EcoAP* (2011), accessed at http://ec.europa.eu/environment/etap/inaction/ecoAp_launched_en.html on 10 January 2012.

To achieve sustainable green growth, eco-innovation policies need to be addressed at the global level. In September 2011, the European Parliament called for global green economy targets which are to be determined at the UN's 2012 Rio de Janeiro summit on sustainable development ('Rio+20' on 20–22 June 2012). Parliament supported the European Commission's call for a 'Green Economy Roadmap' including 'accountable targets' and 'global goals' to increase renewable energy use and energy efficiency. A proposed first step in this direction could put an end to environmentally harmful subsidies by 2020 and—as proposed by the European Parliament—lead to the introduction of an international tax on financial transactions to support climate and biodiversity protection in developing countries.[27]

Against the backdrop of the Europe 2020 flagship initiative on resource efficiency, the European Commission in September 2011 also set out the *Roadmap to a Resource Efficient Europe*. It aims to address resource inefficiency in sectors with particularly strong effects on the environment, such as agriculture, buildings and transport that account for 70–80% of all environmental impacts. Clear targets, however, will only be developed by 2013; policymakers, experts, NGOs, business and consumers will share responsibility for the formulation of these targets. New legislative approaches, market-based instruments, adapted funding instruments and the promotion of sustainable production and consumption will be introduced and long-term objectives on resource efficiency will be defined.[28]

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[27] MEPs Call for Global Green Economy Targets, *European Parliament/News*, accessed at http://www.europarl.europa.eu/news/en/pressroom/content/20110929IPR27849/html/MEPs-call-for-global-green-economy-targets on 05 January 2012.

[28] European Commission, *Roadmap to a Resource Efficient Europe*, COM(2011) 571 final (20 September 2011), accessed at http://ec.europa.eu/environment/resource_efficiency/pdf/com2011_571.pdf on 10 January 2012.

2.2 Green Technology as a Driver of Growth and Employment?

The EU is considered to be a leader in climate policy and the European 'green job market' has developed very rapidly in recent years. Fears that climate policy may cause large-scale job losses have thus far turned out to be unjustified. Most of the decrease in employment has occurred in extractive and energy-intensive industries, where it is largely due to automation, market liberalisation and outsourcing, and not related to climate protection measures. On the contrary, products associated with a 'green economy' usually tend to be more labour-intensive than products associated with traditional fossil-fuel based industries.[29]

Available figures show that in Europe close to 400,000 jobs have been created in the renewable energy sector. About 2.1 million people are employed in efficient transport and over 900,000 in industries that supply energy efficient goods and services. These jobs span a wide range of professions, skill levels and salaries. Green jobs include, for example, the manufacturing, installation and maintenance of wind turbines and solar panels, and construction work related to improving energy efficiency in buildings. They offer a wide array of opportunities for large sections of the labour force. It is estimated, furthermore, that there are another five million indirect jobs created by related branches. Job opportunities in public transportation, building sectors, wind power, solar photovoltaic and bio-energy businesses have been on the rise in recent years. Compared to 130 million jobs in the EU altogether, the number of green jobs remains

[29] M. Ghani-Eneland, *Low Carbon Jobs for Europe: Current Opportunities and Future Prospects Executive Summary* (WWF – World Wide Fund for Nature, 2009), accessed at http://www.wwf.se/source.php/1251674/Low%20carbon%20jobs%20for%20Europe2009_sammanfattning.pdf on 10 January 2012.

small. However, it exceeds the 2.8 million jobs in more carbon-intensive industries such as mining, electricity, gas, cement and the iron and steel sectors. This is a trend that experts expect to continue in the coming years. Between 2000 and 2008, employment in these areas had an annual growth rate of 6.7%.[30]

In total, the EU-27 eco-industry had a turnover of €232 billion in 2004 and €319 billion in 2008, which corresponds to 2.2% and 2.5% of GDP, respectively. Adjusted for inflation, the annual growth rate of the eco-industry within the EU-27 is 5.9%. The four largest sub-sectors are waste management (32%), water supply (21%), waste-water management (11%) and recycled materials (18%). The global market for eco-industries is currently around €1 trillion per year and is expected to triple by 2030; the EU has roughly 33% of the global market share.[31]

According to an 'Advanced Renewable Strategy' modelling exercise supported by the EU, 2.5 million net jobs in the European renewable energy sector could be reached by 2020.[32]

In the area of wind energy, Europe has the potential to grow from today's 154,000 direct and indirect jobs to about 329,000 jobs in 2020 and 377,000 in 2030. The market

[30] Eurostat, *Persons Employed by Sector*, accessed at http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tin00004 on 11 January 2012; Eurostat, *Industry, Trade and Services*, accessed at http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes on 11 January 2012; D. M. Kammen, K. Kapadia and M. Fripp, *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* RAEL Report (University of California, Berkeley, 2004).

[31] European Commission, *EU Environment Policy: Supporting Jobs and Growth* (2011), accessed at http://ec.europa.eu/environment/enveco/industry_employment/pdf/facts_and_figures.pdf, on 13 January 2012.

[32] European Commission, *Overview Report: Meeting the Targets and Putting Renewables to Work*, accessed at http://www.ewea.org/fileadmin/ewea_documents/documents/policy/external_documents/040330_MITRE_overview_-_Meeting_the_targets_and_putting_renewables_to_work.pdf on 11 January 2012.

leaders would be Germany, Spain and Denmark followed by France, the UK and Portugal.[33]

Germany, as a leading global producer of solar cells, accounts for almost two-thirds of Europe's photovoltaic (PV) related employment of about 90,000. The remaining third is almost entirely covered by Spain. By 2020, the EU's PV workforce is expected to reach 727,000 jobs and potentially 1.4 million jobs by 2030. Concentrating solar power (CSP), in contrast, is a very young industry. Nevertheless, companies from Spain, Germany, Belgium and the UK are expected to contribute to the production of collectors, mirrors/reflectors and other components by 2020. Precise capacity predictions, however, are not available. Another young but quickly emerging industry is solar thermal heating. In this sector alone, Germany employs more than 17,000 people, Spain 9,000 and Italy about 3,000. According to an ECORYS study, there is a good possibility that a significant number of additional jobs will be created by 2020 or by 2030.[34]

In the area of bio energy, again, studies suggest a potential of 580,000 jobs in biomass heating, 424,000 in biofuels and 2.7 million in the biogas industry. Most facilities today are in Germany and Austria, but the sector is also booming in Eastern Europe. The development of the second and third generation of biofuels will offer considerable additional opportunities.[35]

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[33] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012.

[34] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012; M. Ghani-Eneland, *Low Carbon Jobs for Europe: Current Opportunities and Future Prospects Executive Summary* (WWF–World Wide Fund for Nature, 2009), accessed at http://www.wwf.se/source.php/1251674/Low%20carbon%20jobs%20for%20Europe2009_sammanfattning.pdf on 10 January 2012.

[35] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012.

Another area with substantial employment potential is urban public transport. Today, more than 900,000 people are employed in this area and every direct job creates another two to two and a half indirect jobs. The expansion and modernisation of transit systems, therefore, can lead to the creation of a significant number of new jobs in operating transport systems, manufacturing buses, light rail and subways, maintaining rolling stock and infrastructure etc.[36]

Further opportunities will open up through a shift away from automobiles and trucks towards low-carbon vehicles, public transit and inter-urban rail. The development of hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs), for example, will create jobs for the production of such cars, which need nickel-metal hydride and lithium ion batteries, charging stations and an expansion of smart grids for handling a growing PHEV fleet. At this point, however, there are no detailed studies concerning the losses and gains of such a shift. Exact predictions are not possible.[37]

These numbers show that the European eco-industry has great potential to serve as a driver for growth and employment. Nevertheless, it is at the same time confronted by daunting challenges.

2.3 The Main Challenges Facing Europe's Green Economy

In its 2007 mid-term review of industrial policy, the European Commission stated:

[36] M. Ghani-Eneland, *Low Carbon Jobs for Europe: Current Opportunities and Future Prospects. Executive Summary* (WWF–World Wide Fund for Nature, 2009), accessed at http://www.wwf.se/source.php/1251674/Low%20carbon%20jobs%20for%20Europe2009_sammanfattning.pdf on 10 January 2012.

[37] Ibid.

"European industry has already made significant advances in improving its energy efficiency. It is also well placed to grasp the opportunities of the emergence of environmental industries. Environmental industries in Europe are at the global forefront on technologies generating a turnover of approximately 2.2% of EU GDP, and employing 3.4 million people. To overcome regulatory and other obstacles, which can however prevent the full exploitation of the new market opportunities, a range of policy tools including market based instruments and well designed regulation will be needed."[38]

Indeed, over one-third of global annual revenues from eco-industries (€600 billion) are generated in the EU. In renewable power generation, the Union has over 40% of the global market share and European waste management and recycling technologies account for 50% of the global market. The bulk of the remaining global turnover for eco-industries is generated by Japan and the US.[39]

Although the European Union is the global leader in green technologies, its eco-industry still has to deal with serious hurdles. These challenges are discussed in the following subchapter.

2.3.1 Market and Supply Chains

In-depth studies, such as the *Study on the Competitiveness of the EU Eco-industry* commissioned by the European Commission Directorate General for Enterprise and Industry in 2009, found that a well-functioning single

[38] European Commission, *Mid-term review of industrial policy A contribution to the EU's Growth and Jobs Strategy*, accessed at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0374:FIN:EN:PDF on 15. March 2012.

[39] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012.

