Green New Deal Series volume 3

GREEN EUROPEAN FOUNDATION

Sustainable Industrial Policy for Europe

Governing the Green Industrial Revolution

HEINRICH BÖLL STIFTUNG

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Green New Deal Series volume 3

Sustainable Industrial Policy for Europe: Governing the Green Industrial Revolution

Memorandum on guiding principles and perspectives for the green transformation of the European industry

A memorandum by the Öko-Institut e.V.

Authors:

Christian Hochfeld
Claudia Kabel

Hendrik Acker
Regine Barth
Carl-Otto Gensch
Beate Kallenbach
Gerhard Schmidt
Christof Timpe

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Commissioned and published by:

GEF
GREEN EUROPEAN FOUNDATION

HEINRICH BÖLL STIFTUNG

Table of contents

Published by the Green European Foundation
Printed in Belgium, March 2010

Text editing and coordination: Dorothee Landgrebe and Leonore Gewessler
Copy editing: Robert Furlong
Production: Micheline Gutman

Printed on Cocoon 100% recycled paper

Cover photograph: Luis Ceifao - Fotolia.com

This publication has been realized with the financial support of the European Parliament.
The European Parliament is not responsible for the content of this project.

This publication can be ordered at:
The Green European Foundation – Brussels Office:
15 Rue d'Arlon – B-1050 Brussels – Belgium
Tél. : +32 2 234 65 70 I Fax: +32 2 234 65 79
E - mail: info@gef.eu I Web: www.gef.eu

Green European Foundation asbl
1 Rue du Fort Elisabeth – 1463 Luxembourg

Foreword

We are at the dawn of the "Third Industrial Revolution". That is the premise of the Institute for Applied Ecology's memorandum "Sustainable Industrial Policy for Europe – Governing the Green Industrial Revolution," published by the Green European Foundation and the Heinrich Böll Foundation.

Climate change and the depletion of oil reserves and other natural resources are changing the energy and resource landscape of our economies. This will have far-reaching consequences. Shifts in the fuel base of industry have always affected all economic sectors and all levels of society. On the one hand, there is potential for crises and social conflicts. On the other hand, such shifts present an opportunity for technical, social and political innovation. Industrial transformations of this kind prompt a revaluation of capital and of professional skills, and necessitate a redistribution of wealth within and between sectors and regions. These changes are already taking place, with the strong growth in renewable energy production and eco-efficient technologies being their most recent and visible manifestation. The question, therefore, is not whether these radical economic and societal transformations are a reality, but rather whether and how this "revolution" can be steered.

Traditionally, industrial policy has rather hindered sustainable development than fostered it. The latest example of this, to name but one, is the massive state aid for Opel. Given this track record, there is widespread scepticism among environmental and social movements about the merits of conventional industrial policy. Nonetheless, industrial policy will always be the main tool shaping the production sectors of our societies. This memorandum clearly states: To have no industrial policy is not a political option.

At a time when Europe is discussing its EU2020 strategy and searching for a vision of economic development, there is clearly a window of opportunity to implement a new and different industrial policy that supports the green transformation of our societies.

The memorandum calls for a "Sustainable Industry Policy" (SIP) that actively shapes the transformation process, taking environmental, social and economic aspects into account.
As a first step it analyzes the shortcomings of current industrial policies at the national as well as European level, and subsequently highlights goals, guiding principles, and measures of implementing sustainable industrial policies for Europe. Finally, it outlines an integrated monitoring and evaluation method assessing the state of industrial policy with regards to the pre-requisites of a shift toward sustainability. Inter-linkages between sustainability and industrial policy must be transparent to understand the strengths, weaknesses, and inter-connections of different policy approaches.

Our ambition for this memorandum is for it to make a valuable contribution to the ongoing discussion about the EU 2020 strategy and for it to provide additional input and guidance to policy makers, the industrial sector, civil society and citizens on the political steering that this Third Industrial Revolution demands.

Dorothee Landgrebe
Head of Department Environmental Policy and Sustainability
Heinrich Böll Foundation

Claude Weinber
Secretary General
Green European Foundation

Executive Summary

When the elaboration of the "Europe 2020" strategy began, as a follow-up of the so-called Lisbon strategy, the European Commission argued in its draft that this strategy should take the end of the current economic crisis as the starting point for *"a new sustainable social market economy, a smarter, greener economy, where our prosperity will come from innovation and from using resources better, and where the key input will be knowledge"*. This memorandum sets out to contribute to the discourse on how the green transformation of European industry can be governed by new guiding principles and perspectives on Sustainable Industrial Policy.

Against the background of the global environmental crisis heralded by the dawn of climate change, the increasingly dramatic loss of natural resources, and the degradation of biodiversity, it is necessary to change our economic structures in a way that exceeds marginal structural improvements. To reach the demanded degree of decoupling of economic growth and use of limited resources, such a change must include the adaptation of existing – as well as the design of emerging – industrial structures. What we need is a Green Industrial Revolution! In our view a new industrial policy approach is urgently needed to induce and govern this Green Industrial Revolution. This new approach, which we call "Sustainable Industrial Policy" (SIP), shall become a key policy field for designing and coordinating the necessary policies in order to actively shape the transformation of European industry. In aiming beyond competitiveness, it builds on a wider understanding of the objectives of industrial policy, taking into account the responsibility to contribute to solving the global environmental and social crisis. It is essential that a Sustainable Industrial Policy acknowledges the ecological imperatives of combating climate change, protecting natural resources, and conserving biodiversity. At the same time, it will have to cope with the enormous social and financial implications of the transformation of current industrial sectors into sustainable structures.

A critical examination of EU and national industrial policies shows that traditional industrial policy has often focused up to now only on short-term economic objectives. Industrial policy in the EU has not sufficiently addressed the apparent conflict of ecological imperatives and national economic performance, thereby hindering the structural change needed for sustainable development. There are already positive approaches that are moving in the right direction, such as the German Federal Ministry for the Environment's concept of ecological industrial policy and the Swedish EU Presidency's call for an eco-efficient economy. However, European industrial policy supporting the Lisbon strategy continues to sacrifice basic social and environmental requirements to short-term economic demands. This is why a radical strategic change of guiding principles and perspectives is needed for industrial policy in Europe and its member states.

Sustainable Industrial Policy needs to start by "thinking from the targets": The environmental imperatives need to be converted into clear, quantified targets. For example, with regard to climate change, the target is to limit the increase in global temperature to a maximum of 2 degrees centigrade above pre-industrial levels. For the other imperatives, comparable targets will also have to be defined. Industry policy measures will have to be assessed in terms of their contribution to reaching those targets. On the basis of this set of targets, strategies and implementing measures have to be developed in a roadmap for the Green Industrial Revolution.

Sustainable Industrial Policy will fail if it is not aligned with other relevant policies; mainstreaming the goals into all relevant policy fields is essential. In order to cope with the possible inconsistency of instruments used in different policy fields and sectors, use of horizontal instruments will often prove helpful. Governments have to consciously assess the impacts of existing policy on industry and make use of a broader set of instruments at hand to build a sound policy framework to facilitate green transformation. This not only relates to traditional industrial policy measures but also includes a much wider array of tools such as economic, informational, cooperation, and educational instruments. Regulatory approaches in particular will have an important role to play. Traditionally, industrial policy regulation has often been understood as avoidable interventionist industrial policy. We understand regulation in industrial policy as avoiding interventions such as unsustainable subsidies ("cash for clunkers") or picking winners.

Internalization of external costs has to be widely used to make markets work efficiently and ensure optimal allocation of limited resources. However,

acknowledging the limits on monetarization of external ("true") costs, realistic policy must not rely entirely on price mechanisms. A veritable Sustainable Industrial Policy also needs to be aware of its global dimension and calls for globally responsible and harmonized action.

As a first step to the implementation of SIP, non-sustainable industrial policy measures need to be identified and removed. In addition, it is necessary to address the demand side as well, by shaping consumption patterns and associated impacts. And as the public sector will not be able to raise the finances needed to build sustainable industrial structures, it is also crucial that public funds are accompanied by appropriate policy frameworks to help leverage private financing. In order to achieve the essential technological innovations, important tools such as more dynamic marked-based instruments are needed.

As a next step toward implementation, it is proposed that Sustainable Industrial Policy Monitoring (SIMON) is used at the European and member state levels to assess the progress made, based on horizontal and sectoral industrial policies, with regard to the changes needed to meet the challenges of a Green Industrial Revolution. Such monitoring can provide a fact-based foundation for a broad multi-stakeholder discourse on future Sustainable Industrial Policy, which should be initiated and coordinated by a High-Level Group on Sustainable Industrial Policy.

The fundamental need for structural change of the EU economy (according to the objectives of a level playing field that is environmentally friendly), related challenges, the opportunities of a Green Industrial Revolution: all point to the necessity of Sustainable Industrial Policy. There has always been industrial policy in Europe and its member states and we expect that there will always be industrial policy. Given its crucial impact on green transformation, we do not regard having no industrial policy as a political option. But at the same time, industrial policy that does not make a greater contribution to environmentally sound sustainable development is not an option either.

1. A Call for Sustainable Industrial Policy for the Green Industrial Revolution

"I believe we are now standing on the brink of a Third Industrial Revolution: the Low Carbon Age [...] Like the previous industrial revolutions, this will be driven by technology and new forms of energy. It will also transform our societies [...]".

José Manuel Barroso, President
of the European Commission[1]

The world today is characterized by a global crisis of environmental nature with the dawn of climate change, of social nature with ongoing poverty and food and water shortages, as well as the financial crisis that has destabilized economic systems, including those of the industrialized world. As analyzed by Jänicke and Jacob, especially in Europe, the current economic situation could be described as the beginning of a Third, or **Green Industrial Revolution** (Jänicke and Jacob 2009). In the First and Second Industrial Revolutions, the availability of fossil fuels for industrial production – coal and oil – initiated profound changes to labor productivity, as well as technological and economic changes in transport, production, and consumption patterns. Industrial mass production based on cheap energy and raw materials and a limited focus on economic competitiveness dominated the industrialized economies in the 20th century, leading the world to its ecological limits and even beyond.

In comparison to the First and Second Industrial Revolutions, today's economic situation in Europe and Germany could be defined as a preceding phase of a Third, or Green Industrial Revolution, where basic innovations are developed and prepared for the market. The preceding phase of this green revolution is characterized by unexpectedly strong growth of renewable energies and new low-carbon or eco-efficient technologies and coexistence between "old" industrial structures and emerging "new" economic structures. As this transformation is not restricted to traditional industrial sectors, since it affects all important economic sectors and includes social consequences with a high potential for distortions and social conflicts, it is described as the third revolution.

The ecological imperatives to combat climate change, protect natural resources, and conserve biodiversity must urgently be integrated in a future industrial policy approach, a concept of Sustainable Industrial Policy (SIP) and become a core part of economic decision-making. Up to now, climate change has been the most immediate threat, but the increasing consumption of resources also needs to be addressed. These ecological imperatives define immovable barriers, "crash barriers," or safety lines that must be seen as converging barriers that critically limit the scope of possible political action in the next 40 years.

The beginning green revolution also can be illustrated by the concept of peak and return in emissions as well as resource consumption due to resource constraints. We are already facing peak oil limits and, in order to combat climate change, we need to reach a peak of greenhouse gas (GHG) emissions in the next 5 to 10 years with a subsequent absolute decrease of emissions in Europe up to 95 percent by 2050 compared to 1990. As an instrument to govern fundamental change of economic structures, the discussed Sustainable Industrial Policy concept can play an important role in steering this change.

Due to global environmental challenges such as climate change, as well as the dramatic, increasing loss of natural resources and degradation of biodiversity, a change in economic structure that exceeds marginal structural improvements is necessary. So far, no technological improvement scenario is in view that could initiate the needed degree of decoupling between economic growth and use of limited resources.

The close interconnection and interdependence of economic, social, and environmental issues need a veritable sustainable approach. On a long view, there will be no way out of the economic crisis without stopping the overconsumption of resources by addressing goals beyond competitiveness. There will be no broad societal acceptance of a green transformation without addressing social aspects and no successful environmental policies without integrating economic mechanisms of production and consumption.

1 Barroso (2007) in his speech "Europe's energy policy and the third industrial revolution," held on October 1, 2007 in Madrid.

In our view, a new industrial policy approach is urgently needed to govern the green revolution via transformation of the European industry. SIP will be the key policy field to actively shape the transformation of economic structures as discussed in this memorandum. At a time when Europe is discussing the EU2020[2] strategy and searching for a vision for economic development and several member states have started fostering renewable energies and eco-efficient technologies, we see a good window of opportunity for a new industrial policy that will support the transformation of our societies.

In this transition period, comprehensive steering and decisive action is essential for answering adequately the environmental, social, and economic challenges of the present and future, and essential in order to avoid disruptive, unpredictable changes as far as possible. **Therefore, having no industrial policy is not a political option.**

In our memorandum, we discuss the possibilities of governing a Green Industrial Revolution through a Sustainable Industrial Policy from EU and member states' points of view. At the beginning, we introduce the definition and scope of industrial policy in general in the following chapter 2. Following that, we analyze the needs, challenges, and opportunities of the Green Industrial Revolution and SIP for political steering of the necessary industrial transformation processes in chapter 3.

With the concepts of modern and post-modern industrial policy, ecological industrial policy (EIP), the EU action plan on Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP), and the concept of an eco-efficient economy, we would like to give important examples for recent developments of industrial policy approaches regarding environmental issues and targets in chapter 4. This chapter concludes with a listing of the necessary prerequisites for an SIP concept. Against this background of the necessary prerequisites, chapter 5 presents SIP goals and guiding principles as well as implementation measures to achieve those goals. In chapter 6 we provide a proposal for a monitoring concept to assess the state of horizontal and sectoral industrial policies with regard to the necessary changes to meet the challenges of sustainable development and the green industrial transformation. This will include a proposal for a multi-stakeholder dialogue on a sector basis on how the most important industrial sectors may deliver on long-term environmental and social goals.

As shown before, Sustainable Industrial Policy aims to enforce the needed fundamental innovations and structural developments of industrial sectors – the Green Industrial Revolution. As of now, there are limitations to these concepts that need to be addressed in further discussions. If structural change implies a limitation of economic growth and how knowledge and technology transfer to emerging economies can be integrated in an industrial policy concept, these are issues that are closely connected with the goals of industrial policy. Those issues are highlighted in chapter 7.