European market has not yet been fully achieved. Due to the very different approaches of Member States to the implementation and enforcement of the Commission's regulations, directives, standards, certification procedures and so forth, this remains an issue, even though there are enough regulations in place to foster a good business environment. Further harmonisation, coordination and simplification of national regulations are therefore necessary to contribute to a more transparent and stable business environment within the Union.[40]

Furthermore, it must be acknowledged that—despite great efforts to reduce barriers in this area—a single labour market has not yet been achieved. Labour market regulation still remains a complex issue for states, even though the mobility of people within Europe has increased significantly. Additionally, the absence of a global market makes it difficult for the EU to attract a competent workforce from other global regions. In order to deal with this situation and to stay competitive, it will inevitably be necessary to revise inflexible labour market regulations and to further develop the education and training of the current labour force in order to effectively meet the altered technological demands of the European eco-industry.[41]

Looking at the supply chain in Europe's eco-industry, it becomes evident that the boundaries between eco-industries and conventional industries are fading. Interdependencies between manufacturing activities in both industries have developed. For conventional industries that are implementing environmental technologies, improving resource efficiency and reducing emissions, 'green strategies' have become increasingly important. Thus

[40] Ibid.

[41] Ibid.

the opportunities for cooperation between conventional and eco-industries have increased as well. As green technologies have the potential to add value and even reduce costs, for example by enhancing energy efficiency, further supply chain integration and alignment between eco and conventional industries can be expected. Nevertheless, challenges remain: In many eco-industry supply chains a 'strong organising entity'—a lead firm that could act as an integrator of supply chains and could retain control over processes within it—is missing.[42]

Moreover, technology transfer is a key issue within the eco-industries' supply chains. The challenge is to remove obstacles to technology transfer between national markets, such as the 'limited adoption and application capacity of environmental technologies in specific supply chains (weak innovation systems, where the technologies are available but not reaching key clients and end-users)'.[43] Here too one of the main problems is the heterogeneous implementation of regulations at the Member State level. A coherent approach to enabling and enhancing technology transfer between national markets and specific companies should be facilitated by EU-wide standard regulations for respective sectors of the eco-industry. The implementation of such measures and, for example, taking into consideration the existing potential for cluster development could help advance the development of integrated eco-supply chains.[44]

2.3.2 International Competitors

Globally, the EU's eco-industry is an established market player. However, it is coming under increasing pressure

[42] Ibid.
[43] Ibid.
[44] Ibid.

from Japanese as well as Taiwanese and Chinese competition in a range of market segments. Furthermore, the US is a serious challenger in the area of bioplastics, the environmental technology with the highest projected growth rate to 2020.[45]

Global awareness of environmental problems and, thus, issues such as renewable energy, energy efficiency and emissions control, has been increasing over the last decade. Accordingly, public investments in R&D projects and technological development in these areas have been increasing as well. In the US and Japan, private investors and commercial banks have started playing a more important role for the eco-industry, as sub-sectors of the eco-industry have increasingly become more economically viable.[46] The EU still benefits from its early creation of environmental policies and regulations. At the same time, however, emerging countries like China have been highly successful in attracting foreign direct investment (FDI) (e.g. in photovoltaics). Looking at the overall state of new financial investment in sustainable energy, it can be seen in figure 1 that other regions are no longer far removed from Europe: in 2009 Europe accounted for 37% of all new global investment in renewable energy, whereas Asia and Oceania accounted for 34% and nearly matched the EU.[47]

More important is the fact that today a shift in activity in renewable energy towards developing countries is evident. According to an analysis commissioned by UNEP's Division of Technology, Industry and Economics (DTIE) from Bloomberg New Energy Finance, new global investment was $211 billion in 2010, a new record (up 32% compared to 2009). New financial investment, however, was $143 billion in 2010, of which $70 billion was in developed countries and $72 billion in developing countries.

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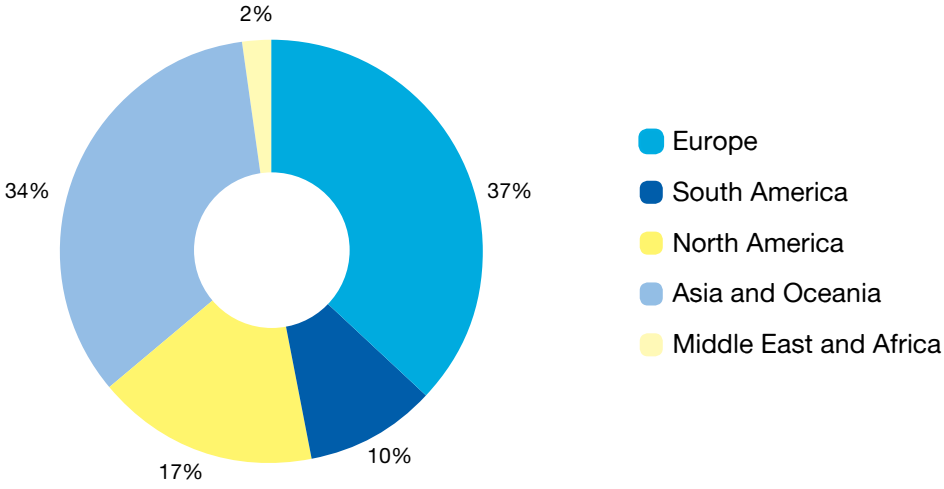
[45] Ibid.

[46] Ibid.

[47] European Commission, *EU Environment Policy Supporting Jobs and Growth* (2011), accessed at http://ec.europa.eu/environment/enveco/industry_employment/pdf/facts_and_figures.pdf on 13 January 2012.

Thus, for the first time, developing countries invested more than developed countries. Even though the new financial investment measure does not cover small-scale projects and R&D investment, where developed economies remain well ahead, a trend is apparent.[48]

Figure 1 New Financial Investment in Sustainable Energy by Region, 2009



Source: European Commission, *EU Environment Policy: Supporting Jobs and Growth* (2011), accessed at http://ec.europa.eu/environment/enveco/industry_employment/pdf/facts_and_figures.pdf on 13 January 2012.

The main investment driver has been China, with $48.9 billion in 2010 (up 28% from 2009). Nevertheless, the developing world's progress is no longer limited to China.

[48] Bloomberg New Energy Finance, *Global Trends in Sustainable Energy Investment 2010: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency* (United Nations Environment Programme and Bloomberg New Energy Finance, 2009), accessed at http://www.rona.unep.org/documents/news/GlobalTrendsInSustainableEnergyInvestment2010_en_full.pdf on 13 January 2012.

New financial investments in renewable energy grew by 104% to $5 billion in the Middle East and Africa and by 39% to $13.1 billion in South and Central America in 2010.[49]

Last but not least it should be noted that, according to several studies, European companies generate on average a lower rate of profit than their competitors in the rest of the world, even those that are less productive. The European eco-industry is in a state of flux. Member States in the East still lag behind the EU-15 in terms of the development of various sub-sectors and, although strong development and improved investment conditions can be expected for the coming years, there are still substantial differences in competitiveness.[50] The major challenge for the future competitiveness of the EU eco-industry is certainly access to finance.

2.3.3 Access to Finance: Public Funding and Private Capital

Investments in environmental technology are usually considered riskier than other technology investments, a situation which, in turn, has a negative impact on capital injections.[51] SMEs especially are affected, as they have to rely on risk-averse local banks for their funding, whereas larger companies find it easier to mobilise private capital from international venture capitalists. Furthermore, local banks in many cases do not have the capacity and technological know-how to evaluate the risks involved in eco-industry projects. Long repayment periods, the relatively high level of uncertainty and the current financial crisis have meant additional strains on the efforts of SMEs to raise

[49] Ibid.

[50] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012.

[51] Nonetheless, there are some exceptions: the main problem in the recycling industry, for example, is not access to finance for innovation but rather a lack of assistance in sourcing necessary funds.

capital. The creation of an attractive investment climate will, therefore, be crucial for the future competitiveness of the European eco-industry.[52]

Unlike the European eco-industry, economic considerations in the eco-industries of the US and Japan have played a more important role and public funds primarily serve to finance investment proposals. Especially in the US, private investments and venture capitalists are showing growing interest and readiness to invest in the eco-industry. In Japan, too, institutional investors, financial institutions and numerous third-party organisations have been increasingly cooperating to develop capital markets for the country's green industry.

According to Ernst and Young, the total US and EU venture capital in clean technologies was almost $3 billion in 2007. No less than 80% of this amount was invested in the US. Although these investments account for a small share of total venture capital investments (5.4% of total US venture capital investments and 4.4% of EU venture capital investments), one should take into account that this share is increasing. From a European point of view, moreover, it should be observed that in the US energy and infrastructure projects have access to debt capital. Developers there make extensive use of investments from institutional market participants (investment trusts, insurance companies, retirement and pension funds, hedge funds etc.), whereas the depth of the European institutional market is relatively shallow. In Europe, the banking sector has been the main financer of debt.[53]

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[52] ECOFYS, *Financing Renewable Energy in European Markets* (Utrecht, 2011), accessed at http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf on 10 January 2012.

[53] Ernst & Young, *Comparative Advantage and Green Business* (London, 2008), accessed at http://webarchive.nationalarchives.gov.uk/+/http://www.bis.gov.uk/files/file46793.pdf on 10 January 2012.