2 COM (2009) 647/3 prov.

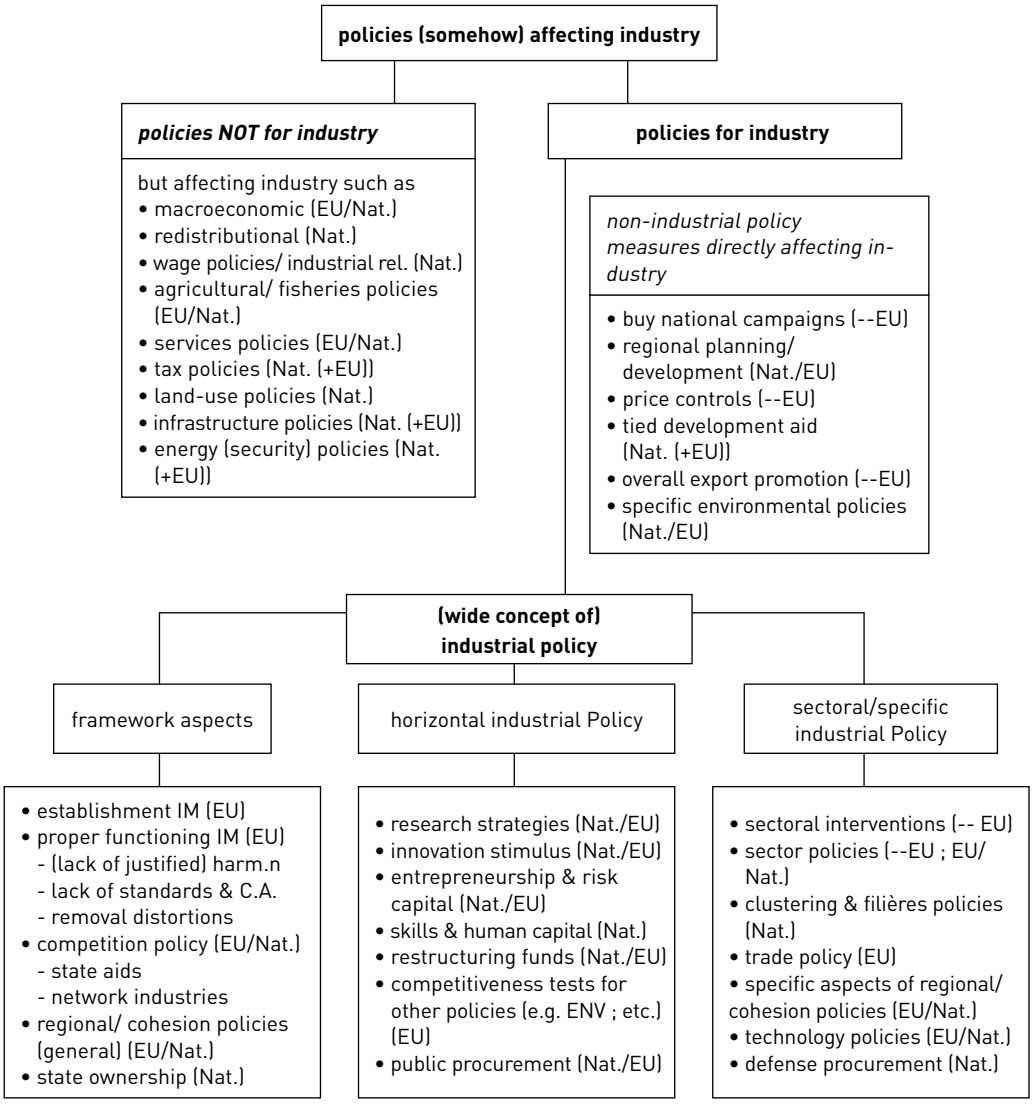
2. The Concept of Industrial Policy

2.1 Industrial policy in the European Union

There is still no generally agreed definition of industrial policy. From a traditional point of view, industrial policy is defined as political decisions and measures that have an impact on the structures and development of the industrial manufacturing sector. As part of economic policy, traditional industrial policy is understood as being part of structural policy and includes those decisions and measures that are directly and intentionally aimed at changing industrial structures.

There is a great deal of confusion about what industrial policy is, a confusion only surpassed by the confusion about what *European* industrial policy might be. The latter is even more complicated because there are ample constraining powers at the EU level *vis-à-vis* member states' instruments and their uses, while at the same time, those at the EU level itself are also restricted in

Figure 1 Definition and scope of industrial policy (Pelkmans 2006)



Notes :

EU	➔ EU powers	Nat./EU	➔ shared powers, mainly national
EU/Nat.	➔ shared powers	Nat. (+EU)	➔ national & EU constraints or marginal inputs
Nat.	➔ Member States' powers	--EU	➔ little national leeway, strict EU constraints

their actions and do not dispose of anywhere near the same range of tools that those in the member states might employ. In the European Union, industrial policy is pursued at (at least) two levels of government: the EU level and the member state level.

Figure 1, taken from Pelkmanns (2006), should help to reduce such confusion to an appreciable extent. It combines three features: a comprehensive classification and definition of industrial policy and other policies that somehow influence industry, a six-fold breakdown of how EU and national powers are related. The classification begins by distinguishing two sets of policies that influence industry, yet are not part of industrial policy, namely, "policies *not* for industry that affect industry", for obvious reasons (such as macroeconomic stability with fiscal and monetary instruments; redistributional tools; agricultural and services policies; tax policy; energy; land-use, and so on) and "policies that directly help or constrain industry but are *not meant* (only) for industry" (such as price controls, buy-national campaigns, targeted development aid, or environmental policies addressing specific hazards such as poisonous chemicals or smog). The remainder is defined as a "wide definition of industrial policy" and consists of three building blocks: framework aspects, horizontal industrial policy, and sectoral and specific industrial policy.

Even a wide definition of industrial policy will not encompass all influences on industrial structure and performance. Conversely, when trying to encompass all such influences, the term industrial policy eventually becomes meaningless. The bottom half of Figure 1 already stretches the definition very far.

The **framework aspects** follow directly from what the EU is. The European Union is, in economic terms, essentially an economic and monetary union. The *Economic Union* consists of the internal market (an extremely comprehensive concept with a strong legal basis and powerful institutional backing) and the set of "cohesion" policies. The framework aspects will not be stressed much, as they will not be focused upon much in this paper. The boundaries between the framework aspects and horizontal industrial policies are not always clear-cut and the distinction between the two is, at times, fluid.

Horizontal industrial policy is of relatively recent origin and the main emphasis nowadays in the Union. A clear definition of what "horizontal" means in actual practice is not easy. The term probably originates from the desire not to intervene sectorally (vertically) and to defend policymakers against ad-hoc pressures for rescue operations and direct interventions in individual enterprises. Such "specific" industrial policy, another term often used, is not desirable in case declining industries or badly performing companies ask to be helped by the state, nor is the state any better than market players at "picking winners" for the future (see below). Horizontal industrial policy measures – as they are specified in the middle box at the bottom of figure 1 – are influenced by the EU level when imposing disciplines on national industrial policies under some of these rubrics.

Sectoral and specific industrial policy lies at the origin of the Community. European economic integration began in 1952 with a "deep" free trade area in coal and steel. The legal commitments consisted of a combination of intra-ECSC (European Coal and Steel Community) free trade in coal and steel with extensive actual and potential interventions in the sectors, including investment plans and even the administrative organization of intra-ECSC trade. Three decades ago, an entire range of sectors were subject to sectoral European industrial policy of the old variety, in one way or another, via the relaxing of state aid supervision, explicit (often "gray") protectionism, special regulations, anti-dumping, and so on. Around 1980, the range came to include cars, aircraft, shipbuilding, coal, steel, textiles and clothing, railway rolling stock, telecommunication equipment, consumer electronics, and so on. Picking winners – meaning the direct support of rather big companies that were important for economies of the EU or individual member states – took place as well in often ingenious ways. Looking back on the ECSC five decades later, the contrast with today's economic thinking about the functioning of markets and specific interventions is rather sharp.

Sectoral and specific industrial policy of the old days has largely disappeared. In this sense, the sectoral and specific industrial policy of the EU has modernized and become far more modest. Sectoral interventions are limited to a few remnants of the past. Modern EU-specific industrial policy can have a sectoral slant but this should only be in a non-interventionist way. In contra-

diction to that, some parts of the recovery and stimulus packages of the EU and its member states were sectoral and interventionist, such as the "cash for clunkers" program in Germany, which stirred controversial debate with regards to cementing unsustainable structures in the car industry. So all in all, the sectoral and specific EU industrial policies are by no means dead, but have altered radically in nature as there is much more awareness that they are more, rather than less, non-interventionist.

Since 2000, industrial policy in the European Union has largely been dominated by the so-called Lisbon strategy.

2.2 Industrial policy and the EU-Lisbon strategy

The Lisbon strategy – the EU's strategy on growth and jobs agreed by leaders of the EU member states in Lisbon in March 2000 – is fundamental for the present-day EU approach to economic and industrial policy. The Lisbon strategy called for "a new strategic goal for the Union in order to strengthen employment, economic reform and social cohesion as part of a knowledge-based economy". The objectives of the Lisbon strategy were stated as:

- stimulating innovation and competition and investment in know-how;
- guaranteeing a level playing field in the single market and outside of it in third countries; and
- reducing frictions and transaction costs in the European economy, such as the administrative burden.[3]

With its strategic goal to make the EU "the most competitive and dynamic knowledge-driven economy by 2010," the Lisbon strategy is not a totally new orientation but a stronger focus on the acceleration of the competitiveness of the European economy and industries, which has important implications for the industrial policy of the EU and its member states. As a consequence, industrial policy has moved even closer to the hard core of European policy in the last 10 years. One of the main tasks of the Lisbon strategy was also to foster the coordination of an alignment of EU policy and the policy of the member states, as the EU has often only indirect influence on industrial policy. But in this regard the Lisbon strategy largely failed. European industrial policy measures were mainly not backed by national governments. Especially in times of economic crisis, they are even contradicted by national measures with protectionist intentions. In addition, the strong rules for the internal market, different national interests, and scattered decision-making processes hindered the implementation of a more comprehensive and strategic industrial policy. That is one of the reasons why it is more and more a common belief that the objectives of the Lisbon strategy cannot be reached by this year (Kaiser 2009).

But even if the Lisbon strategy had been more effective and successful regarding its tight objectives, the Lisbon strategy and the related focus for European industrial policy would still have missed on delivering the essential sustainability goals of the European Union, which are part of the Sustainable Development Strategy of the EU.

2.3 Industrial policy and sustainable development

In 2001 the EU Council agreed in Gothenburg on the Sustainable Development Strategy (SDS) and reviewed it in 2006. Already in 1998, heads of government agreed to set up strategies to integrate environmental considerations into their activities (environmental integration strategies) based on Article 6 of the EC Treaty beginning the so-called Cardiff Process, which was reaffirmed by the Sixth Environmental Action Programme for 2006–2012. In its review of the SDS 2009, the European Commission stated that sustainable development is linked to a "low-carbon, knowledge-based and resource-efficient economy" (COM 2009 400). As a basic principle of EU policy, the SDS strategy is of more formal importance, although the Lisbon strategy has gained much more political momentum and strengthened deregulation and neoliberal trends in the EU and its member states. In the Commission's 2009 progress review, even a streamlining of the role of the SDS strategy in its relation to other EU strategies was demanded. Even though the Lisbon strategy formally proposes to drive job creation alongside environmental and social policies, it focused practically on growth and competitiveness. As a key policy of Mr. Barroso, president of the European

3 http://ec.europa.eu/enterprise/policies/industrial-competitiveness/industrial-policy/index_en.htm

Commission, the Lisbon strategy influenced and still influences large parts of EU policies in a one-dimensional economic way. This does not comply with the fundamental goal of sustainable development and does not address effective measures to reach environmental goals such as securing the protection of natural resources.

Already at the High Level Conference "Industrial Competitiveness: challenges opportunities, and the role of policy in difficult times," former Vice-President of the European Commission and Commissioner for Industry and Enterprises Günter Verheugen in March 2009 in Brussels concluded that the Lisbon strategy and the related industrial policies failed to contribute toward the transformation of the European industry regarding sustainable low-carbon development. He also called for a new – green – industrial revolution that enables human welfare in the environmental limits.

Against that background, we see the crucial need for an integrated strategy of the EU after 2010, and the related industrial policy will have to address the environmental challenges of sustainable development as a Sustainable Industrial Policy to govern a **Green Industrial Revolution.** The following chapter describes in brief the challenges and opportunities of such a Green Industrial Revolution.

3. Challenges and Opportunities of the Green Industrial Revolution

3.1 The idea of the "Green Industrial Revolution"

The term "Green" or "Third Industrial Revolution" refers to a comprehensive upheaval that has already been labeled by other authors as a "green industrial transformation," "efficiency revolution," and a fundamental transformation toward "green capitalism". US President Barack Obama has proposed a "green energy revolution". And the IEA (2008) refers to a global "energy technology revolution" in a narrow sense. Some authors have used the term "industrial revolution" without addressing the environment as a central theme. These different contributions all stress the radical nature of both the necessary and possible technical change. Furthermore, they all share an expectation of phases of abrupt change. This paper mainly shares the analyses and observations of Jänicke and Jacob (2009), which form the foundations for the descriptions in the following section.

In general, two different understandings of the concept "industrial revolution" can be identified. Whereas the narrow understanding only refers to a change of the energy base, the broader assessment includes the comprehensive changes in energy; technological, ecological, and social conditions; and the necessary governmental leadership.

"Industrial revolution" should be understood as a radical and abrupt but also long-lasting ("secular") change at all levels of society. Due to fundamental technical innovations in the energy field – especially in generation and utilization – a new balance between the economy and the institutional framework is developing. Industrial revolutions are also the result of radically innovative answers to development crises in the global economy.

Numerous suggestions for categorizing and dividing transitions can be found in the literature. These terms are especially meaningful if they define the relevant differences between the transitions. The production methods, means of transportation, raw material, energy base, and social changes of the First Industrial Revolution in the 18th century are very different from the mass production, mass communication, and mass democracy of the Second Industrial Revolution in the 20th century, with its development of electrification, motorization, chemicalization, and use of concrete. These modes of industrial production have become unreliable since the end of the 20th century. The limitations of the fossil energy base, which carried the first two industrial revolutions, has become apparent. The fact that clear alternatives have already been heralded justifies the concept of another, Third Industrial Revolution, thus emphasizing the growing urgency of this

Table 1 From the First to the Third Industrial Revolution (Jänicke and Jacob 2009)

	1st Industrial Revolution: 1780-	2nd Industrial Revolution: 1890-	3rd Industrial Revolution: 1990-
Dominant technology and raw material	steam engine, power loom, iron processing	electricity, chemistry, combustion engine, assembly line	ICT, microelectronics, new materials, cleaner technology
Dominant energy source	coal	coal, oil	renewable energies, energy efficiency
Raw material	steel	plastics	renewable raw material, biotech, recycling
Transport/ communication	railway, telegraphy	car, plane, radio, TV	high-speed railway systems, internet, mobile telecommunication
Society/state	liberal state, freedom of trade, constitutional state, property rights	welfare state, mass production, mass society, parliamentary democracy	environmental state? civil society, globalization, global governance
Core countries	UK, Belgium, Germany, France	USA, Japan, Germany	EU, USA? China ? Japan?

transformation and the dramatic need for political steering.

The current crisis of resource-intensive growth – irrespective of innovative activity – extends beyond the current capabilities of markets and civil society to manage the crisis. Framework conditions must change radically. This also applied to the first two industrial revolutions. The first one – through its new requirements of free trade, property rights, market development, and societal division of labor – increased the pressure for the creation of the rule of law and the political participation of citizens and the bourgeoisie ("liberal revolution"). The second – with its transition to mass production – necessitated a minimum of social standards and thus, social redistribution ("social revolution") occurred. With the introduction of social security systems, the social costs of industrial labor, which had previously been largely externalized, were internalized or compensated to a certain degree. As a result, purchasing power emerged, which in turn allowed for vast growth.

The emergence of both the liberal state and the welfare state were characterized by serious conflicts, expressed by parties, social groups, and ideologies. An important part of these conflicts was a re-evaluation of physical and human capital: Innovations regularly devalue investments, resources, and skills connected to them. Often those who are negatively affected fight against these changes politically.

Similarly, the Green Industrial Revolution is not only a broad wave of innovation that will be potentially accompanied by welfare effects. It is about typical innovation conflicts. Economic sectors that have defined the exploitation of natural resources as their commercial basis see their existence threatened. They perceive this threat to be the competitive resource-saving and environmentally friendly technologies currently favored by civil society actors and regulatory measures. At the same time, compared to the innovators, the old sectors often have an advantage in terms of the political influence that they were able to gather in the previous boom. That is why "old industries" are often quite powerful. However, with the increasing technical and economic maturity of competing technologies, the political pressure on the affected sectors will increase, and in the end the capital flows reorient themselves in favor of new technologies. Continuing to generate electricity from coal, to promote nuclear power, and to disregard energy-saving and environmental protection in the automobile industry clearly show that there are relentless influential advocates for the conventional model of growth. These advocates are avoiding the pressure of innovation – very often with political support.

All industrial revolutions so far have been accompanied by the development of new functions and capacities of the state apparatus. The Second Industrial Revolution, for example, was connected with the extension of national state activity and public finance. Social core functions have been added to the economic core functions of the liberal state.

Since the 1970s in industrialized countries and the 1990s on a global level, a third basic state function in addition to the core economic and social duties has emerged. This new undertaking is in most cases even anchored in the constitution: the protection of the natural bases of life. In this sense many industrialized countries and the EU have taken important steps toward an "environmental state". This movement again is grounded in the political party spectrum as well as in the social institutional arrangement – German environmental organizations have nearly as many members as the trade unions (Jänicke 2007). Pioneering states that are leaders in this respect participate more intensively in international political processes and have political systems that tend to be more open toward new interests. Interestingly enough, these states are also more competitive on a global scale.

All three industrial revolutions also represent significant gains in importance of the global market. Already in the Communist Manifesto (1848) it was stated that the big industries were the ones that created the global market. Industrialization in its current state was only possible by building infrastructures that could transport energy sources, raw materials, and final goods to and from remote areas of the world at low prices unimaginable until then. The emergence of an international (however fragmented) legal system is connected with this globalization, and through standardization, regulation of cash, and commodity flows, etc., it represents another functional basis for global markets. These regional and international regimes are increasingly including environmental standards.

Severe recessions (1975, 1982, 1993) of the previous decades have demonstrated that the

production methods of the 20th century have reached their limits, both ecologically (chapter 3.1.1) and economically (chapter 3.1.2). This has found widespread acknowledgement only due to alarming climate change and the renewed energy price explosion. The increasingly unequal income distribution further strengthens the general demand for change (chapter 3.1.3).

However, these challenges are also accompanied by opportunities and an impressive potential for innovation. As has been the case in previous growth cycles, the crises of the current resource-intensive growth model also holds the opportunities of a new development model. For the first time, there is an opportunity to politically shape this radical industrial change. To unfold these opportunities, we need a targeted, politically reinforced, and structured change on a broad social basis and at all levels of the global system.

3.1.1 Environmental issues

Climate change and critical loss of natural capital

Global assessments of the state of the environment, for example the reports from the IPCC, the Millennium Ecosystem Assessment, or the Global Environmental Outlook, show that the carrying-capacity of the Earth in many regions and the impacts of climate change on a global level have reached critical limits. Most of the ecosystem services are in a state of advanced or continuous degradation (Millennium Ecosystem Assessment 2005). Central functions of nature, essential to both the preservation of life and economic systems, seem to be threatened. We live from the very substance of the planet itself. Yet, maybe most disturbingly, this is not a steady development. Instead, there are "tipping points" – when critical limits are exceeded and incalculable and volatile self-perpetuating developments are set in motion: The drying out of the Amazon Basin, the melting of the Antarctic ice, the slowing of the Gulf Stream, and the melting of the permafrost in Siberia with large-scale emissions of embedded methane are all critical areas affected by such self-reinforcing feedback mechanisms.

All of the current major assessments of the state of the environment – in spite of the regional differences – reveal a serious global environmental and ecological crisis and call for major changes to avoid the economic impacts. The costs of the damage due to climate change, including loss of biodiversity and natural resources, were calculated for a scenarion where climate protection was neglected: Global GDP will decrease by 5 to 20 percent according to the Stern Report (Stern 2007) and by an additional 6 percent by 2050 due to global deforestation (European Communities 2008). However, there can be no doubt that the resource-intensive growth pattern of the Second Industrial Revolution, particularly when its counterproductive economic effects are taken into account, cannot be sustained.

Resource conservation always comes down to environmental protection, whether it concerns the consumption of energy, natural resources, water, soil, or biodiversity. Climate change, in particular, calls for a broad new concept of resource use. Resource conservation also offers profitable solutions – covering and exceeding the costs of damage prevention.

Renewable energies and an increase in energy efficiency are crucial contributions to climate protection. Innovations in this field would considerably increase the potential for relative climate relief. Similarly, an efficient use of raw materials not only assists in increasing productivity but also environmental protection. The environment benefits from the reduction or substitution of material flows in many ways. Not least, because these are related to diverse burdens (transportation, secondary energy consumption, storage, dissipative losses), which are difficult to control without further regulations.

Beyond this, there is a broad ecological modernization of the whole industry that cannot be quantified and takes place usually within the enterprises. Such a mainstreaming of environmental concerns is also not restricted to the technological products of a certain environmental sector. The potential is considerably higher if efficiency improvements are not only undertaken within technology, but also if innovations occur within base functions and systems. The needs of habitation, sustentation, energy, and mobility have to be met, but this must not occur through existing dominant technologies.

3.1.2 Economic issues

Resource scarcity and increasing environmental cost

The limited availability of finite, cheap raw materials and, in particular, of fossil energies has reached its natural limit of growth. The present crisis of the car industry is only a symptom. Also, the high economic dynamics of the newly industrialized countries are impacting the development of prices: oil, copper, and steel are spectacular examples. Similar demand and price surges are to be expected for other raw materials. While some developments may be due to speculative markups and prices can be expected to decline temporarily, the markets react to long-term scarcities of raw materials and fossil energies. Resource efficiency becomes imperative for economic development, and is an indicator of success in the competition for innovations.

Even with renewable raw materials, we can see limits of availability: The land-use competition between food and bio-fuels is just one example. The extension of farmland at the expense of unspoiled natural lands is another. However, the struggle for land is not limited to competition between food and fuels alone. Renewable raw materials play an ever-greater role in the production of chemicals. Traditional users of biotic raw materials – be it the paper, furniture, or building industries – are also interested in growth.

According to the UN Global International Water Assessment, the availability of water will dramatically shrink due to changes in land use, climate change, pollution, overuse of drinking water, and further increases in industrial and agricultural demand in many parts of the world. Steppe formation and desertification are expected in numerous regions, which further increase the strain on the remaining fertile areas. Already current weather events have repeatedly devastated the food resources of many countries and regions.

Industrial transformations have previously taken shape around industry clusters and their related key technologies (e.g., the textile and iron industry in the early phase of the industrial revolution or the electrotechnic and automobile industry in later phases). The clusters contribute above-average to economic growth and, as a result, their share in overall economic output increases.

Innovations in environmentally-friendly, resource-efficient technologies have the potential to become key technologies for industrial transformation and thus lay the foundation for long-term industrial growth. As shown above, a growth process for technological environmental relief to avoid environmental damage is needed more than ever. From an ecological standpoint, new basic innovations in the areas of mobility, energy supply, agriculture, recycling, chemistry, construction, and telecommunications – all of which facilitate or are linked to a radically lower energy and resource consumption – are necessary.

The creation of lead-markets in the EU may result in regulative dominance (e.g., the EUROnorms for vehicles, the chemical legislation REACH, or the recycling of electronic devices), thereby leading to foreign providers adapting these standards. As a result, European environmental norms are adopted by other economic regions. This is the case also with some support programs, such as the German Renewable Energy Law, which was copied worldwide, including by some US states. The knowledge base, the capital, and the political and institutional environment all contribute to give Europe the opportunity to actively shape the process of a Third Industrial Revolution. That is the unique chance of the upcoming challenges.

3.1.3 Social issues

Modernization and social policy

The Second Industrial Revolution in the beginning of the 20th century allowed mass production to be accompanied by mass income, which supported the requisite trend of demand. The worldwide development of mass markets from the 1950s onwards led to a rapid increase in the use of natural resources and emission releases.

The internalization of social costs of labor with the help of social security systems gave a strong incentive to reduce the labor factor. This was accompanied by a rapid development of labor productivity, which caused structural unemployment in the 20th century. Economic crises and their social impacts deter the acceptance of more ambitious efforts to protect the environment and resources. Furthermore, under pressure from globalization, a broad redistribution at the expense of those with lower incomes has taken place. The question of fairness in the distribution of wealth and resources is also relevant to the

fact that the increasing consumption of luxury goods (e.g., vehicles) is linked to additional environmental pollution.

Another critical aspect is the need for substantial investment in human capital in view of the dramatically increasing knowledge-intensity of production.

The transformation needed will make it necessary to break with conventional ideas of development and growth in traditional economic branches. Traditional business sectors, their investments, their employees, and their skills are in danger of being called into question due to the challenges of an environmentally sound sustainable development and the related rise in energy and raw material prices and more demanding standards. In the long-term, renewable energies and renewable raw materials are potential sources of prosperity. Yet, the necessary funds for the development threaten to aggravate current inequality. The costs of environmental pollution and the costs of solutions could easily be dumped on those social classes that only have limited means to raise concerns. This not only threatens the acceptance of environmental policy but also the long-term purchasing power of lower socio-economic classes. Thus, the broad acceptance of comprehensive industrial modernization also has to be secured on a socio-political level.

As described above, the redistribution of income during former economic recessions at the expense of the lower classes may be seen as being at the limits of social acceptance. With regard to the need for investment in human capital described above, the rapid growth in eco-efficient technologies clearly shows how future technological breakthroughs will be connected with broad employment potential. But regardless of potential new "green jobs," it also has to be mentioned that jobs in some sectors will get lost due to necessary structural changes of the green industrial transformation. For example: If we see a middle- and long-term shift from cars with internal combustion engine to electric vehicles, engine production jobs might get lost, as they cannot be compensated by the production of electric motors or batteries. However, the basic question is whether the decisive basis for public revenue in the future should be labor income or resource consumption. If labor income is the main basis, the problem of mass unemployment will remain. Therefore, it is in general sensible to direct taxation toward environmental and resource consumption. Environmentally-related luxury taxes can be considered a source of revenue that can assist in income redistribution policies.

3.1.4 Governance issues

The first two industrial revolutions were characterized by a profound change in the concept of statehood. The present industrial revolution again represents fundamental changes in the political system and ways to respond to newly emerged problems and claims. This may already be observed in the emergence of a multilevel system of global politics, especially since the 1990s (e.g., the UN summit in Rio). But the magnitude and scope of the challenges and resistance by conventional interests show an urgent need for steering mechanisms. This is demonstrated by striking contradictions in the area of climate protection. On the one hand, the global public and politicians are terrified by the results of the 4th IPCC report (2007). At the same time, many countries are investing primarily in coal power (a capacity growth of 60 percent is expected till 2020) and investments in energy efficiency and renewable energies are often neglected. In general, while there is a broad societal consensus that environmental protection is needed, in cases of conflict of interest, decisions are often made at the expense of the environment. Thus far environmental policy has rather focused on "win-win" situations in which efficiency gains and environmental benefits can also be obtained from a microeconomic perspective.

The particular difficulties of environmental policy – limited capacity for intervention in the case of private property, spatial and temporal divergence of cause and effect, and the difficulty in coordinating players from different political fields and operational levels – have led to the creation of policy innovations extending the capacity for action (Jacob, Feindt et al. 2007). Examples include calculable target-setting, the internationalization of environmental policy, the inclusion of private players, and the development of new market-based and regulative instruments (Jänicke 2007). At the same time, the complexity of the actor constellation has dramatically increased, raising the question of final responsibility as well as accountability.