Table 1 Public R&D Budgets for Control and Care of the Environment in Selected Countries, 1990–2005

					Million USD at 2000 Price Levels and PPP		
Country	**1990**	**1995**	**2000**	**2002**	**2003**	**2004**	**2005**
Iceland	..	2.3	0.6	0.6	0.6	0.5	0.6
Norway	27.8	26.6	29.8	31.7	30.9	28.6	27.8
Switzerland	24.1	..	2.6	5.2	..	2.5	..
Canada	70.3	152.1	206.7	249.8	267.0	250.3	254.8
US	482.8	596.1	536.8	568.0	532.9	604.8	507.5
Japan	59.6	87.3	169.4	203.3	210.7	213.2	201.9
Germany	545.4	596.9	552.2	510.5	556.8	570.4	574.1
France	115.8	293.0	263.0	471.9	507.4	487.4	433.2
UK	149.1	235.7	238.8	189.7	218.2	210.6	219.3
					As % of total R&D budget		
Iceland	..	3.4	0.6	0.6	0.4	0.4	0.4
Norway	3.2	2.8	2.8	2.6	2.4	2.2	2.1
Switzerland	2.3	..	0.2	0.3	..	0.1	..
Canada	1.7	3.7	4.5	4.6	4.8	4.4	4.4
US	0.6	0.8	0.6	0.6	0.5	0.5	0.4
Japan	0.5	0.6	0.8	0.9	0.9	0.9	0.8
Germany	3.5	3.6	3.3	3.1	3.3	3.5	3.4
France	0.7	1.9	1.7	2.9	3.1	3.0	2.7
UK	1.4	2.3	2.3	1.6	1.8	1.8	1.8

Source: OECD, *Statistics from A to Z: Environment Environmental Expenditure and Taxes* (2006/2007), accessed at http://www.oecd.org/document/0,3746, en_2649_201185_46462759_1_1_1_1,00.html on 11 January 2012.

Nevertheless, public expenditures on R&D in green technologies have been an important driver in markets other than the European one as well. As can be seen in table 1, the share of the total R&D budget in most cases was clearly lower. Total expenditure until 2005, however, was comparable to the amounts spent by large European countries such as Germany, France and the UK.[54]

In the future, US public spending for green technologies may be expected to continue to increase. Many US states have already taken initiatives and the economic stimulus programmes implemented during the financial crisis will most likely strengthen this trend. Moreover, emerging countries like China and India that are faced with serious impacts of environmental pollution have already announced new political commitments and stimuli for their green economies as well.[55] As a result of the financial and economic crisis, about 20 governmental stimulus programmes totalling $2.8 billion have been introduced worldwide. About $430 billion is intended for investments in green technologies. Asian countries, in particular, such as China and South Korea, are planning to use a significant share of their stimulus programmes for green investments (see figures 2 and 3). For the EU this means that competition in important future markets continues to intensify.[56] According to UK Trade and Investment 2008, double-digit annual growth rates for the Chinese environmental goods and services sector can be expected over the coming years.[57]

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[54] The only exception was Canada, which spent up to 4.4% of all public R&D funding for environmental R&D.

[55] ECOFYS, *Financing Renewable Energy in European Markets* (Utrecht, 2010), accessed at http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf on 10 January 2012.

[56] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012.

[57] ECOFYS, Financing Renewable Energy in European markets", (Utrecht, 2010), accessed at http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf on 10 January 2012.

Figure 2 Global Green Stimulus Spending, from September 2008 through December 2009 (Billion USD)

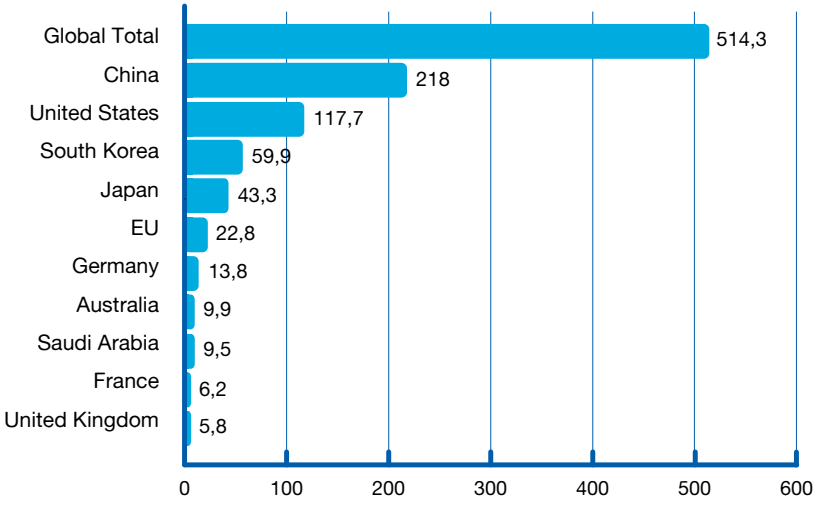
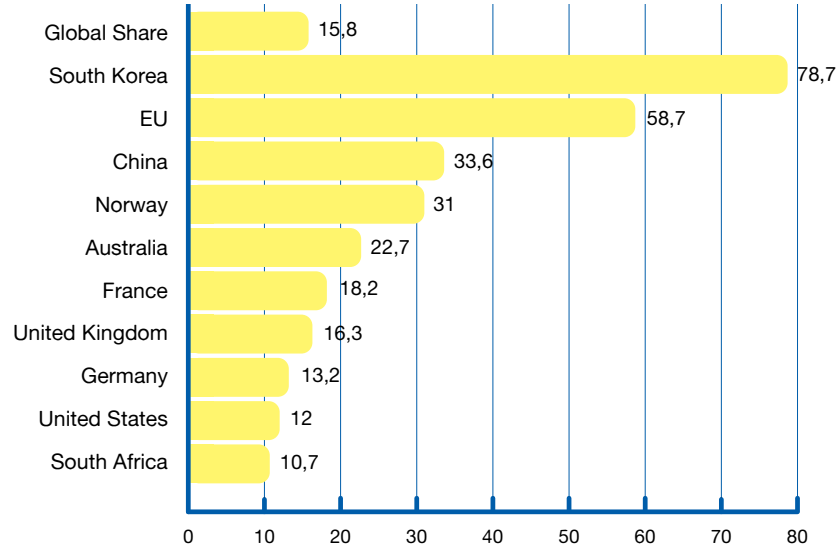


Figure 3 Green Stimulus as a Share of Total Fiscal Stimulus, from September 2008 through December 2009 (Billion USD)



Source: Barbier, E.S., 'Needed: A Global Green New Deal', *Forbes* (9. June 2010), accessed at http://www.forbes.com/sites/davos/2010/06/09/needed-a-global-green-new-deal/ on 12. April 2012.

The large-scale economic stimulus packages passed by several EU members following the global financial crisis in 2008 were regarded as another opportunity for Europe's green economy. However, so far, less than 9% of a combined €42 billion in stimulus funds has been used as an incentive for the development of green sectors. At any rate, given the necessity of budget consolidation in most EU states, stimulus programmes cannot be considered a sustainable source of funding for renewables. Therefore, the focus must lie on the establishment of a business-friendly environment that stimulates private investment to contribute to economic recovery and, at the same time, serves to set Europe on a course towards a low-carbon, sustainable economy.[58]

As Europe's competitive edge is fading, the issue of private capital investment is coming to the fore again. Existing policy and financing mechanisms has enabled investments in the European eco-industry to increase constantly in recent years. Nevertheless, achievement of the 2020 objectives will not be possible with a constant capital inflow at the current level. According to Bloomberg New Energy Finance, the peak investment level was reached in 2008 with €35 billion. For the period 2010 to 2020, however, the annual cost for achieving the 2020 goals is estimated to be some €70 billion. Consequently, Bloomberg New Energy and Finance projects a possible total investment gap of €350 billion between 2010 and 2020. This projection is confirmed by a model-based assessment prepared by Ecofys Consultancy in January 2011, although the study concedes that certain policies have the potential to narrow the gap to €26 billion per year. Nevertheless, in the field of

[58] Ghani-Eneland, Low Carbon Jobs for Europe: Current Opportunities and Future Prospects Executive Summary (WWF – World Wide Fund for Nature, 2009), accessed at http://www.wwf.se/source.php/1251674/Low%20carbon%20jobs%20for%20Europe2009_sammanfattning.pdf on 10 January 2012.

wind energy alone €150 billion (€15 billion per year) would be needed in order to realise an additional 40 GW of offshore wind energy capacity, which is anticipated for 2020.[59]

Given this major financial challenge and competitive markets that currently attract more private capital, the future competitiveness of Europe's green economy will depend on the ability to mobilise private investments. At the same time, the projected financial gaps make clear that an early cutback of public financing of renewable energy does not appear realistic if the EU wishes to retain its 20-20-20 targets (see section 3.1). Nevertheless, improvements within the realms of policy and financing instruments are possible and will be discussed in the subsequent section.

3. Policy and Financial Instruments

3.1 Incentives and Subsidies: Shortcomings and Necessary Improvements

At regular intervals, debates arise on cutting subsidies for fossil fuels in favour of the promotion of renewable energy sources. According to the European Commission, subsidies for the production of coal alone, for example, exceed the subsidies granted for all renewable energy sources combined.[60]

[59] ECOFYS, *Financing Renewable Energy in European Markets* (Utrecht, 2010), accessed at http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf on 10 January 2012.

[60] European Commission, *EU Environment Policy Supporting Jobs and Growth* (2011), accessed at http://ec.europa.eu/environment/enveco/industry_employment/pdf/facts_and_figures.pdf on 13 January 2012.