The challenges of the Third Industrial Revolution prove to be challenges for governmental and

societal steering. Fundamental to all steering mechanisms are:

(1) competent and globally networked governments capable of strategic action;
(2) informed voters and consumers open to innovation;
(3) a significantly higher degree of readiness for innovation on the part of companies and national economies; and
(4) a highly productive system of innovation.

These aspects are further elaborated in the following section for the different relevant societal groups.

Governments

The Third Industrial Revolution requires multi-level political systems with an extraordinary capacity to act. It is first and foremost a matter for the states, as there is no alternative to their legitimate powers and responsibility to pursue long-term public interests. States still possess considerable resources and expertise. In a crisis, the population always holds the state responsible first. Nevertheless, there is a lack of strategic capability. Long-term public interest policies have to be established in spite of short-term special interests, such as concerns of traditional industries and social groups that consider the long-term change to be a threat. Such persistent interests often have attained an influential position that innovative new sectors have not yet been able to achieve. Innovations are always ambivalent processes during which innovators face the resistance of the "dinosaurs". Long-term policy orientation is a challenge for the traditional policy inclination toward short-term economic and political cycles.

Another common obstacle effective worldwide is the neo-liberal doctrine that a general retreat of state influence would improve economic growth, innovation, and welfare. This doctrine – regularly ignoring irrational actions in the business sector (banks, automobile, or power industry) – is the wrong answer to the increasing demands for the expertise, regulatory intelligence, and financial capabilities of states. Although the neo-liberal doctrine has reasonably broached the issue of bureaucracy, it has largely underestimated the function of governmental regulation in the market economy. The general discrediting of government influence is questionable, particularly considering that many studies deem the imminent environmental and energy-technical revolution to be especially policy-driven (Jänicke/Jacob 2009). Against this background, the rediscovery of the regulatory role of the state as a functional condition ("regulatory capitalism") is hardly astonishing.

Enterprises

Short-sightedness, the orientation toward shareholder value, and short cycles also present obstacles to innovation in the business sector. The assumption that rational, informed companies will use their efficiency potential in production out of self-interest, and adapt their energy and resource consumption accordingly, is not generally confirmed by reality. Empirical studies regularly show that economically sensible investments in energy efficiency are not only made because of missing information, but also due to prevailing priorities, or dominating attitudes in a company hampering reorientation.

It has to be mentioned that large influential corporations often have the privilege of ignoring even obvious innovation needs.

As an example, companies with products that have a high environmental impact, for example in the electricity industry, do not have effective incentives to help reduce energy consumption in their field. The normal reaction to energy-saving by consumers will be new marketing strategies to generate more energy consumption.

Furthermore, financial markets primarily favor short-term profits. An orientation toward a long-term development of the company is impaired by having to demonstrate profit in a very short period. While some instruments have been developed to change this pattern (e.g., reporting commitments regarding long-term environmental effects of financial assets for pension funds in Great Britain), these instruments need to be applied on a much wider scale. But in most cases, those will only be effective in combination with regulatory standards (Hey et al. 2008).

Consumers

The basic conditions for a radical shift in awareness are still largely missing. The tendency to redistribute income at the expense of the middle- and lower-income groups produces an

unfavorable environment for innovation. People suffering from poverty have other priorities than climate protection. The media would have a central role to play as a transport mechanism for knowledge necessary in handling the industrial revolution as well as the new production model, which is based more on knowledge than on cheap resources. The media must contribute to the knowledge that is needed by consumers as well as voters to support innovative products and policies.

If policies fail to address the challenges of climate change and resource scarcity, the mechanisms of democratic decision-making could be called into question. The impending economic and ecological crises could be attributed to the alleged slowness of the democratic decision-making process, and thus encourage authoritative forms of statehood. Such a reaction, however, underestimates the innovative potential contained in political competition and opportunities for civil society to participate. It is no coincidence that authoritative systems failed to protect the environment. The openness of political systems to new interests, despite the difficulties this entails, is a central prerequisite for political innovation and problem-solving.

Innovation system

The challenges of a comprehensive technical-economic change require the development of adequate education and science systems to increase our human capital, knowledge, and qualifications. For example, it has been reported that the lack of well-trained skilled workers is an obstacle to further development of environmental technologies. The demographic change will aggravate this problem even further. Education and research institutions as well as private companies will have to do a better job in responding to the new challenges.

There is also a need for increased public spending on R&D and flexibility to advance relevant future innovations (i.e., through a broad pre-structuring in funding). However, approaches that only add further innovation programs for environmental technologies to the existing ones will fail to meet the challenges. Apart from promoting environmental technologies in the narrower sense, it is also necessary to consider environmental aspects in all technology fields.

3.1.5 Risk of failure

Given the extent of the resource-intensive growth crisis, failure in the transformation of our industrial patterns is certainly possible, with the risk of irreversible damage. Markets, societies, and states may not react sufficiently and may constrain themselves to the usual levels of innovation. Increasing the amount of electricity generated by coal points in that direction. It may well raise the belief that the potential of the existing technologies is sufficient. There is the tendency to leave dominant, large-scale structures and trajectories untouched or even praise them as the solution to the problem. One example is the discussion about a renaissance of nuclear power or so-called geo-engineering. Such approaches are very risky and comparatively expensive. In addition, this idea postpones solving the urgent crisis and ignores the complexity of resource and environmental problems.

In the end, what is needed are radically new innovations. In comparison to incremental innovations reinforcing the successful industries of the past, these will enable existing structures to adapt to new requirements. This difference in the types of innovations will result in the rise and fall of nations and regions. Over the last 200 years, dynamic innovations have occurred due to the fact that old structures were left behind and new, open structures were preferred.

To bring about these innovations needed for the Green Industrial Revolution described above, a new understanding of industrial policy is needed in our view. The following chapter gives an overview about different approaches in that direction that are currently being discussed or introduced.

4. Sustainable Industrial Policy for the Green Transformation

The prior chapters compared basic conceptual deficits of industrial policy approaches to the needs, challenges, and opportunities of the Green Industrial Revolution: In contrast to the broad confirmation to the overall concept of sustainable development, the actual policy agenda set by national and European political leaders lacks concrete political commitment and often sacrifices essential social and environmental needs to short-term economic demands. The self-imposed restriction in governmental steering by industrial policy measures created a lack of political action to initiate and model urgently needed structural changes and to promote green innovations. Another main deficit was the lack of coordination of national, European, and international governmental steering.

It can be concluded that traditional industrial and economy concepts do no sufficiently address the global collision between ecological imperatives and national economic performance.

As the last chapter demonstrated the shortfalls of industrial policy concepts and economic strategies of the past, the following chapter gives examples of current industrial policy approaches that can function as conceptual building blocks for a Sustainable Industrial Policy concept to shape the transformation process.

4.1 Strategic approach of modern and post-modern industrial policy

Alongside changing economic factors in a globalized world, there also are changing perceptions of industrial policy objectives. As analyzed by Meyer-Stamer[4], modern and postmodern industrial policy has to be understood as a multidimensional concept that is currently shifting, moving from a narrow one-dimensional concept to a broader strategic approach that goes beyond enhancing regional business location conditions. With the proposed support of new markets, a future-oriented approach is added.

Modern and postmodern industrial policy as a strategic approach broadens the focus from manufacturing sectors to all economic sectors, and shifts from selective support of sub-sectors to a generic approach that aims to improve or change the overall business environment. Traditional industrial policy focuses exclusively on the traditional manufacturing sector and does not address the ongoing outsourcing processes of services from manufacturing companies, which still maintain a close relationship to the manufacturing sector. There also is no comparable policy field for the service sector to contradict this limited focus. To avoid distortions of competition, commonly accepted and broad generic measures to improve the business environment – instead of selective support of individual branches – have gained in importance.

Modern and postmodern industrial policy as a strategic instrument also implies a shift away from first-aid industrial policy measures and a narrow focus on competitiveness. The maintenance and adjustment of industrial structures are often used as a form of urgent crisis management that has a strong implicit social political motivation, but is discussed in an economic context. As societal problems become increasingly complex and interdependent, especially in times of crisis, there is also a growing societal claim to use industrial policy to contribute to the achievement of broader goals. That means the central question of traditional industrial policy – how to enhance economic competitiveness most effectively – is already altered to implement broader, socially accepted goals rather than only enhancing competitiveness. A strategic industrial policy approach aims to strengthen prospering industrial branches with the motivation of safeguarding existing employment in the medium term. Especially in view of a limited financial scope in times of financial and economic crisis, this is of growing importance.

Going beyond the maintenance of existing industry structures, modern and postmodern industrial policy also includes future-oriented approaches by focusing on the fostering of emerging markets. This means a shift from trying to decelerate the reduction of market segments to trying to accelerate the growth of new future markets. There also is a differentiation in the stated purpose. In comparison to the position of other national industrial sectors, support can be granted to rebuild or develop industrial structures in a catch-up process or to create starting position

4 FES (2009a).

for new industrial sub-sectors that are as strong as possible.

Concerning the level of action, traditional industrial policy strongly emphasizes the role of national governments and regional policies. With the growing influence of EU structural policy and a change from top-down to bottom-up approaches in regional policies, the level of decision-making in industrial policy differentiates and gets more complex.

4.2 Ecological industrial policy

With its work on the concept of the ecological industrial policy (EIP) over the last three years, the German Federal Ministry for the Environment has answered the major environmental challenges of our time[5]. Assuming that the general understanding of an industrial policy was as given above, the concept of ecological industrial policy includes further important aspects that must be included in the Sustainable Industrial Policy concept: the integration of ecological aspects in industrial policy and a focus on the economic and employment opportunities of clean technologies.

The main objectives of EIP can be described as such:

- Protection of the climate and other environmental safeguards.
- Preparation of the industry for scarcity of energy and other resources.
- Adjustment of industry to the upcoming lead-markets and technologies.
- Stimulation of leaps toward more efficient technologies.
- Development solutions that allow a sustainable industrialization in other areas of the world.

With its additional aims to provide incentives for a "greening" of mainstream technologies (horizontal EIP) and to support the development of a visible green tech sector (sectoral EIP), the concept of an ecological industrial policy goes beyond technology-oriented environmental policies. The main differences are described in the table below.

Table 2 Characteristics of an ecological industrial policy UBA + BMU (2009)

	Technology-oriented environmental policy	Ecological industrial policy	Mainstream industrial policy
Technological focus	environmental and integrated technology	environmental and integrated technology	technology generally
Legitimacy	precautionary principle, external costs	environmental efficiency, competitiveness	competitiveness
Objectives	to develop eco-efficient technology	to develop and diffuse eco-efficient technology, to improve market access	competitiveness and market access, to strengthen entrepreneurship
Main actors	departments for environment, research, industry, environmental NGOs	departments for environment, innovation, industry, other ministries, social partners	economic ministry, other ministries, social partners
Other policy areas	research, economic affairs, transport, energy, agriculture	research, economic affairs, energy, social affairs, external relations	research, social affairs, external relations
Time horizon	short and medium-term	medium and long-term	medium and long-term

5 BMU (2008a).

All major economies have set up large spending programs to support the development and marketing of clean(er) energy solutions. EIP assumes that the potentials of demand-side regulatory measures have not been fully utilized so far: For example, CO_2 standards for cars and housing, or regulating market access for energy-using products, have the potential to multiply the impacts of R&D programs by mobilizing private capital.

The frequent calls for internalization of external costs and removal of environmentally harmful subsidies have received additional momentum by EIP but have not been practiced as of yet.

Although there are no agreed upon methods and sets of indicators to measure the impact of EIP, the focus is still largely on spending programs, especially on the European level. Because industrial policy lies traditionally in the hands of the member states, the potentials of regulatory approaches and other demand-side measures to mobilize and direct innovation and investments that would indicate a real policy change have not been utilized on a European level so far.

Another important issue regarding EIP is that it is strongly motivated by a "green race" for "green jobs" between the large and emerging economies. Europe, the United States, China, Japan, South Korea, India, as well as other countries support industrial sectors in the highly competitive and fast-growing markets for green technologies and have displayed increasing protectionist tendencies. By demonstrating the political, technological, and economic feasibility of environmental policies and technologies, a rapid global diffusion is achieved and could be further fostered. Besides finding new paths for industrial policy, the main deficit of the EIP concept as promoted by the Federal Ministry for the Environment remains its restricted view on competiveness: It still focuses very much on supporting eco-innovation in the green tech sector rather than governing structural change in the main industrial sectors to address the challenges of a sustainable development.

Table 3 Instruments of an ecological industrial policy UBA+BMU (2009)

Objectives/ instruments	Development of new technologies	Access to markets	Diffusion	Promotion of export
Direct promotion	R&D subsidies	Public procurement	Public procurement	State aid for exports
Economic incentives	Tax deduction for R&D	Provision of venture capital	Internalizing of external costs, e.g. by taxes	Internalizing external costs, e.g. by international agreements
Regulatory framework	Stimulating research cluster e.g. by patent law	Opening of home markets	Opening of home markets	Opening of international markets
Regulation	Technology forcing		Dynamic standards	Development of European and international standards
Information-based instruments	Innovation-radar	Obligatory risk assessment for products	Environmental label	Market studies

4.3 EU action plan on SCP and SIP

Balancing supply and demand

In July 2008 the EU published its Sustainable Consumption and Production/Sustainable Industrial Policy (SCP/SIP) action plan [6], which includes the goals of the 2002 Johannesburg summit and 1992 Rio summit to change patterns of consumption and production to achieve sustainable development. The action plan was conducted by DG Enterprise and Industry with a focus on SIP, DG Environment with a focus on SCP, and DG Energy and Transport with a focus on the Directive on Ecodesign of Energy using Products (EuP) and on energy labeling.

The action plan clearly connects sustainable production with sustainable consumption and addresses known facts and important interconnections between current patterns of consumption and production. While the Commission's SCP/SIP action plan addresses the fostering of sustainable demand quite clearly, it remains quite vague in terms of specifying sustainable industrial policy initiatives. Even though the accomplishment of sustainable consumption is fundamental to achieving sustainable production, additionally consistent sustainable industrial policy measures are needed.

The Commission's SCP/SIP action plan also lacks a clear vision of what has to be done to tackle more fundamental change beyond resource efficiency, which is needed to effectively reduce Europe's ecological footprint.