According to the International Energy Agency (IEA), state spending to reduce the retail prices of gasoline, coal and natural gas rose by 36% and reached $409 billion in 2010. Subsidies for biofuels, wind power and solar energy, by contrast, rose 10% to a comparatively low $66 billion. In its World Energy Outlook 2011, the agency concluded that subsidies for fossil fuels—which meet about 80% of world energy demand—are 'creating market distortions that encourage wasteful consumption.' Furthermore, the IEA's assessment comes to the conclusion that 'the costs of subsidies to fossil fuels generally outweigh the benefits.'[61]

Given that the environmental and financial costs are massive, the G20 group of industrialised nations pledged to phase out subsidies for fossil fuels. In its 2009 Pittsburgh summit declaration, the G20 noted that '[m]any countries are reducing fossil fuel subsidies while preventing adverse impact on the poorest. Building on these efforts and recognising the challenges of populations suffering from energy poverty, we commit to . . . [r]ationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption.'[62]

The European Commission, as noted above, supports this proposal as part of a 'global green economy roadmap' that is to be decided on at the Rio+20 Earth Summit in June of this year.[63]

But what is meant by 'fossil fuel subsidies'? Several countries, such as China, India, Indonesia, Russia and Saudi Arabia, subsidise end-use prices of one or more fossil fuels.

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[61] International Energy Agency, *World Energy Outlook 2011* (Paris, 2011), accessed at http://www.worldenergyoutlook.org/docs/weo2011/factsheets.pdf on 13 January 2012

[62] G20, 2009 *Pittsburgh Summit Communiqué* (2009), accessed at http://www.g20.org/images/stories/docs/eng/pittsburgh.pdf on 13 January 2012.

[63] O. Alapekkala, 'Commission Calls for Global "Green Economy Roadmap"', *EurActiv*, 22 June 2011, accessed at http://www.euractiv.com/sustainability/commission-calls-global-green-economy-roadmap-news-505794 on 13 February 2012.

These consumer subsidies, which occur when fossil fuels are supplied to consumers at prices below a reference or 'world' level, are easy to identify. In most cases, petroleum products for private transport, kerosene and liquified petroleum gas ('bottled gas' used by residential consumers) are subsidised. Furthermore, many countries subsidise fossil fuels used by power generators and certain industries of strategic importance. Less easily identifiable are the indirect subsidies for consumption provided by most OECD countries. Almost all OECD members provide subsidies for airline services to remote areas, for example. Moreover, producer subsidies, such as direct grants, preferential tax treatment, below-market access to publicly owned resources, subsidised or government-guaranteed loans, and government-assumed liability for accidents exist in most OECD countries.[64]

However, there is no doubt that phasing out subsidies for fossil fuels is a medium-to-long-term project which requires the establishment of standardised and regular reporting on fossil fuel subsidies and an international framework for monitoring them. Clear objectives and timeframes need to be set and rigorous and thorough research is needed to identify subsidies and evaluate their effects. Based on this, a coherent package of policies, a communication strategy and a process for reviewing progress towards reform will have to be implemented. In short, rapid progress can hardly be expected.[65]

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[64] Global Subsidies Initiative, *Achieving the G-20 Call to Phase Out Subsidies to Fossil Fuels* (Geneva: International Institute for Sustainable Development – GSI, 2009), accessed at http://www.iisd.org/gsi/sites/default/files/l_policy_brief_on_G-20_Announcement_Oct_09-1.pdf on 15 February 2012.

[65] Global Subsidies Initiative, *Achieving the G-20 Call to Phase Out Subsidies to Fossil Fuels* (Geneva: International Institute for Sustainable Development – GSI, 2009), accessed at http://www.iisd.org/gsi/sites/default/files/l_policy_brief_on_G-20_Announcement_Oct_09-1.pdf on 15 February 2012.

In the area of renewable energy, the challenge will be to establish a European eco-industry that is competitive enough to live without subsidies in the medium to long term as well. However, in light of the EU's ambitious 20-20-20 targets described in the first section of this paper, and the major financing challenges described in section 2, a reduction of subsidies before 2020 can hardly be accomplished without seriously jeopardising the prospects of meeting those objectives.

EU calculations as a basis for the renewables directive assume that at least 500 TWh more renewable energy above the current level will be needed in order to achieve the renewables targets in 2020. To achieve this, growth will have to be doubled compared to the period between 2005 and 2010. Renewable technologies, however, are generally not competitive at the current power price level (see table 2). According to estimates provided by Statkraft, total subsidies for renewable energy in the EU leading up to 2020 can be expected to be somewhere between €26.6 billion and €66.5 billion per year, even if costs for renewables fall as assumed.[66]

Renewable energy subsidies in the EU include feed-in tariffs, cash transfers paid directly to producers, consumers and related bodies as well as less transparent support mechanisms such as tax exemptions and rebates, price controls, trade restrictions, planning consent and limits on market access. With the exception of the annual report of direct state aid for the coal industry, there is no harmonised reporting mechanism for energy subsidies in the EU.

[66] Statkraft, *Annual Report and Sustainability Report 2009* (Oslo, 2009), accessed at http://annualreport2009.statkraft.com/activities/market-and-business-conditions/renewable-energy/ on 15 February 2012.

Table 2 Cost of Electricity Generation in the EU (€c/kWh)[67]

Nuclear energy	3.3
Lignite	5.4
Hard coal	3.8–4.0
Natural gas	5.7–6.2
Hydropower	6.8–8.0
Wind (on-shore)	6.2
Wind (off-shore)	6.5
Biomass	4.6
Photovoltaics	36.8–45.6

Source: Canton, J., Lindén, A., *Support Schemes for Renewable Electricity in the EU*, European Economy, Economic Papers 408 (April 2010), accessed at http://ec.europa.eu/economy_finance/publications/economic_paper/2010/pdf/ecp408_en.pdf on 15 February 2012.

In order to evaluate the appropriateness of the amounts and structures of subsidies, however, consistent subsidy data are necessary. Therefore, a harmonised energy subsidy reporting framework on the basis of an agreed EU-wide definition of 'subsidies' is recommended as a first step towards a revision of the structures of renewable energy subsidies.[68]

In light of the urgent need for fiscal consolidation in the EU as well as soaring costs for wind and solar power, for example in the Netherlands, Spain and Germany (see section 4), a cutback or reorganisation of subsidies for renewables should be planned some time after 2020. In

[67] J. Canton and A. Lindén, *Support Schemes for Renewable Electricity in the EU*, European Economy, Economic Papers 408 (European Commission, April 2010), accessed at http://ec.europa.eu/economy_finance/publications/economic_paper/2010/pdf/ecp408_en.pdf on 15 February 2012.

[68] European Environment Agency, *EEA Technical Report 1/2004: Energy Subsidies in the European Union: A Brief Overview* (2004).

order to achieve the renewables objective for 2020, however, there first needs to be a phase-out of fossil fuel subsidies in favour of renewable energy subsidies. As this is to be considered a long-term project as well, the mobilisation of private capital for the European eco-industry has to take first place on the agenda. Necessary improvements to policy and financial instruments are discussed in the following section.

3.2 Mobilising Investments: Shortcomings and Necessary Improvements

In order to maintain its competitiveness, the EU must react to impending financing gaps and build up a modern sustainable capital stock. For this purpose, existing investment incentives for companies and investors need to be improved, and new demand-side and supply-side instruments need to be developed. For entrepreneurs, planning certainty plays a central role in decision-making. Therefore, 'green framework' conditions that will help to develop the markets and create sales opportunities in the foreseeable future are necessary. At the same time, obstacles to corporate financing need to be removed and the pressure on the banks needs to be reduced in order to prevent still-pending credit crunches.

The EU is the market leader in the area of green technologies. A solid, sustainable financial arrangement is indispensable for maintaining and strengthening this position. Financial products tailored to the eco-industry and more transparency in the financial markets can play a key role in achieving the 2020 goals. Institutional investors should be provided with better information and stronger incentives to enable them to determine the sustainability of new business models.

At Member State level, moreover, a study could be conducted concerning how public pension plans, for example, could be adapted to help increase investments in sustainable technologies. The allocation of pension fund assets to green investments is still limited. Why?

Projects in the field of renewable energy and clean technologies usually include technologies at different stages of maturity and, therefore, are considered riskier than other investments. Pension funds, however, are 'buy and hold' investors focusing on long-term income from low-risk investments that provide a steady, inflation-adjusted income stream. Other obstacles to investment include a lack of appropriate investment vehicles and market liquidity, issues of scale, regulatory disincentives and a lack of knowledge, experience and expertise among pension fund managers.[69] Indeed, for pension funds investment in green projects involves new types of risks that are difficult to assess and to hedge. The Overseas Development Institute has categorised these risks as follows:[70]

- Currency risk;
- Regulatory and policy risk;
- Execution risk;
- Technology risk;
- Unfamiliarity risk.

[69] R. Della Croce, C. Kaminker and F. Stewart, *The Role of Pension Funds in Financing Green Growth Initiatives* (OECD, 2011), accessed at http://www.oecd.org/dataoecd/17/30/49016671.pdf on 15 February 2012.

[70] J. Brown and M. Jacobs, *Leveraging Private Investment: The Role of Public Sector Climate Finance* (2011), accessed at http://www.odi.org.uk/resources/download/5701.pdf on 12 February 2012.