The Commission places a growing focus on natural resources and views SCP policy as contributing to improving resource efficiency. But in order to tackle the transformation to a veritable sustainable level of resource consumption, a clearer signal to industry is essential: The consumption of resources must stabilize and then fall if the combined objectives are to stay economically competitive and if, at the same time, a globally equitable share of resources is to be reached. The proposed package of actions seeks to stimulate demand for more sustainable goods and production technologies, which is crucial to sustainable consumption and production. But in complex matters such as the ecological footprint of different products, too many demands will be made on consumer responsibility. Preferable to overemphasizing consumer responsibility, regulatory measures have to ensure that only the most effective and least-damaging products have market access. Clear political commitment for sustainable industrial policy is needed.

Although the Commission made a first step in terms of providing an integrated approach, there is an unbalanced emphasis on voluntary measures such as voluntary benchmarks on the environmental performance of products. As a large transnational union of national governments, the EU should go beyond this voluntary approach and develop effective coordination tools to accomplish sustainable consumption and production. By fostering sustainable consumption and production, product innovations and increased international competitiveness could be reached.

4.4 European eco-efficient economy

On a European level, the Swedish Presidency of the Council of the European Union in 2009 has chosen to invite the energy, environment, and competitiveness ministers to informal meetings to discuss how to enable an eco-efficient economy through EU policymaking. As a common basis for discussions, the Swedish government commissioned the report "A European eco-efficient economy: governing climate, energy and competitiveness" (SEI 2009).

The study stresses that environmental policy and mainstream economic policy areas must be integrated. In line with the concept of EIP, the study underlines that the eco-efficient economy works: environmental improvements can go hand-in-hand with competitiveness. Policymaking – whether fiscal stimulus or environmental regulation – needs to integrate economic as well as environmental goals, which means it needs to multi-task: It means balancing issues such as climate change and ecosystems with economic growth, jobs, and welfare, and entails being mindful of conflicts while capitalizing on synergies and opportunities.

The development of long-term competitiveness relies on Europe's ability to innovate, get research to market, improve market conditions, and adapt to changes. The EU already has made progress in this direction, but there still remains significant untapped potential: European governance for an eco-efficient economy must set the direc-

6 COM (2008) 397 final.

tion, encouraging the member states to consider market-based instruments to be an efficient way to internalize the costs of pollution created by economic activity, resulting in prices that better reflect the total environmental and economic costs occurring during production and consumption.

The invention, innovation, and diffusion of technological systems are essential prerequisites, and development and deployment must be driven by new policy instruments to support innovation, demonstration programs, and lead-market initiatives.

The second important point of the study is to widen the focus from innovation support and new technologies to adaption of mature industrial sectors. With their economic weight, the responses of mature industrial sectors such as chemicals, cars, and steel industries to economic and environmental challenges – especially in the field of efficiency improvement – are integral to the eco-efficient economy agenda.

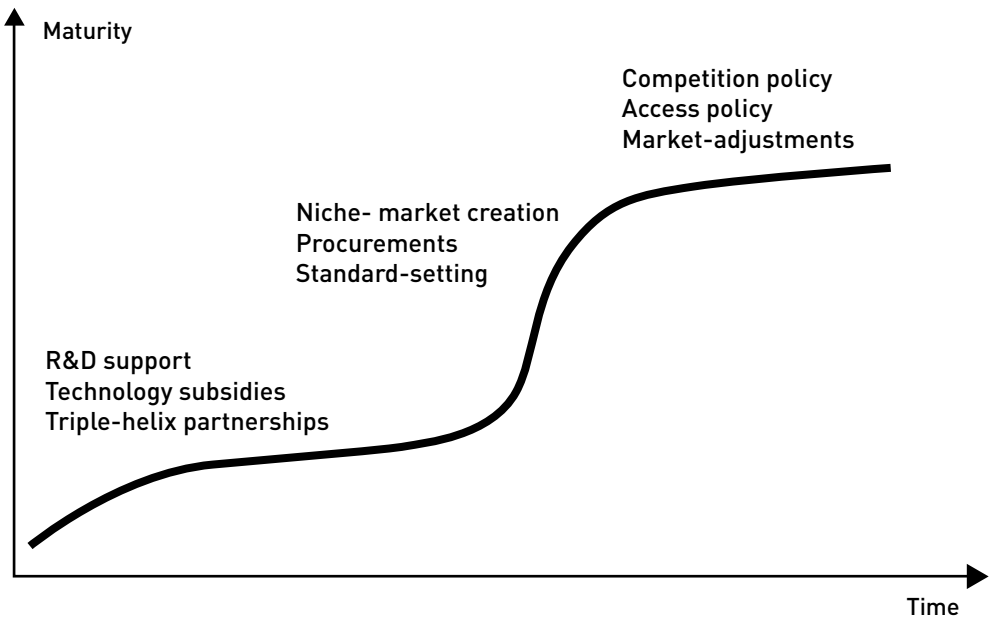
Instead of relying on single-support measures, a differentiated approach is recommended: Governance packages that differ according to the maturity of the industrial sector and its economic development will show the best results. To induce investor confidence, these packages must stay in place for at least a decade.

Concurrent with the abovementioned broadening of economic policy instruments and measures, policies also need to be integrated horizontally and vertically. The study recommends an effective horizontal integration across themes and sectors, depending on the social, institutional, and technological characteristics of particular economic sectors. Especially in the EU with its different levels of competences, vertical integration of policies between different levels of governance is necessary.

The study also takes international aspects into consideration. As the eco-efficient economy is a global agenda rather than a European one, Europe's international policies must interact more closely. Still, industries, resources, and environmental impacts all diffuse across borders. Problems like carbon leakage or capital flight become real without global framework rules. Therefore, environmental diplomacy, neighborhood policies, and international policy agendas such as aid and trade policies must be included. The EU is the world's largest integrated market and can play a true leadership role as best practitioner and standard setter.

On an international level, global solutions, such as a stable carbon price, are necessary. But at the same time, the EU needs to assist emerging

Figure 2 Policies governing environmental innovations (SEI 2009)



economies in making substantive commitments to reducing greenhouse gas emissions by finding ways to combine a global carbon price that grows their economies and improves their welfare. Therefore, policy discussions have to be broadened from global burden-sharing negotiations to questions about technology transfer, financial assistance, and opportunities for developing countries to access European markets.

Resume: Guiding principles of industrial policy must change!

As shown, modern and postmodern industrial policies, as described by Meyer-Stamer (FES 2009a), broadened the concept of industrial policy to include a structural economic concept that addresses industrial sectors instead of merely focusing on enhancing regional business location conditions (see chapter 4.1). Ecological industrial policy included ecological aspects and underlined the economic opportunities of green technologies (see chapter 4.2). The EU action plan on Sustainable Consumption and Production and Sustainable Industrial Policy showed an approach to balance industrial production and supply with consumer consumption by addressing the demand side (SEC (2008) 2111) (see chapter 4.3). With the concept of an eco-efficient economy, the Swedish Presidency of the EU Council finally presented a concept that integrates ecologic and economic goals and showed a differentiated approach to structural change for existing and emerging industrial structures (see chapter 4.4). These conceptual steps form the necessary prerequisites for a changed understanding of the objectives of industrial policy for the necessary green transformation, which, in the authors' view, will only be achieved by means of a veritable Sustainable Industrial Policy.

In order to develop an SIP concept, it is important to realize the close interconnection between the revolution and structural transformation, as analyzed by Jänicke and Jacob in detail (Jänicke/Jacob 2009). The described process for a Green Industrial Revolution emphasizes the growing urgency of a structural industrial transformation and the urgent need for political steering. An industrial revolution should be perceived as a radical and abrupt but also long-lasting ("secular") change at all levels of society. Due to fundamental technical innovations, a new balance between the economy and the institutional framework is developed. The First and Second Industrial Revolutions had very different production methods, means of transportation, raw materials, energy bases, all of which are also modes of industrial production that have become unstable since the end of the 20th century and at the dawn of the Third Industrial Revolution. The current crisis of resource-intensive growth – irrespective of innovative activity – extends beyond the current capabilities of markets and civil society to manage the crisis. Therefore, the guiding principles of industrial policy – and with them the framework conditions – must change radically.

With a view on the financial and economic crisis, the Commission published a commission document for a post-Lisbon strategy – the EU 2020 strategy, which would make the EU a smarter and greener social market and try to find new opportunities for sustainable growth.

The EU 2020 strategy is a starting point to widen the focus to include sustainable growth, but the main question of how large reductions in the EU's ecological footprint can be achieved within the next 20 years remains unanswered.

Beyond addressing issues of energy and resource efficiency, clear EU-wide targets for use of non-renewable resources and natural resources are required to close circular resource flows. This includes new waste prevention and recycling targets. So far, there is no technical solution to decouple economic growth from resource and energy use in a way that the race between intensive use of resources could be won against resource depletion.

As depletion of natural resources and loss of biodiversity is growing, the value of ecosystems for the economy – which is in addition to the intrinsic value of ecosystems – moves closer to the center of attention. Biodiversity and healthy, resilient ecosystems are the foundation of an eco-efficient economy. So the protection of biodiversity should become a core part of economic decision-making. Targets to decrease the loss of biodiversity are needed, including a systematic view on the effects of EU policy to biodiversity.

So far, all industrial revolutions have been accompanied by the development of new governmental functions and capacities (see chapter 5.1.4). One example is the new social core functions of governments in industrialized countries after the Second Industrial Revolution.

This has been continued by a development that has been observable since the 1970s in industrialized countries and the 1990s on a global level: A third basic state function in addition to the core economic and social duties, the protection of the natural base of life has emerged. In this sense, many industrialized countries and the EU already have taken important steps toward an "environmental state". The emergence of an international (however fragmented) legal system is connected with this globalization, and through standardization, regulation of cash, and commodity flows, etc., it represents another functional basis for global markets. These regional and international regimes are also increasingly including environmental standards.

In order to face the challenges and opportunities of a green transformation as described in chapter 3, SIP must govern targeted, politically reinforced, and structured changes in our economic system along guiding principles presented in the following chapter.

5. Goals and Guiding Principles

In the previous sections of our memorandum, we defined the broader scope of a Sustainable Industrial Policy in contrast to traditional – as well as the furthering of – industrial policy concepts and focused on the relevance of SIP as a prerequisite in the context of a Green Industrial Revolution. Against this background, the following section aims to summarize the goals (see chapter 5.1) as well as the guiding principles for an SIP. We distinguish between guiding principles (see chapter 5.2) and measures for implementation (see chapter 5.3).

5.1 Goals

Sustainable industrial policy aims to achieve the following goals:

To aim beyond competitiveness

It is fundamental that the industrial policy aims beyond competitiveness and widens the scope of industrial policy. SIP must assume responsibility in contributing toward solving global environmental and social/societal crises. Common economic goals, such as strengthening competitiveness, must be integrated with ecological and social goals. The competition of different nations in fostering new technologies and to be in leading positions in developing low-carbon or clean technologies is only one step on the path to a future sustainable economic development.

To observe ecological imperatives

Central goals of sustainable industrial policy are to combat climate change, to conserve nature by abating hazardous pollutants, and to protect biodiversity as well as to use finite resources in an efficient and equitable way, both on the national and global scale. Climate change, finite resources, loss of biodiversity, and the limited capacity of natural systems to absorb pollutants are the most important imperatives that define the borders of the economic system.

These ecological imperatives are equitable. Despite the fact that climate change is presently the most immediate threat, a sustainable and sufficient use of resources and the protection of biodiversity also need to be integrated into political decisions right now to prevent a collision between economic performance and ecological imperatives.

To achieve green transformation

Sustainable Industrial Policy measures aim at the restructuring of industrial sectors in a sustainable way. This transformation must go beyond an only marginal change and include adaptation of existing as well as the design of emerging industrial structures. Unsustainable industrial structures must be adjusted if possible or constricted in a short or medium time frame. Maintenance of all costs of unsustainable industrial structures is not an option. Crises caused by short-time needs sidetrack from essential action to response to long-term needs. The economic crisis challenges financial *ad-hoc* recovery actions that further constrain future options to act.

To bind the social and ecological dimensions

The broad discussion on clean or low-carbon technologies and green jobs shows that there is common agreement that one important aim of Sustainable Industrial Policy in Europe is to establish and secure occupational employment at a high educational level. This requires high levels of investment in education and training as well as research and development.

But SIP faces much more of a challenge and includes high potentials for societal tensions. The restructuring of industrial sectors into sustainable structures needs broad social acceptance because it will have enormous financial and social impacts and will present a more active governmental role in steering industrial policy. In order to achieve the needed social acceptance to govern the Green Industrial Revolution, questions of justice and fairness will have to be raised and answered. As shown in chapter 3.1.3, social challenges such as fairness of distribution of wealth, resources, and environmental pollution are awkward issues that have to be dealt with to reach a just transition. The European Trade Union Confederation text "Resolution on the climate change, the new industrial policies and the ways out of the crisis" (ETUC 2009) and the broad support of environmental, social, and development organizations of the springalliance[7] are examples

7 http://www.springalliance.eu/home

of a growing awareness that the social and environmental dimensions of Sustainable Industrial Policy are closely connected.

5.2 Guiding principles

The structural change needed in order to respond appropriately to economic and environmental crises can be achieved if industrial policy measures are aligned with guiding principles.

5.2.1 Thinking from the targets

A promising SIP needs to observe ecological imperatives covering climate change, biodiversity, pollutants in natural systems, and resources. These goals have to be converted into clear targets and their effectiveness has to be assessed. To give an example: In the case of climate change, the target is to limit the increase in global temperature to a maximum of 2 degrees centigrade over pre-industrial levels. Accordingly, specified and quantified targets corresponding to the ecological imperatives mentioned above are needed.

On the basis of this set of targets, it is possible to develop and define strategies and take measures in order to achieve these specific targets and refine their implications to sectoral approaches. For the 2-degree target, this principle was carried out in a new groundbreaking WWF study by Prognos AG, Öko-Institut, and Dr. Ziesing (WWF 2009). It might be helpful to develop such strategies starting from the end, using the so-called back-casting methodology.