However, in general, investors are not looking for a risk-free environment, but rather one in which risks can be understood, anticipated and managed.[71] A UNEP examination of public financing mechanisms which could be combined with financial instruments in order to mitigate these risks, concluded with the following recommendations:[72]

- Country risk cover: insurance against country risk should be expanded and explicitly provided to support low carbon funds (e.g. provided by the Multilateral Investment Guarantee Agency (MIGA) of the World Bank and the US Government's Overseas Private Investment Corporation (OPIC)).
- Low-carbon policy cover risk: insurance should be provided where countries renege on policy frameworks/ incentive schemes that underpin low-carbon investments.
- Funds to hedge currency risk: public finance could provide currency funds which offer cost-effective hedges for local currencies which would otherwise not be available in the commercial markets (e.g. provided by the Currency Exchange Fund supported by the Dutch Ministry for Development Cooperation).
- Improving deal flow: vehicles specialising in early-stage, low carbon projects could be developed and technical assistance provided.

[71] K. Hamilton, 'Unlocking Finance for Clean Energy: The Need for Investment Grade Policy', *Chatham House Briefing Paper* (2009), accessed at http://www.chathamhouse.org.uk/files/15510_bp1209cleanenergy.pdf on 17 February 2012.

[72] The list is the authors' condensed summary of the recommendations provided in: United Nations Environment Programme (UNEP), *Catalysing Low-carbon Growth in Developing Economies: Public Finance Mechanisms to Scale up Private Sector Investment in Climate Solutions* (2009), accessed at http://www.energy-base.org/fileadmin/media/sefi/docs/publications/PublicPrivateWeb.pdf on 17 February 2012.

- Public sector taking subordinated equity positions in funds: public sector could invest directly in low carbon funds via first equity loss, thereby improving the overall risk-return profile of such vehicles.

According to the Overseas Development Institute, *pledge funds* can contribute to risk mitigation as well. In this case, public finance sponsors provide a small amount of equity in order to encourage larger pledges from private investors.[73]

Last but not least, a common definition of 'green' and common standards and methodologies for the assessment of green projects need to be established. A rating agency that sets these standards, offers reliable information and approves green projects, such as green bonds or green funds, could potentially contribute to increased investments.[74]

For policymakers, this means providing a supportive environmental policy backdrop, creating right investment vehicles, fostering liquid markets, supporting investments in green infrastructure, removing investment barriers, providing education and guidance to investors and improving pension fund governance. In its working paper *The Role of Pension Funds in Financing Green Growth Initiatives* of September 2011, the OECD identifies the main barriers for pension fund investments and recommends the solutions summarised in table 3.[75]

[73] K. Hamilton, 'Unlocking Finance for Clean Energy: The Need for Investment Grade Policy', *Chatham House Briefing Paper* (2009), accessed at http://www.chathamhouse.org.uk/files/15510_bp1209cleanenergy.pdf on 17 February 2012.

[74] R. Della Croce, C. Kaminker and F. Stewart, *The Role of Pension Funds in Financing Green Growth Initiatives* (OECD, 2011), accessed at http://www.oecd.org/dataoecd/17/30/49016671.pdf on 15 February 2012.

[75] Ibid.

Table 3 Pension Funds' Infrastructure Investments: Barriers and Solutions[76]

Barriers	Solutions
Lack of experience and knowledge (with infrastructure / private equity and other investment vehicles / direct investments)	Encourage improved knowledge and understanding by pension fund stakeholders and supervisors of infrastructure assets Encourage development of appropriate investment vehicles Support consolidation and pooling of pension funds
Shortage of data (performance / costs / risks / correlations)	Support stronger efforts in independent data collection and objective information provision in the field of infrastructure investment Recommend upgrade of national and supra-national statistical data collection with a view to the better understanding of infrastructure assets (and other alternative asset classes)
Fees	Promote higher transparency standards in private equity vehicles and direct investments
Political risks / regulatory instability Emerging market risks (currency, etc.)	Enhance the investment environment Ensure stable regulatory environment Create platform for dialogue between investors / financial industry / governments (OECD) Develop national, long-term policy frameworks for key individual infrastructure sectors; improve the integration of the different levels of government in the design, planning and delivery of infrastructure through the creation of an infrastructure agency / bank; and create a National Infrastructure Pipeline. Encourage the study of more advanced risk analysis beyond traditional measures, including the specific risks of infrastructure
Funding and accounting regulatory constraints	Correct funding and investment regulations which are inadvertently preventing infrastructure investments
Regulatory constraints on investment (e.g. restrictions on asset classes / liquidity / non-listed / diversification requirements / leverage / valuation rules)	Establish international guidelines for performance and risk management of infrastructure (and other alternative) vehicles

[76] Ibid.

Besides the pension funds and their contribution, banks will have to continue to play a crucial role in the design of 'green' financial markets. Public banks, such as savings banks and the Landesbanken in Germany, should examine the green potential of their financial products. Policymakers, on the other hand, need to create the necessary conditions to ensure that financial markets become a central lever for investments in Europe's eco-industry. The changes to financial markets should pursue the following targets:[77]

- the elimination of short-term financing problems;
- the provision of venture capital for start-ups and early-growth financing;
- an increase in the transparency of financial markets; and
- the creation of new forms of investment for mobilising capital.

Fiscal and financial policy incentives need to be designed with a view to obtaining a long-term return on capital investments. Speculation in green assets should be avoided or reduced to a minimum of hedging. Moreover, projects and investments could aim at specific technologies in order to maintain Europe's technological advantage. As for financial market actors, they need to develop greater competence in assessing green industry projects and identifying sustainable investments. Today, many banks cannot provide the necessary technological knowledge and expertise, which may result in missed market opportunities.[78]

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[77] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012.

[78] F. Mayer and C. Velten, 'Nachhaltiges Wachstum finanzieren – Strategien und Finanzierungsinstrumente für eine Green Economy' (2010), accessed at http://www.managerkreis.de/media/GreenEconomy_2010.pdf on 12 January 2012.

A glance at the US market clearly illustrates the crucial role of financing mechanisms. The US's competitiveness has been improving in recent years. To a large extent, this can be attributed to fast-growing investments in the country's eco-industry. Large funds take greater risks than in Europe, as they are expecting attractive returns. In Europe, the markets are liquid but investments often fail due to a lack of readiness to take risks. To counter this, measures to mitigate risks must be taken (see above). Although funds exist that grant credit at favourable rates for economically viable renewable energy and energy efficient projects and businesses, they are not sufficient. Additional initiatives and new instruments are necessary to finance Europe's green industry. Possible policies and financing measures to preserve Europe's position as the global green market leader are discussed below.

3.2.1 Venture Capital for Start-Ups and Sustainable Growth

Start-ups and young enterprises—not only in the eco-industry—are dependent on equity financing and entrepreneurial investments. Here, venture capital funds and the corporate venture capital funds of established companies can play a positive role. Although a number of such investments do take place in Europe, they are relatively small by international standards (see section 3.3). In order to attract more green-tech investments, it is important that Member States amend their framework conditions and fiscal regulations for venture capital investments and bring them in line with existing European benchmarks and provisions. As the share of investment in green technologies is increasing globally, EU states should try to attract a considerable portion of this increase (table 4).[79]

[79] ECOFYS, *Financing Renewable Energy in European Markets* (Utrecht, 2010), accessed at http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf on 10 January 2012; F. Mayer and C. Velten, 'Nachhaltiges Wachstum finanzieren – Strategien und Finanzierungsinstrumente für eine Green Economy' (2010), accessed at http://www.managerkreis.de/media/GreenEconomy_2010.pdf on 12 January 2012.

Table 4 Global Growth of Venture Capital Investment[80]

Year	Total investment (billion USD)	Total clean tech investment (billion USD)	Share in %
2006	26.5	1.308	4.9
2007	29.4	2.867	9.8
2008	28.3	3.213	11.4
2009	17.7	2.216	12.5

3.2.2 New Investment Forms and Capital Mobilisation

Product and process innovation in the eco-industry involves many uncertainties. It is particularly difficult during the seed phase to make forecasts concerning the market maturity of a specific product. This is why investments in European green industries are still comparatively low. The situation is further exacerbated by the fact that innovation in climate protection technologies is usually relatively expensive. For this reason, again, existing funds do not cover the investment needs in the area of environmental technology. At the same time, however, this segment is enjoying more public interest, and the financial industry is increasingly seeking economic opportunities in this field. A solution to this challenge is the establishment of 'greentech funds' (at the Member State level) designed as public private partnerships. Such funds should be able to provide broad and comprehensive support in the form of equity and venture capital for start-ups and technologically innovative projects. Investment criteria may include the degree of innovation, the strategic competitive advantage of the

[80] Ökofirmen schaffen globalen Gewinnsprung', *Spiegel Online*, 16 March 2010, accessed at http://www.spiegel.de/wirtschaft/unternehmen/0,1518,683809,00.html on 12 January 2012.

technology, the growth potential of the market, market entry barriers for competitors (patents) and the opportunity and risk profile.[81]

3.2.3 More Transparency on the Part of the Eco-Industry

By providing more information, the eco-industry itself can contribute to an increase in the willingness to invest in green technologies. Key performance indicators (KPI) for sustainable development (SD), for example, could be part of annual business reports. Furthermore, the provision of general information on intersectoral environmentally relevant indicators (e.g., CO_2 emissions, the share of R&D expenditure necessary to increase energy and resource efficiency etc.) would contribute to more investment certainty as well. The minimum requirement for companies could be the provision of information concerning the three most relevant SD-KPIs of a branch. Therefore, policymakers should consider the compulsory integration of SD-KPIs into the annual business reports of green industry companies. By attaching the guidelines to existing accountancy rules, the bureaucratic burden could be kept at a minimum.[82]

Furthermore, Eurostat could also contribute to more transparency. Today, eco-industries such as renewable energy, air pollution control and eco-construction, for example, are not identifiable as separate sectors in the NACE classification scheme.[83] Structural business statistics

[81] ECOFYS, *Financing Renewable Energy in European Markets* (Utrecht, 2010), accessed at http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf on 10 January 2012; F. Mayer and C. Velten, 'Nachhaltiges Wachstum finanzieren – Strategien und Finanzierungsinstrumente für eine Green Economy' (2010), accessed at http://www.managerkreis.de/media/GreenEconomy_2010.pdf on 12 January 2012.