5.2.2 Mainstreaming for all relevant policies

As elaborated in chapters 1 and 2, SIP will fail if it is not aligned with other relevant policies. Therefore, the objective of sustainable transformation of our economic structures needs to be mainstreamed into all relevant policies. As seen above, a wide range of policy fields may contribute to this objective. On the other hand, this makes it necessary to find mechanisms that assure as far as possible the coherence of instruments used in different policy fields and sectors.

The issue of an EU-wide carbon tax provides a good example. Since the early 1990s, there have been several attempts to introduce a harmonized carbon tax across all EU member states. But an EU carbon tax has never materialized due to member states' reluctance to render national competencies on taxation to the EU. Consequently, the EU built its climate policy around an emissions trading scheme instead. However, the EU emissions trading scheme (ETS) only covers around 45 percent of the EU's greenhouse gas emissions, leaving out major emitting sectors, notably agriculture and transport. In order to cope with the weaknesses of the current policy framework, it is now again proposed to amend the 2003 Energy Taxation Directive and to oblige member states to levy a CO_2 tax on fuels. This raises questions of overlap with the EU's ETS. The Commission now proposes extending the scope of the Energy Taxation Directive to energy products that fall under the ETS but exempt them from CO_2-related taxation.

This example confirms the need for designing a coherent regulatory framework. While being fully aware that managing policy and operations involving more than one sector requires a careful balancing of competing interests and objectives to avoid these problems, it would be worthwhile to make use of horizontal instruments to avoid these problems to begin with instead of having to harmonize effects of differing instruments over a range of sectors.

5.2.3 Broadening of industrial policy instruments

When seeing industrial policy in a wider, strategic way, we need to understand that governmental action always influences the conditions either in favor of or against the transformation toward sustainable economic structures. As a consequence, governments should consciously assess the impacts of existing policy on industry and make use of a complete set of instruments at hand to build a sound policy framework to facilitate the transformation. An extended use of instruments is consistent with a responsible-minded, more active governmental role model. This should not only relate to traditional industrial policy measures but should include a much wider array of tools such as economic, informational, cooperation, and educational instruments. Especially regulatory approaches may have an important role to play.

By prescribing norms and standards, regulatory law may contribute to a sustainable industrial policy. Norms and standards may be applied to achieve ecological targets like reducing emissions and waste, increasing resource or energy

efficiency, reducing the use of toxic substances and protecting ecosystems. Furthermore, they aim to increase the application of certain technologies regarded as beneficial, for example for resource-efficiency gains.

Economic theory has highlighted the relationship between environmental regulation, innovative activity, and competitiveness to an increase in product quality, efficiency, and boost to innovations eventually resulting in medium- and long-term competitive advantages for the regulating country, as well as for the regulated companies (Porter/Linde 1999). Numerous examples have shown that high environmental standards can promote technological development.

Interestingly, approaches like the Eco-design Directive open existing environmental regulation to dynamic benchmarks like the "top runner approach". It should be taken into consideration whether this approach can be used to cover other environmental issues that go beyond energy efficiency.

5.2.4 Internalization of external costs

The internalization of external costs is an important principle in making markets work efficiently and ensuring optimum allocation of scarce resources. At the same time, it establishes an approach for sustainable management, which reconciles economic, ecological, and social interests.

Functioning markets and internalization of external costs are important central issues of any ecological industrial policy. However, it must be taken into consideration that there are limits to monetarization of external ("true") costs. This is due to global markets and the actual international competition situation, because costs frequently only arise in the future or cannot be calculated, or because of political opportunism. A realistic policy has to take these limits into account and must not rely entirely on price mechanisms.

5.2.5 Acting globally responsible

A veritable Sustainable Industrial Policy also needs to be aware of its global dimension and calls for globally harmonized action. This can be illustrated with the current situation associated with waste from electric and electronic equipment.

On the one side, there is a global agreement upon the various gains that information and communication technologies (ICTs) can strengthen economic, social, and cultural development. And following the Tunis Commitment, Africa is now the last continent deploying ICT on a large scale with numerous publicly and privately sponsored projects (WSIS 2005).

On the other side, most ICT equipment becomes obsolete after only a few years of use and the growing e-waste volumes, together with the absence of well-organized collection and management systems, has manifold impacts on the environment, local communities, and the economic system. By disposing of e-waste in uncontrolled dumpsites and minimizing their volume by burning releases a whole range of toxic substances, heavily contaminating air, soil, and water resources.

But the ecological consequences reach even further on a global scale: If scarce metals like palladium, indium, or germanium are not recovered at an early stage of waste treatment, their loss has to be compensated by intensified mining activities, which again lead to severe sustainability impacts in mining areas worldwide.

This example illustrates that, due to globalized trade flows, a sound SIP in Europe must be embedded in transcontinental agreements in order to tackle the access of European industry to rare earth metals as well as to prevent manifold impacts on the environment in Africa and to allow access to ICTs, thereby bridging the "digital divide". While there is a constantly rising demand for scarce resources, the present e-waste management in Africa not only pollutes natural resources and endangers people's health, it also shuts Africa out of substantial business opportunities in material recovery and recycling. Although the high-tech know-how for environmentally sound recovery of metals is not yet in sight in Africa, international business cooperations could link strategic advantages of recycling industries in Africa and industrialized economies.

5.3 The implementation: Setting the course for transformation

In order to implement the guiding principles, there are a lot of possible measures for implementation. In the following, we discuss those measures and instruments that are especially

relevant in relation to SIP, as they set the course for transformation.

5.3.1 Identification of non-sustainable measures

Industrial policy measures have often not been designed in a way so as to avoid detrimental effects on the environment or negative social effects. There is the need to identify those policy measures that are particularly harmful in this regard. And a close look should be taken at aims and purposes as well as adverse side-effects on the environment and the economy. Where measures are non-sustainable, their practice needs to be discontinued. When designing measures in the future, these should be subject to a systematic examination of the impact on environmental assets such as climate, air, water, soil, biodiversity, and landscape as well as on health and resources. In this respect, tradeoffs between ecological and social and/or economic targets should be disclosed explicitly, especially regarding ecological imperatives.

The impacts of subsidies are a clear case in point. Not all subsidies can or should be abolished, but many make little ecological or economic sense. This needs to change. We need to eliminate as far as possible subsidies that conserve industrial systems that are counterproductive regarding the ecological imperatives. While the price-distorting effects of subsidies sometimes may be necessary to bring about socially desirable developments or if the markets alone do not perform the desired allocation function, we need to be cautious about reinforcing vested rights that, for example, result in over-exploitation of natural resources.

5.3.2 Dynamic renewal by market-based instruments

Although classic regulatory legislation with its prohibitions, requirements, and threshold values frequently brings about a singular surge in innovation, it does not always create incentives to make technological renewal a permanent factor: Once the threshold value is reached, there is no longer any reason for further modernization, unless there is a dynamic set of requirements. In recent years, therefore, there has been a rise in the importance of economic instruments as a significant additional resource for steering environmental policy. Market-based instruments mostly use the price mechanism as their incentive and lever. Taxes and public charges, for example, can be used to achieve important control effects and to influence demand for resources. From a regulatory point of view, economic instruments actually have a key role to play, because the price of a good conveys relevant information (see chapter 5.2.3).

Ecological charges and taxes allow for correcting this and to monetize such costs; in other words, they help prices to tell the ecological truth, or at least to get closer to this ideal situation. However, there are limits to such monetization. In order to avoid unintended impacts like the migration of production sites and jobs to countries that allow even more ruthless exploitation of nature, other instruments and transnational agreements will be necessary. Therefore effective economic instruments are to be adopted in relation to international framework conditions and the competitive environment.

5.3.3 Change of consumption patterns

In order to achieve the transformation for sustainable industrial structures, it is necessary to shape consumption patterns and associated impacts, too. Innovation researchers have long been aware that interaction between good framework conditions on the supply side and activated demand is the best basis for helping innovative sustainable technologies on the market. This means that supply-oriented and demand-driven instruments must be combined wisely and not played off each other. This also means activating the public sector as an innovation-driving demand factor. The role consumers may play in this regard – as well as the model-building function of (green) public procurement – have to be considered.

In order to make use of their great demand power, a sustainable industrial policy has to actively put consumers in a position to perform this task consciously. As prices alone frequently fail to provide adequate information about products, measures to increase transparency of markets are needed to contribute to the identification of resource- or energy-efficient products or products that have been produced under fair working conditions.

It is only on the basis of additional information transported through marks or ad labels that purchase decisions become genuine decisions. Labels and marks are thus an important basis for strategic consumption and their design must transmit

a clear and comprehensive message to the consumer. The recent amendment of the EU Energy Labelling Directive provides a negative example.

5.3.4 Directing investments in a sustainable and ecological way

The green transformation of industrial structures will require considerable investments and therefore a shift in both public and private investments. Investments for the public as well as the private sectors need to be directed to projects that support sustainable development in the context of a set of targets (see chapter 5.2.1). Firstly, the public sector will have to make all efforts to reorganize its budgets to directly support this transformation and carefully target its limited funds. However, considering the likelihood of decreasing state revenues in the years to come to make up for the deficits accrued in the fight against the financial crisis, the public sector will not be able to raise the finances needed to build sustainable industrial structures. Therefore, it is crucial that public funds be accompanied by appropriate policy frameworks to help leverage private financing.

With regard to climate change, a recent UN Framework Convention on Climate Change (UNFCCC) report states that "with appropriate policies and/or incentives, a substantial part of the additional investment and financial flows needed could be covered by the currently available sources. However, improvement in, and an optimal combination of mechanisms [...] will be needed to mobilize the necessary investment and financial flows" (UNFCCC 2007).

The present difficult situation in the financial markets offers a real opportunity to adopt a transformational policy that addresses longer-term global systemic issues. Business corporations and short-term investors have a natural tendency to focus on short-term profits and share prices to the detriment of a broader concept of long-term sustainable growth. Therefore, it will be necessary to regulate the financial markets in such a way that long-term performance, with Environmental, Social and Governance ("ESG") issues will play an increasing role.

One cause for misguided investments consists in the lack of assessment by banks and financial intermediaries of the risks presented by ecological disasters, climate change, or social inequalities. To build the basis for such assessments, greater transparency from companies is needed and reporting of relevant data required. Consequently, in order to transform traditional investment policy, the regulator should mandate greater transparency from companies about the environmental and social impacts of their businesses. Institutional investors should also be made more transparent about the extent to which ESG considerations are taken into account in the selection, retention, and realization of investments.

A good example that this approach is working may be seen in the Carbon Disclosure Project (CDP). CDP brings together more than 475 institutional investors with considerable finances under its management to focus attention on carbon emissions, energy usage, and reduction. The project works with thousands of corporations in the world to help them ensure that an effective carbon emissions reduction strategy is made integral to their business, starting with the requirement to measure and disclose their emissions. Even if the limited focus on a selective part of the product's lifecycle is a severely methodical weak point of this approach that has to be solved, the provision of comparable environmental information is helpful to investors in making informed decisions with regard to moving toward a low-carbon economy.

5.3.5 Strengthening Corporate Social Responsibility

By its very nature, the Corporate Social Responsibility (CSR) debate touches on controversial issues related to the roles of the state, private companies, and individuals. To date, the European Commission has avoided proposals involving additional obligations and administrative requirements as more regulation of CSR risks being counter-productive. But although the decision to engage in CSR activities may be voluntary, the way in which this is done by companies should be regulated to a certain extent (Barth/Wolff 2009). Advocates of such an approach argue that the growing number of reporting formats undermines their credibility, thus justifying some kind of regulation.

The dual challenge of dealing with the climate crisis and the economic crisis has pushed CSR higher up the policy agenda. More than ever, the forces stimulating business to contribute to more sustainable development need to be harnessed and strengthened.

A policy that fosters CSR in European business and has a real impact for sustainable development has to be a part of a Sustainable Industrial Policy that governs the green transformation of European industry.

The former chapters indicate how complex the task is to establish a Sustainable Industrial Policy to govern the necessary green transformation. But concerning the outstanding environmental challenges from our point of view, there is no alternative. Derived from the experiences and failures of the industrial policies from the past (see chapter 2), an SIP for governing the Green Industrial Revolution demands an ambitious approach on two levels:

1. Integrated policymaking: We currently have to deal with the fact that the strategy for the economic development and competitiveness in Europe (still the Lisbon strategy) does not address the targets of the Sustainable Development Strategy. Therefore, conflicting strategies exist that make it impossible to reach the targets in an effective and efficient way. That is why we need commonly agreed, overarching policy targets that are addressed by industrial policy.

2. Policy coordination and cooperation: For a comprehensive approach, the industrial policy in Europe is already facing the challenge to coordinate:

a. different policy fields on the European level forming the EU industrial policy framework for a consistent horizontal approach,
b. between the competences and interests on the European, member state, and sub-national levels of industrial regions, as well as
c. between interests of industrial sectors for a consistent sectoral approach that defines sector targets and compatible sector strategies.

This challenge will become even bigger if the environmental sustainability targets are added to the agenda of European industrial policy.

The necessary change is complex and has no simple solution. That is why we propose an integrated monitoring based on facts from system-analysis instruments **as a first step** to make the interlinkages between sustainability and industrial policy transparent. Such a monitoring system will facilitate **dialogues** as a learning process, to which policy approaches could be successfully linked to the agenda of governing the Green Industrial Revolution. This would provide a better knowledge-base for driving forward the agenda of an SIP for the future and show if and how long-termed environmental targets can be met by the green industrial transformation.

6. Blueprint for a concept for Sustainable Industrial Policy Monitoring (SIMON)

The following chapter will provide a proposal for a monitoring concept to assess the state of horizontal and sector industrial policy with regard to the necessary changes to meet the challenges of sustainable development and the green transformation. This will include a proposal for a multi-stakeholder dialogue to determine how the most important industrial sectors may contribute to the delivery of the long-term environmental sustainability targets and which industrial political framework will be required.

The fundamental need for a turnaround of our industrial society in Europe regarding the objectives of an environmental sustainable development and the related challenges as well as the opportunities of the Green Industrial Revolution (see chapter 3) indicate the necessity for an SIP that is closely linked to the SDS of the European Union.