[82] F. Mayer and C. Velten, 'Nachhaltiges Wachstum finanzieren – Strategien und Finanzierungsinstrumente für eine Green Economy' (2010), accessed at http://www.managerkreis.de/media/GreenEconomy_2010.pdf on 12 January 2012.

[83] NACE is the acronym used to designate the various statistical classifications of economic activities developed since 1970 in the EU.

of Eurostat only cover recycling (NACE 37) and waste collection and management (NACE 90.01; 90.02 and 90.03), as Eurostat trade data focus primarily on goods. It would be helpful also to cover services, which are an important part of the eco-industry.[84]

3.2.4 Sustainable Financial Products

In many EU states sustainable investments do not exploit their full market potential. In Germany, for example, their market share is only about 1%, whereas in the UK they account for 20% of total investments. This disparity results from divergent national approaches to the disclosure and distribution of financial products. In the area of customer consultation, for example, EU-wide requirements should be considered that require banks and insurance companies to highlight the sustainability criteria of specific investments. For insurance companies that build up a capital stock, moreover, mandatory customer information on a regular basis could be introduced. Thus, customers could be informed about the relevance of sustainability criteria whenever their money is being invested.[85]

[84] ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012.

[85] F. Mayer and C. Velten, 'Nachhaltiges Wachstum finanzieren – Strategien und Finanzierungsinstrumente für eine Green Economy' (2010), accessed at http://www.managerkreis.de/media/GreenEconomy_2010.pdf on 12 January 2012.

4. Case Study

4.1 Germany's Solar Future: Some Clouds in Overall Sunny Skies, but Crucial Tests Still lie ahead

The central assumption underlying Europe's turn to renewables and sustainable development in general—and its main selling point—has been the idea that ecology and economy go hand in hand. Not only, the argument goes, does environmentalism not hinder economic success, but on the contrary it is on course to become one of the most prosperous growth sectors in the twenty-first century. In economic terms, the result is a win-win situation in that the environment and the economy mutually benefit from exploring alternative energy sources.

By linking business and the environment, Europe expects, and has been actively pursuing, the development of a European renewables sector. This final section will take a closer look at one case study—the solar sector in Germany—in order to illustrate some of the main underlying processes in the introduction and commercialisation of renewable energy sources and to draw preliminary conclusions about future developments.

Given the size of the German economy, it was reasonable to expect that the country's turn to renewables would also spark the development of a strong indigenous renewables sector there, including solar.

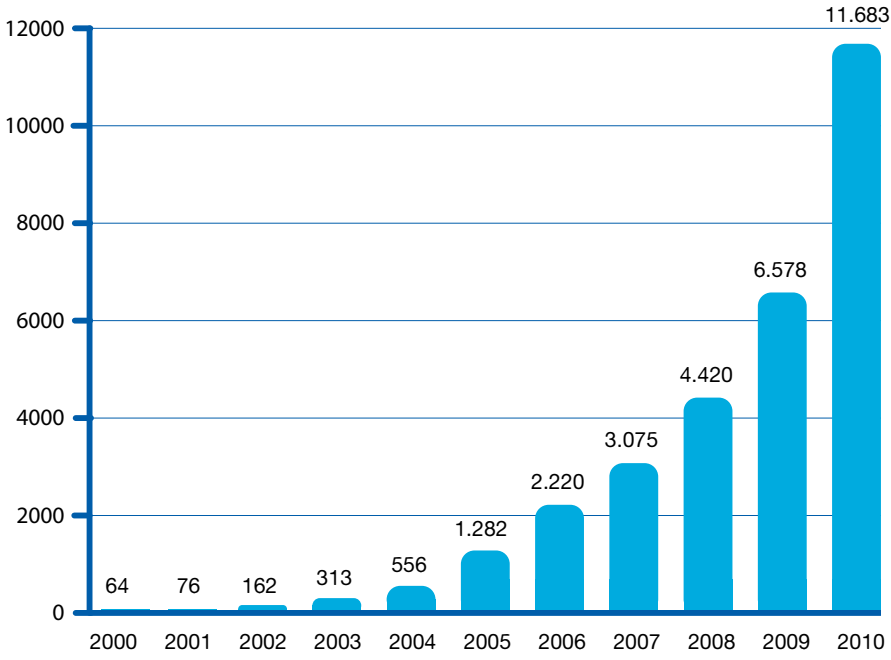
The institutional backbone of the increased spread of solar energy (alongside other forms of renewable energy) has been a generous system of subsidies that has its

roots in the 1990s but that did not truly materialise on a large scale until 2000 when the Erneuerbare-Energien-Gesetz (EEG), or German Renewable Energy Act, was passed. The EEG's core is a system of feed-in tariffs that guarantee grid access to renewable energy producers as well as payments exceeding those for conventional forms of energy. Rates of remuneration differ for different sources of energy, depending on the cost of generation, and gradually decrease over time.

The concept is based on the idea that young industries cannot initially compete on their own against mature ones. Institutional support through guaranteed feed-in tariffs is supposed to lower start-up costs in order to attract investors who would otherwise shy away from exploring new industries given the uncertainties and risks involved. Another justification for higher remuneration for renewable energy is that the price for conventional forms of energy does not reflect a large number of externalities or unintended consequences, such as carbon emissions.

The Renewable Energy Act precipitated a boom in renewables, including in the solar sector. Over time, the share of solar power in overall German energy consumption has steadily increased; solar power currently covers the annual electricity demand of over 3.4 million German households, according to the German Solar Industry Association (BSW-Solar).

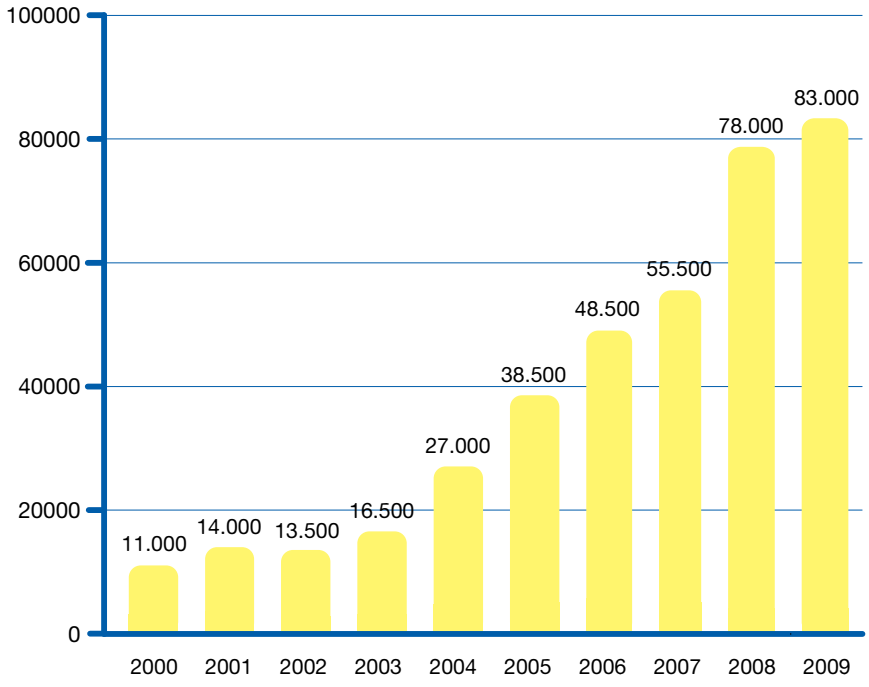
Figure 4 Development of PV Power Generation in GWh 2000–2010 (in Thousands)



Source: Authors' figures, based on 2011 data available from the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), the German Association of Energy and Water Industries (BDEW) and German Solar Industry Association (BSW-Solar).

Since 2000, the number of jobs created in the German solar industry has increased from some 11,000 to about 83,000 in 2009. Currently, there are approximately 10,000 solar companies in Germany that have a total turnover of roughly €19.1 billion (including suppliers), export revenue of more than €6.5 billion and have paid over €40 billion in taxes to date (€1.4 billion in 2010). In addition, BSW-Solar estimates that the solar industry in Germany will provide additional dividends by 2030 including savings of about €26

Figure 5 The Number of Jobs in the German Solar Industry (in Thousands)

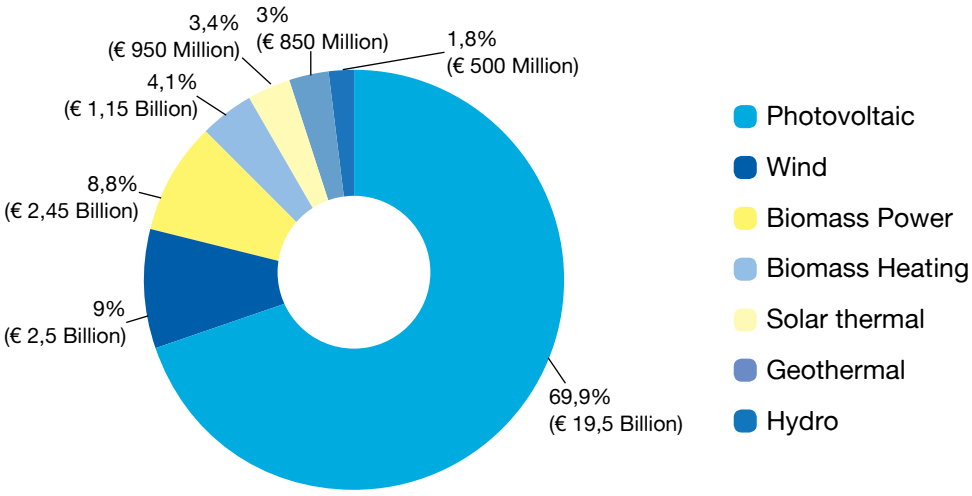


Source: Authors' figures, from 2010 data provided by BSW-Solar.

billion for natural gas and coal imports as well as related healthcare and environmental costs of about €16 billion.

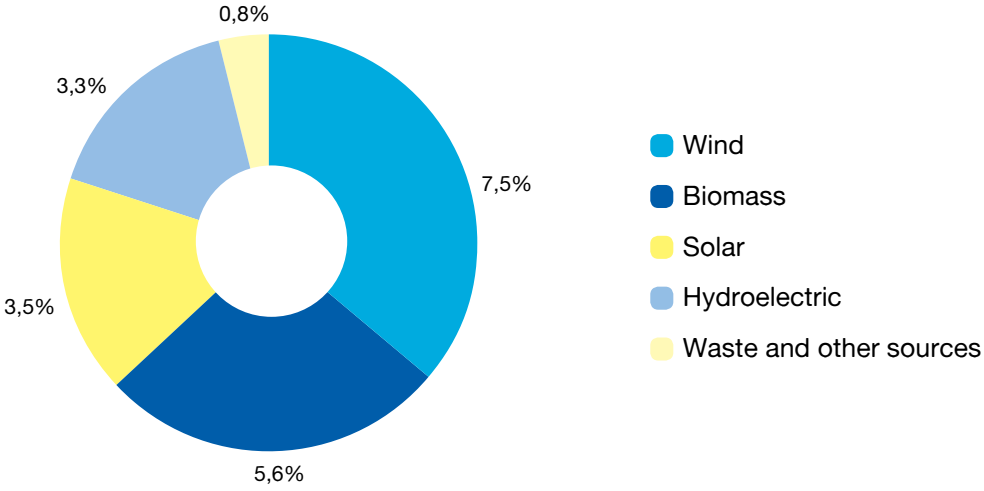
However, despite substantial investments of €27.9 billion in the sector in 2010, solar power still only represents 3.3% of Germany's total electricity generation, of which renewables accounted for about 20% in the first half of 2011.

Figure 6 Investment in the Construction of Renewable Energy Facilities in Germany, 2010



Source: Authors' figures, from 2011 data provided by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Figure 7 Share of Renewables in Germany's Total Power Mix, 2011 (Total: 20.7%)



Source: Authors' figures, based on 2011 data available from the German Association of Energy and Water Industries

Moreover, in recent years the German solar industry has faced some economic setbacks, culminating in late 2011 when two major German solar energy companies (Solon SE and Solar Millennium AG) were forced to file for bankruptcy; together, the two companies employ nearly 1,200 people.[86] Prices for photovoltaic components had been falling for several years already, but up until two years ago Germany's solar industry had been able to compensate for this trend thanks to increasing revenue; 2011, however, marked the first year that the solar sector reported losses—while prices continued their plunge.[87]

4.2 The Future of Solar Energy in Germany

It is important to stress that the future of the German solar energy industry and solar power production in Germany are related yet distinct issues. What they undoubtedly share is the fact that both have yet to pass two crucial tests: (1) Both need to prove that they are competitive in their own fields; and (2) both need to demonstrate that their competitiveness is not *essentially* dependent on subsidies.

Still, their fate is not necessarily linked, quite the contrary in some ways. In order to understand both the current trends and likely future developments, it is important to recognise the interaction between solar industries and solar power.

Solar companies around the world find themselves increasingly in a global competition. Some of the volatility in the market is due to more short-term trends; subsidy policies also, beyond doubt, have an effect on the global contest. More fundamentally, however, broader trends

[86] E. Wesoff and B. Prior, 'German Solar Shakeout: Solar Millennium Insolvency', *Greentechmedia*, 21 December 2011, accessed at http://www.greentechmedia.com articles/read/German-Solar-Shakeout-Solar-Millennium-Insolvency/ on 22 January 2012.

[87] S. Schultz, 'Solarbranche fürchtet massenhaftes Firmensterben', *Spiegel Online*, 28 November 2011, accessed at http://www.spiegel.de/wirtschaft/unternehmen/0,1518,798569,00.html on 22 January 2012.

manifesting themselves in recent years are a product of the maturing of the industry. This process is driven by the struggle for market share, which largely depends on superior technology and pricing, along with solid management.

A number of international competitors, especially Chinese firms, currently have an edge over at least parts of Germany's solar industry.[88] The main underlying reason for the apparent success of a limited number of global solar players is that they have been better able to benefit from economies of scale compared to their competitors. It is important to emphasise, however, that the overall trend does not resemble a general decline for solar energy as a whole. Rather, the developments are the consequence of a shake-up, which occurs in any maturing market, especially one with strong international competition. The computer industry provides a good comparison given that it too is relatively recent and is also a high-tech industry: many early leaders experienced a fairly rapid decline; some were taken over, some reinvented themselves, others disappeared entirely. No one was able to predict in the 1970s who would eventually dominate which market segment in the industry; yet all the major players in the computer world today are similar in that they survived the maturing process and were able to develop an effective business model based on superior technology and successful pricing.

The good news for Germany is that this process does not spell the end for its solar industry as a whole, as labour costs are not necessarily the main determinant of success in the high-tech world. There are many factors that allow companies to gain market share, including innovation and efficiency, which have traditionally been mainstays

[88] K. Klooß and L. Liersch, 'Wie China deutsche Solarfirmen attackiert,' *Manager Magazin*, 17 August 2011, accessed at http://www.manager-magazin.de/unternehmen/energie/0,2828,780667,00.html on 23 January 2012.

of German industry. Ultimately, the main exogenous determinant of viability and success is the overall business environment in any given country.

What does this process mean for the German solar sector? Is it competitive in global markets as well as domestically as a source of power generation? How does subsidy policy factor into the equation?

A look back at how the German solar market evolved helps us to understand current dynamics and assess future trends. It has to be acknowledged that in the German case—as elsewhere—the boom in the solar market during the last decade was fundamentally dependent on the subsidy programme. Although of fundamental importance, this was not the only factor to contribute to the surge in the solar sector. Research and development in solar technology had been underway in Germany since at least the 1970s when a fledgling industry started to take shape. The underlying reasons then were globally growing concerns about the sustainability of an economic model based on perpetual growth, increasing awareness about the threats posed by environmental degradation as well as continuing resource depletion and rising concerns about energy security. Aside from these global, long-term factors, the growing public opposition in Germany towards nuclear power, especially after the Chernobyl disaster in 1986, were domestic factors that fuelled the search for and development of alternative sources of energy, including solar.

Nonetheless, although these factors can account for the emergence of renewable energy technologies in Germany (as elsewhere) per se, they explain neither the specific timing nor the scale of the development of the solar market and the domestic industry. The technology has so far never been competitive on its own; it was the subsidies that filled

the gap to create demand and a stable investment climate, which led to the solar boom in the 2000s. For example, the Bavaria-based solar company IBC Solar, which currently employs around 400 people, was founded in 1982, yet their sales began to soar only in the last decade, increasing from €75.5 million in 2003 to €971 million in 2010.

As for the prospects of the solar industry in Germany and its dependence on subsidies, it is essential to look at the underlying global trends. The main reason for the current 'solar crisis' is the sharp decline in prices coupled with increased international competition for market share, not a drop in demand for solar technology. The industry experienced steady growth throughout the last decade; despite a still-recovering global economy, in 2011 global grid-connected PV capacity rose from 39.7 GW at the end of 2010 to 67.4 GW, with Germany remaining the largest market, according to a recent report by the European Photovoltaic Industry Association.[89]

Nor has technological development and innovation stagnated. On the contrary; according to a recent study on the solar industry commissioned by the Swiss bank Sarasin and released in November 2011, during the last ten years solar technology has seen the 'steepest cost-cutting rate of all forms of renewable energy' due to steady efficiency gains.[90] Leading experts expect the technology to reach grid parity over the course of the next ten years in many markets, which would make solar energy competitive against other sources of energy, even without subsidies.[91]

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[89] European Photovoltaic Industry Association, *Market Report 2011* (Brussels, 2011), accessed at http://www.epia.org/ on 23 January 2012.

[90] M. Fawer and B. Magyar, 'Solar Industry: Survival of the Fittest in a Fiercely Competitive Marketplace', Basel, Bank Sarasin, 30 November 2011, accessed at http://www.sarasin.ch/internet/iech/en/index_iech/news_iech?reference=132800&checkSum=DD6511E0132EE829C7AFA39B3E55ABFF on 15 February 2012.

Siegfried Dais, Deputy Chairman of the Board of Management of Robert Bosch GmbH, expects solar power to reach grid parity in Germany by 2019.[92] Until that time, the solar industry will remain dependent on subsidies. But the Sarasin study predicts that a large number of the German solar companies will not be around at that time, even if the subsidies are maintained over the coming years. According to their sustainability study, smaller solar businesses will not benefit from economies of scale to the degree that they would have to in order to prevail in international competition. Fawer and Magyar, along with many other analysts, expect the industry to undergo a major shakeup in the coming years. After this consolidation of the industry, the remaining businesses are expected to lead another period of growth, as solar is projected to attract growing interest in many parts of the world, for example in India.