Long-term environmental targets for the "Europe 2020" strategy

Therefore, we see the strong need to integrate long-term environmental targets in the strategic debates of the European Union, even for economic transformation considering the environmental limits. This long-term orientation – especially regarding the environmental targets – is very important for the effectiveness and efficiency of an SIP. It provides the private sector with the opportunity to adjust their future planning to act on creating a robust framework.

Having in mind the importance of the Lisbon strategy for the industrial policy of Europe over the last 10 years, we see the necessity to integrate environmental targets in the "Europe 2020" strategy following the Lisbon agenda in 2010. The draft for public consultation from the end of 2009 does not sufficiently refer to quantitative or qualitative environmental sustainability targets. From our point of view, the lack of such objectives gives a misleading signal for the further development of the economy and the necessary transformation to a low-carbon, energy- and resource-efficient economy.

Even the agreed European targets for combating climate change – reducing GHG emissions by at least 20 percent by 2020 compared to 1990 – are not mentioned in the strategies. Regarding climate change, we would see the need to integrate even longer-term goals, such as GHG emission reductions by 2050 of up to 95 percent compared to 1990. This would indicate more clearly what we are facing if we talk about the need for the Green Industrial Revolution.

In addition to that, we would demand the development of comparable environmental objectives (as quantitative as possible) at least for the use of resources (including re-use and recycling) and the limitation of the loss of biodiversity. But also the minimization of toxins as well as emissions to air and water should be taken into account (as described in chapters 5.1 and 5.2.1).

The systematic setting of longer-term environmental targets in the Europe 2020 strategy is a crucial step toward the convergence and integration of the several political agendas of the European Union. It is also an essential prerequisite for the effective and efficient development and implementation of integrated policies to govern the green transformation of the European industry. Knowledge about how the Green Industrial Revolution can be governed is very much fragmented today. The agenda is complex and interconnected. Better **systems analysis instruments** are needed to provide knowledge for informed dialogues and decision-making processes as well as to overcome the lack of policy coordination. This involves both developing new and better analytical systems-approaches to understanding technological innovation and combined policy impacts, and developing new platforms for evidence-based policy debates at the European level as well as at the level of the individual member states.

Systems analysis: Blueprint Germany – A strategy for a climate-safe 2050

An example of such a systems analysis tool has been developed and applied for in Germany by Prognos AG, the Öko-Institut, and Dr. Hans-Joachim Ziesing and was commissioned by the WWF Germany.

The task was to analyze if and how a reduction of GHG by approximately 95 percent compared to 1990 emission levels could be achieved assuming that the industrialized countries would have to reduce more to reach an internationally agreeable path and to leave some room for the economic

Figure 3 Reference scenario: emission reductions broken down into sectors, 1990 – 2050, in million t of CO_2 equivalent

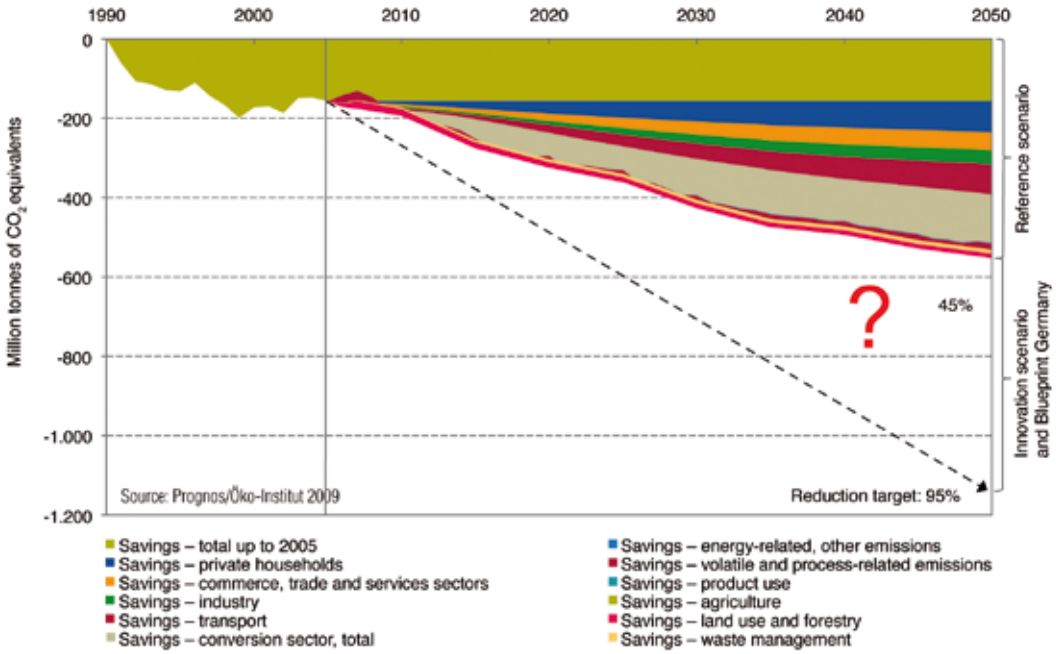
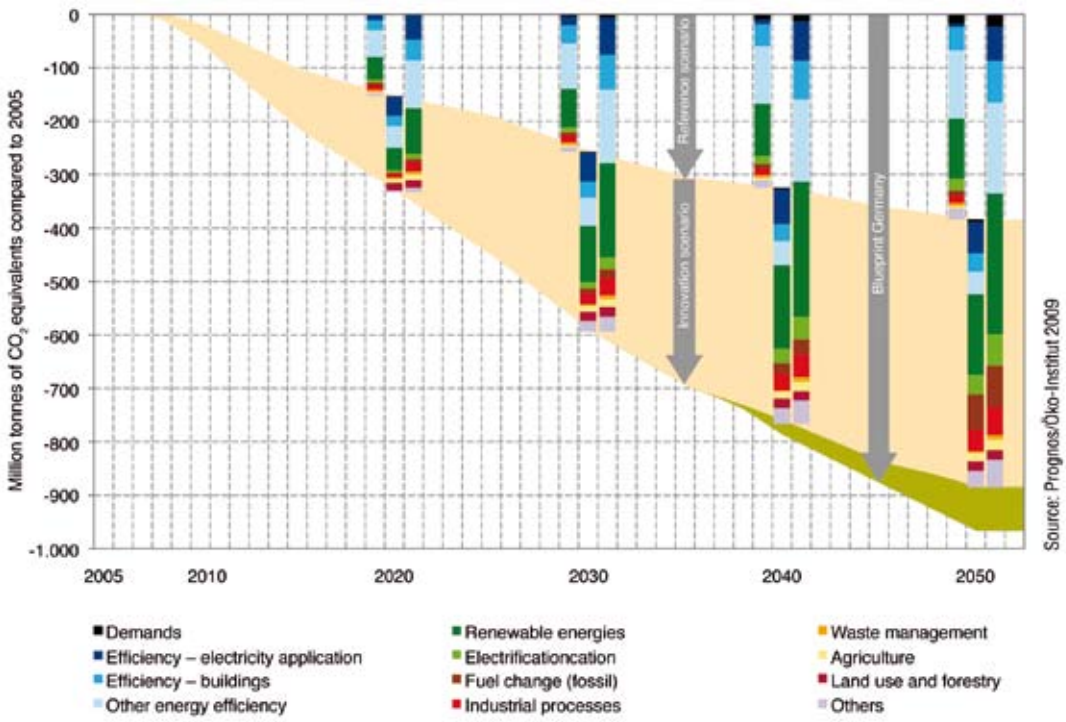


Figure 4 Sectoral contribution to GHG emissions trends



development of emerging economies and developing countries. That task reflects very well what we understand as the guiding principle to "think from the target" (see chapter 5.2.1).

How can and how must a highly industrialized and technology-based society be transformed in order to reach this goal? Which technical measures and political instruments are required if economic growth, safety, and comfort are to be warranted in the future? Will we have to make sacrifices or can we replace quantity with quality? Since 1990, targets have been pursued in energy and climate policy and the related instruments implemented. A brief look at the current situation clearly shows that there is still a very long way to go before we reach the 95 percent target.

SIMON

In addition to the question "What can and must happen on the technological level and what does the corresponding policy have to look like?", the intention was also to assess how far these solutions are from the current political path.

This is why two quantitative scenarios had been developed: one scenario with an ambitious continuation of today's energy and climate protection policy (reference scenario), as well as an innovation scenario that investigated the transformation to a low-carbon society geared toward a 95 percent reduction. The continuation of today's energy and climate protection policy clearly failed to reach the target by 2050. The reference scenario was used as the basis when calculating the costs and identifying the instruments of the innovation scenario. The comparison of emission trends in the reference scenario and in the innovation scenario showed that considerable GHG reductions are feasible up to 2050 in all sectors. Despite this, the emission-reduction target of 95 percent against 1990 could not be achieved with the measures considered in these scenarios. The remaining reduction gap had to be filled with measures that are beyond the general framework specified in the scenarios.

Such a systems analysis instrument may serve as a very good foundation for a broader Sustainable Industrial Policy Monitoring, as it helps to identify system connections and interactions that have to be considered and that must also be taken into consideration in the strategic design of the respective policies. There are several examples for this from the scenario analysis of "Blueprint Germany":

- A very high share of the additional emission reductions required (around 60%) is related to long-life capital stock (buildings, power stations, infrastructures, etc.). Delays in implementing measures will mean that the target will not be reached or that the costs of climate protection policy will rise very steeply. This is why measures are urgently required over the course of time in the field of electricity demand (efficiency on the one hand and electrification on the other), electricity generation, buildings (new and existing buildings), infrastructures (electricity, gas, heat, CO_2, transport) as well as in the transport shift.

- Advances for a range of central emission-reduction options are inevitably linked to complementary options; without systematically designed strategy approaches, the reduction targets may not be achieved:
→ Electrification of motorized individual traffic is inevitably linked, on the one hand, to the development of additional options for electricity generation based on renewable energies (or CCS) and, on the other, on the creation of intelligent electricity grids.
→ The massive use of bio-fuels in road and air transport requires the availability of bio-fuels that meet high sustainability standards.
→ The use of decentralized efficiency technologies that initially run on natural gas (e.g., decentralized cogeneration), as well as the switch of industrial process heat generation to renewable energies require in the medium- to long-term the availability of considerable quantities of biomethane that is fed into the gas grids.

Finally, a careful analysis of the long-term implementation of strategies and the short- to medium-term political instruments must take into account the consistency of short-term, medium-term, and long-term solution contributions. Not all approaches that will no longer be relevant in the long-term target structures are automatically problematic in the short- to medium term (e.g., the distribution of fossil energy generation with a bio-gas potential that is limited in the long term). What is central here are the medium-term switch strategies and the precondition that no counterproductive structures are created in the short- to medium term. At the same time, the solutions required in the long term can lead to problematic structures (e.g., bio-fuels with insufficient

sustainability standards). Targeted policy and innovation approaches with clearly defined time horizons are vital in these areas.

For a broader use of such a system analytical scenario tool for a Sustainable Industrial Policy Monitoring, the following adaptations have to be made:

- The scope has to be broadened for the whole European Union considering global challenges, too.

- The scope has to be broadened for other important environmental impact categories such as resource consumption or biodiversity. If not, the same analytical methodologies can be used – as expected, that is, for biodiversity – and the scenario analysis has to be supplemented by other tools.

- There has to be an additional focus on the relevance of other industrial policy instruments that are not intended to have an effect on reaching the sustainability objectives but may nevertheless have an effect on it – especially counterproductive effects such as subsidies have to be taken into account.

- There has to be a broader search for a policy impact assessment that not only focuses on environmental impacts but also takes economic and/or social impacts into account. The EU needs to make policy assessments and other forms of evidence-gathering more routine.

- Especially for the industrial sector, the monitoring has to go into more detail and to distinguish between the individual industrial sectors.

In this sense, SIMON is highly recommended as an integral part of the follow-up to the communication of the Europe 2020 strategy. It is a first, necessary step to initiate the political debate at the European level about how governance systems can be orchestrated to facilitate sustainable industrial strategies. This could ensure a more systematic and consistent development of horizontal policy approaches to govern the Green Industrial Revolution. Policy coordination is a crucial issue for both industrial policy and sustainability strategies in general. Therefore, on the one hand, we see the urgent need for an analysis of which existing horizontal approaches are supporting the overall environmental goals. On the other hand, it is also important to identify what kind of policy approaches may be counterproductive for the sustainability goals. According to the wide definitions for industrial policies that are described in chapter 2.1, this analysis should be as comprehensive as possible in developing and analyzing horizontal policy packages. One of the most important challenges will be to address the necessary dynamic for **system innovations** in the industry with the right policy mix.

In this regard the main question is: What are the technologies that have to be supported? How should the mix of additional policy measures look in order to move the sectors and their markets in a way that the ambitious objectives for sustainability can be achieved? One of the main challenges of these policy packages is that it is not enough to only support the technology and product development, but that there also have to be consistent measures for the market introduction and probably the diffusion in the markets as well as a potentially necessary phase-out of certain technologies or products (triple regulatory challenge). The assessments and analyses in the context of the study "Blueprint Germany" have shown how important it is to direct certain innovations and technologies as well as its applications in certain (industrial) sectors to fully realize their potential to deliver the ambitious sustainability goals. This can only be achieved by a smart mix of measures for the supply side as well as for the demand side, which may differ from sector to sector. In the past, the technological developments and innovations were often supported solely without preparing for their application in certain markets.

The SIP of the future may have an additional challenge. In view of the deep worldwide economic and financial crisis, the development and market introduction of important technologies and products might become increasingly challenging compared to the past. In view of the recovery and stimulus packages of the European Union and across the member states, it is hard to imagine that comparable public spending may ever happen again. Moreover, the recovery and stimulus packages will more likely result in a future cut in public spending. This means that there will also be less money to support technology developments and market introductions of key technologies that will be necessary to deliver the long-term environmental sustainability goals. Therefore, how these necessary developments can be supported by a "regulatory stimulus" rather than by large public spending or subsidies will be an impor-

tant issue to resolve. A special focus will also be on the question of what political framework is needed to direct sufficient private investments in key technologies to deliver sustainable development. From our perspective, this will be one of the challenges where a Sustainable Industrial Policy Monitoring should provide a new focus.