Thus, for now Germany's solar industry remains dependent on subsidies. Yet it is projected that even with the help of subsidies a large number of firms will not survive the competition. This begs the question: Is maintain the costly feed-in tariffs the right course of action? This study comes to the conclusion that (continually decreasing) subsidies are indeed still needed up to 2020. It is important for the industry to have a stable investment climate. Further, a drastic cut in subsidies would lead to a sudden drop in demand, leaving the struggling industry with no time to adjust to the economic trends. Many companies will indeed not survive the competition, yet maintaining the subsidies

[91] See D. Powell et al., "Crystalline Silicon Photovoltaics: A Cost Analysis Framework for Determining Technology Pathways to Reach Baseload Electricity Costs', *Energy and Environmental Science*, February 2012. This study by researchers at the Massachusetts Institute of Technology estimates that solar power will reach grid parity in the United States by 2020, when solar power will be cheaper than electricity generated from coal.

[92] 'Im Gespräch: Siegfried Dais, der stellvertretende Vorsitzende der Geschäftsführung der Robert Bosch GmbH "Das Solargeschäft ist kein Selbstläufer"', *Frankfurter Allgemeine Zeitung*, 7 February 2012, accessed at http://www.seiten.fazarchiv.de/FAZ/201202073393340.html on 20 February 2012.

programme over the coming years, coupled with a phase-out plan, will prevent a more disorganised restructuring and give the industry the chance to reorganise through mergers and streamlining in order to develop sustainable business models. This will leave the German solar industry in a better position further down the road and will also help to absorb some of the inevitable negative consequences of the shakeup, most importantly job losses.

Yet the level of the subsidies could be more directly tied to efficiency gains in the industry. Further, a greater share of the subsidies might be better allocated towards research and development (for example through tax breaks or loan guarantees) rather than feed-in tariffs. Finally, a definite phase out should be announced as early as possible in order to ensure that solar companies focus their efforts on developing sustainable business models.

5. Conclusions and Recommendations

The EU has set itself ambitious targets to expand its eco-industry by 2020 and beyond. As a global leader in green technologies, it is in a good position to achieve its objectives and, in addition, to generate growth and to create green jobs.

Nevertheless, the Union is facing great challenges. On the one hand, global competition in environmental technologies is increasing rapidly; on the other, the EU must

do its homework and tackle structural deficiencies. First and foremost, the financing of green technologies will be a central issue in achieving the 20-20-20 objectives.

In order to preserve its current competitive advantage, the EU will need to mobilise considerably greater amounts of venture capital than it has in recent years. To be able to do so, new investment forms, sustainable financial products and more transparency on the side of the eco-industry are necessary. The example of Germany shows that decisive actions by policymakers are a prerequisite for sustainable development. At the same time, however, it illustrates that public incentives and subsidies alone are not sufficient. Rapidly increasing labour costs in the German solar industry and recent job reductions—*inter alia* due to Asian competitors who produce at lower prices—show that a constant technological edge is necessary to stay competitive. To achieve this, public investment in R&D projects as well as subsidies and incentives for green technologies will remain necessary. In the short, medium and long term, however, the greater involvement of private capital is indispensable to prevent imminent financing gaps and to achieve the 20-20-20 objectives.

A common approach by politicians, businesses and the financial industry (particularly banks and insurance companies) is necessary to attract more venture capital, to establish new investment forms and to create more transparency on the side of the eco-industry. This common approach requires policy measures to be taken and framework conditions to be met.

Summing up, policymakers should consider establishing a forum for dialogue among stakeholders in the financial industry, potential investors from traditional industries and

governments at the EU level. Possible goals for such a forum include:

- promoting *capital funds and corporate venture capital funds* of established companies at the national and EU level;
- creating greentech funds designed as *Public Private Partnerships* that provide venture capital for start-ups and technology innovation projects;
- introducing guidelines that require banks and insurance companies to accentuate the *sustainability criteria of specific investments* and to regularly provide customers with information on the relevance of sustainability criteria whenever their money is being invested. This could contribute to awareness-raising for, and an increase in, sustainable investments (even in the case of the comparatively lower profits of specific green investments).

As we noted in this paper, *risk mitigation* and confidence building are crucial for the mobilisation of new investments in green projects. Therefore, the following measures should be considered as well:

- *increasing transparency* on the side of the eco-industry through the establishment of key performance indicators for sustainable development as a part of annual business reports in specific branches;
- establishing EU-wide common investment and evaluation criteria for *greentech-funds*, such as 'degree of innovation', 'strategic competitive advantage of the specific project/technology', 'growth potential', 'opportunity/risk profile', etc.;

- elaborating an EU-wide definition of 'green' and common standards and methodologies for the assessment of green projects;
- establishing a *rating agency* that sets these standards, monitors and evaluates projects, offers reliable information and thereby approves green projects;
- improving the *statistical assessment of the European eco-industry* (NACE classification). Eurostat trade data focus primarily on goods. In the future, relevant sub-sectors of the eco-industry should be better identified. Services, for example, are an important part of the eco-industry and should therefore be covered as well.

In the areas of energy subsidies, incentives and support schemes for the eco-industry, the following measures should be considered:

- establishing a harmonised *energy subsidy reporting framework* on the basis of an EU-wide agreed definition of 'subsidy' as a first step towards a revision of the structures of renewable energy subsidies;
- *maintaining renewable energy subsidies.* Numerous in-depth studies[93] on the European eco-industry have concluded that the substantial involvement of national support schemes and, moreover, additional alternative financial instruments (private investments) will be necessary if Europe is to meet its 2020 targets;

[93] See, for example, ECORYS, Research and Consulting, *Study on the Competitiveness of the EU Eco-industry* (Brussels, 2009), accessed at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=5416 on 13 January 2012; ECOFYS, *Financing Renewable Energy in European Markets* (Utrecht, 2010), accessed at http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf on 10 January 2012.

- phasing out harmful subsidies. Institutions such as the IEA and OECD have emphasised the challenge of phasing out environmentally harmful subsidies in numerous studies.[94] According to the IEA's *World Energy Outlook 2011*, for example, the costs of fossil fuel subsidies generally outweigh the benefits. Hence, a *phase-out of subsidies for fossil fuels* in favour of renewable energy subsidies is recommendable. A next step should be the promotion of a phase-out at the Rio+20 United Nations Conference on Sustainable Development on 20–22 June 2012. The adoption of a *Green Economy Roadmap* that includes clear, achievable objectives and global goals, timeframes and progress monitoring instruments should be pursued (details to be negotiated). If this cannot be implemented at the UN level, an alternative would be to adopt these within the OECD framework or at the EU level.

For the promotion of a better-integrated green labour market, the following recommendations are pertinent:

- promoting environmental skills: the introduction of harmonised focussed *environmental technology degrees* including EU-wide curricula; EU-wide job training programmes initiated by private companies; and lifelong learning initiatives to assure an adequately trained labour force;
- establishing new and the continuation of existing *forums for the exchange of information among*

[94] See, for example, OECD, *Subsidy Reform and Sustainable Development: Economic, Environmental and Social Aspects* (Paris, 2006); OECD, *Subsidy Reform and Sustainable Development: Political Economy Aspects* (Paris, 2007); International Energy Agency, *World Energy Outlook 2011* (Paris, 2011); TEEB, *The Economics of Ecosystems and Biodiversity for National and International Policy Makers* (2009), accessed at http://www.ieep.eu/whatsnew/newsitem.php?item=212 on 15 February 2012.

researchers, businesses and technical schools to improve eco-construction skills;

- the establishment of *forums between industries* in order to bridge information shortages between eco-industries and other industries. As environmental technologies are very complex, potential clients sometimes are not aware of applications, technologies and methods available to improve their competitiveness. The EU Framework Programmes could form the institutional framework for such forums.

Last but not least, it should be noted that the removal of trade and investment barriers between countries with renewable resources is generally favoured. A trade policy that contributes to a more *level playing field* enables producers and service providers to grow. Therefore, the development of globally comparable certification and labelling procedures is necessary, while the *removal of trade barriers* in general ought to be addressed in the appropriate fora (EU Commission, WTO, etc.). In this context, however, it is necessary to point out once more that subsidies for the eco-industry *are not* a sustainable long-term solution. As long as renewable energy sources are not economically viable because they have not reached price parity with conventional energy sources, subsidies are necessary to achieve the EU's 20-20-20 objectives. Nevertheless, over the medium to long-term, a 'level playing field' means phasing out subsidies for fossil fuels and renewable energy sources. Measures to achieve this goal should be undertaken today (see above).

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This paper examines the current state of renewable energy in the European Union (EU). It outlines the evolution of the EU's renewable energy policy, assesses the current status of renewables within Europe's transformation toward a green economy, analyses the challenges that the Union currently faces in this effort and, finally, formulates policy implications. The authors identify the need to mobilise adequate amounts of private investment capital as the most pressing current challenge to ensure the eco-industry can grow sustainably. Further, public investment, especially in the R&D sector, remains necessary until green technologies become economically viable on their own. Subsidies and public incentives have helped get the young eco-industry off the ground and should not be discontinued before renewable technologies have achieved price parity. Instead, this study recommends starting with the phase out of fossil fuel subsidies now. Nonetheless, the planning for a definite phase out of subsidies for renewables should also be undertaken and written into law in tandem with the phase out of fossil subsidies to help ensure that all energy technologies compete against each other on a level playing field as soon as possible.

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