The current debate – even on an Ecological Industrial Policy – focuses on future technologies and future sectors such as the water sector or the renewable energy sector. From our point of view, a Sustainable Industrial Policy Monitoring should also put a focus on the "mature" industrial sectors that may not only be responsible for the development of new technologies but for their market introduction and application. The individual sectors have to be viewed from two sides. On the one hand, how the performance of the sectors can be improved by the introduction and application of new technologies and services; but on the other hand, a SIMON should also look at the question of how technologies, products, or services of certain sectors can improve the performance of other sectors. For example, the sustainability performance of the European chemical industry can surely be improved by switching the fuel and resource base to renewables. But chemical products such as insulation materials also help sectors such as the building sector to improve their performance significantly.

Sectoral approaches

In this context, one of the main tasks of a Sustainable Industrial Policy Monitoring would be to break down development goals for individual industrial sectors where sector-specific initiatives are necessary to supplement the horizontal approaches. The guiding questions for sectoral approaches would be:

- What are the most important sectors for the achievement of the environmental sustainability goals?
- Where are they part of the problem and where are they part of the solution?
- What are the system and technology innovations that have to be supported?
- What are the costs related to the necessary changes? How can the policy ensure that the transformation costs are covered either by financial support or a regulatory framework that may direct private investments?
- What is the right policy mix to govern the necessary green transformation of a certain sector?
- What middle- and long-term structural changes can be expected? What are the economic and social implications of the potential structural changes?

We expect that the green industrial transformation for the different individual sectors will look very different, meaning that the political framework and measures for governing the transformation will have to be different. So, the way the guiding principles of an SIP as well as the measures of implementation as described in chapter 5 will differ from sector to sector.

The economic and social implications are an important argument concerning an SIP. The estimation of the implications regarding the creation of jobs will be a central part of the upcoming debate. In contrast to horizontal approaches such as an ecological fiscal reform, where the implications for job creation result from the shift from labor costs to energy and resources costs, a comparable analysis has to be sector-specific. Recent debate on the economic and social implications of a Sustainable Industrial Policy has focused on the creation of "green jobs". However, the necessary structural changes for the Green Industrial Revolution will not only be related to the creation of new jobs. It will also be associated with a loss of certain jobs. For example: If we see a middle- and long-term shift from cars with internal combustion engine to electric vehicles, the engine production jobs might get lost as they cannot be compensated for by the production of electric motors or batteries. From the Öko-Institut's point of view, that issue has to be discussed openly on how to deal with jobs that might get lost due to the necessary green industrial transformation. Only if the relevant stakeholder are actively engaged to jointly search for solutions to preserve jobs will there be a chance that the necessary changes will not be blocked due to the fear of job losses. We see this as a major task that has to be a core component in the discussion around the Green Industrial Revolution.

High-Level Group for a Sustainable Industrial Policy

As mentioned above, the success of a Sustainable Industrial Policy is dependent upon integrated policymaking and a better policy coordination and cooperation at different levels, which is quite a big challenge. We see it as a first necessary step to establish a strategic political debate at the European level on how a governance system can be orchestrated to facilitate the strategy of the Green Industrial Revolution.

Therefore, we propose to set up a High-Level Group for a Sustainable Industrial Policy at the European Commission in the context of the implementation of the "Europe 2020" strategy. The aim of this group would be to set up the long-term environmental objectives that will form the framework for the green industrial transformation over the next decades.

In addition, the group should ensure the development and application of analytical scenario tools to identify the potential for integrated policymaking and better policy coordination and cooperation for governing the fundamental change. Such an analysis would need to consider the specific issues at both the European level and the national level regarding framework conditions as well as horizontal and sectoral approaches. This analysis could be the backbone for a monitoring system at the European, national, and sectoral levels that indicates if the policy framework is giving the right guidance for improvements toward the Green Industrial Revolution.

National and sectoral dialogues

From our point of view, the work of the High-Level Group should be complemented by comparable groups at the national and national sectoral levels to discuss the potential of implementing a more Sustainable Industrial Policy.

Even if such dialogues are a rather soft policy instrument due to the complexity of the task, it seems to be a fruitful step for making important progress in the right direction. The Öko-Institut believes that it is simply not an option to fail to link the agenda of industrial policy in Europe and its member states with the sustainability agenda. Since the establishment of the European Union, there has always been an industrial policy; in order for such a policy to remain relevant in the future, it is important that it is linked to the challenges and opportunities of the Green Industrial Revolution. A failure to incorporate the issue of sustainability into an industrial policy may potentially conflict with the essential goals of environmentally sound development. **Having no industrial policy does not seem to be a political option. But industrial policy without governing the Green Industrial Revolution is not an option either.**

7. Limitations of Concept for Sustainable Industrial Policy

As shown before, Sustainable Industrial Policy aims to enforce the needed fundamental transformation of industrial sectors – the Green Industrial Revolution – in order to attain the central goal to reach the ambitious long-termed environmental targets as a prerequisite to ensure and foster human welfare. Discussing opportunities and enhancements of Sustainable Industrial Policy also constantly alludes to its limitations: interdependencies between national competitiveness and international knowledge and/or technology transfer, sustainable development, structural change and growth, as well as the needed rate of "green" technology deployment. From today's view, they are limitations to the concept, but in fact they should be perceived as fundamental challenges to the concept that are closely connected with the proposed goals and guiding principles of a sustainable industrial policy. They urgently need to be addressed by political debate as, otherwise, they do have the potential to constrain the green transformation of economic structures.

From a global perspective, a process of knowledge and/or technology transfer between and within economic regions will be necessary for sustainable development inside ecological limits. Eco-innovations and accelerated technological progress as one of the main pillars of the concept of Sustainable Industrial Policy lead to the question: How can this transfer be established considering the legitimate interests of inventors?

It should be a main assignment of the former EU trade commissioner and newly appointed EU High Representative of the Union for Foreign Affairs and Security Policy to build the foundation of a future, mutual-interest-oriented EU policy for foreign trade and economics, concerted with actual political dialogues between economic players such as the EU-China-US or EU-ACP. Industrial and economic policy dialogues between nations and/or economic regions could clear the way for bilateral and multilateral industrial policy agreements that ensure the continuity of core economic sectors in Europe and at the same time ensure a sustainable development of its partners. These agreements could, for example, combine technology and knowledge transfer with warrants for resource availability. Trade conflicts could be replaced by cooperative approaches, resulting in international technology partnerships that could combine shared research and development expenses with commercialization of the results by different companies and reduced tariffs for the resulting goods.

Another limitation to the concept of Sustainable Industrial Policy is the interdependence of sustainable development, structural change, and economic growth. Structural change in terms of eco-innovations and environmental improvement can go hand-in-hand with enhanced competitiveness in an eco-efficient economy and hence with economic growth in certain sectors (BMU 2008, SEI 2009). Industrial policy measures following the guiding principles proposed in chapter 5 can help to restructure sectors to redirect them to sustainable economic development that could include economic growth. But with view to all economic sectors, the concept of Sustainable Industrial Policy does not focus on an increase of growth rates, but on an acceleration of an innovation and transformation progress in order to reach sustainable development obeying ecological imperatives.

The traditional concept of economic growth defined as a growing GDP is based on a focus on national economies. In the context of globalized social and environmental interconnections, the measurement of economic development also needs to be perceived in an international context. As shown in the fisheries sector, national or European growth of an economic sector can constrain sustainable development in other world regions. The focus on economic growth also touches on the question of how national progress could be measured other than comparing GDPs, which is addressed by the term "beyond GDP".

But the limitation of sustainable development through the concept of economic growth goes even further. With the shock of the oil crisis in the 1970s and 80s, the concept of growth as the foundation of an economy was criticized. But with the recent financial crisis and its subsequent economic crisis, the questioning becomes even more fundamental and more urgent as one tries to figure out the growth rates that are needed solely to pay off financial debts accumulated up to now. Additionally, the debate on growth can hardly be led in a constructive way: The path to a vision of a society with an economic system that does not grow goes through deep ideological divides. In the

case of Europe, this would have to be envisioned for a society in which most economic needs have been satisfied.

If economic growth is not to be limited, this has tremendous consequences for economic development inside of the ecological imperatives. In the case of a low-carbon economy, Galiana and Green (2009) state that in view of the G8 proposal to cut global GHG emissions in half by 2050 to limit global long-term temperature increases to 2°C – and at the same time not slow economic growth – would mean a tripling of the average annual rate of decline in the economy's carbon intensity for the next 40 years.

As soon as the process of structural transformation is started in all industrial sectors, the costs – and especially the rate of technology deployment – will draw more attention in political debate. The transformation of industrial structures differs from the market spreading innovative consumer goods: The process is closely connected with social developments and international aspects, and a longer time frame for replacing old technologies is needed.

Covering the costs of transformation is an important factor that has to be dealt with, as shown before. But even more important is the rate of change, especially the needed high rates of change. In the case of existing low-carbon technologies, the limiting factors for deployment are the scale of the energy system and, therefore, the time needed to build human capacities and scale-up processes of technology development. A possible way to accelerate technology deployment was shown by the "Blueprint" scenario of the Shell study 2008[8].Tailored policies for specific technologies, depending on their state of development, could help to accelerate deployment and hence the rate of change.

Berlin, Darmstadt, Freiburg, March 2010

8 Shell: Energy Scenarios to 2050, http://www.shell.com/scenarios

Abbreviations List

CDP	Carbon Disclosure Project
CSR	Corporate Social Responsibility
ECSC	European Coal and Steel Community
EIP	Ecological industrial policy
ESG	Environmental, social and governance
ETS	Emissions trading scheme
EuP	Energy using products
GHG	Greenhouse gas
ICT	Information and communication technology
SCP	Sustainable consumption and production
SDS	Sustainable Development Strategy
SIMON	Sustainable Industrial Policy Monitoring
SIP	Sustainable Industrial Policy
UNFCCC UN	Framework Convention on Climate Change

References

The references include the documents cited in the paper as well as some selected background documents that were used within the preparation of the memorandum paper but not formally cited.

Barbier (2009) A global green new deal. Executive Summary of UNEP–DTIE report. February.

Bardt (2008a) "Ökologische Industriepolitik oder angebotsorientierte Umweltpolitik?" Wirtschaftsdienst. Zeitschrift für Wirtschaftspolitik, 88. Jahrgang, Heft 1, 2008, S. 31-39.

Bardt (2008b) "Industriepolitik bleibt Industriepolitik". Frankfurter Allgemeine Zeitung, July 7.

Barroso (2007) "Europe's energy policy and the third industrial revolution". Speech (SPEECH/07/580) held at the Loyola de Palacio energy conference. October 1, Madrid.

Barroso (2009) Political guidelines for the next Commission. September 3, Brussels.

Barth/Wolff (2009) Corporate Social Responsibility in Europe – Rhetoric and realities. Cheltenham/ Northhampton: Edward Elgar Publishing.

BDI (2007) Industriepolitik in der Marktwirtschaft. Diskussionspapier vom 23. August, Berlin.

BDI (2008a) Für eine strategische und ganzheitliche Rohstoffpolitik. BDI-Kernforderungen zur Rohstoffpolitik vom 10. November, Berlin.

BDI (2008b) "Ökologische Industriepolitik". In Fakten und Argumente, Positionen des BDI für das Wahljahr 2009.

BDI (2009a) Energiepolitische Kernforderungen des BDI. Positionspapier vom 12. Januar, Berlin.

BDI (2009b) Industrielle Basis der europäischen Wirtschaft stärken – Zehn Handlungsfelder für eine moderne EU-Industriepolitik. Positionspapier. September, Berlin.

BIS (2009) Building Britain's future: New industry, new jobs. Department for Business, Innovation and Skills. UK Government. April.

BMU (2006) Ökologische Industriepolitik. Memorandum für einen "New Deal" für Wirtschaft, Umwelt und Beschäftigung.

BMU (2008a) Ecological industrial policy. Sustainable policy for innovation, growth and employment. Berlin.

BMU (2008b) Die dritte industrielle Revolution – Aufbruch in ein ökologisches Jahrhundert. Dimensionen und Herausforderungen des industriellen und gesellschaftlichen Wandels, Berlin.

BMU (2009a) Dienstleistungen in der Umwelttechnik-Branche. Vorstellung erster Ergebnisse. Juli.

BMU (2009b) Gabriel kritisiert Guttenbergs "industriepolitisches Gesamtkonzept". BMU-Presse-Dienst Nr. 264/09 vom 15. August, Berlin.

BMWi (2008) Schlaglichter der Wirtschaftspolitik. Monatsbericht, Januar.

BMWi (2009a) Schlaglichter der Wirtschaftspolitik. Monatsbericht, Dezember.

BMWi (2009b) Industriepolitisches Gesamtkonzept. Für eine nachhaltige Industriepolitik in Deutschland. Entwurf vom 3.Juli.

Bruegel (2009) "Cold Start for the green innovation machine". Bruegel Policy Contribution, Issue 2009/12, (authors: Aghion, P.; Veugelers, R. & Serre, C.). November.

BUE90 (2008) Die Krisen bewältigen – für einen grünen New Deal! Beschluss (vorläufig) der 28.Ordentlichen Bundesdelegiertenkonferenz. Erfurt, 14.-16. November.

BUE90 (2009) Grüne Industriepolitik: Zukunftsfähig durch ökologische Modernisierung, Fraktions-beschluss vom 21. April.

Climate Risk Pty Ltd+WWF (2009) Climate solutions 2: Low-carbon re-industrialisation. A report to WWF International based on the Climate Risk Industry Sector Technology Allocation (CHRISTAL) model. Executive Summary.

COM (1985) 319 final: Completing the internal market. White Paper from the Commission to the European Council. June 14, Brussels.

COM (1990) 556 Industrial Policy in an open and competitive environment: Guidelines for a Community Approach. October 16.

COM (1995) 688 final Green paper on innovation. December 20, Brussels.

COM (1998) 333 final A strategy for integrating environment into EU policies. May 27, Brussels.

COM (1998) 718 final The competitiveness of European enterprises in the face of globalization. How it can be encouraged. January 20, Brussels.

COM (2001) 641 Sustaining the commitments, increasing the pace. November 8, Brussels.

COM (2002) 1340 Statistical elements in support of the Communication on Industrial Policy in an enlarged Europe. December 11, Brussels.

COM (2002) 714 Industrial policy in an enlarged Europe. December 11, Brussels.

COM (2003) 704 Some key issues in Europe's competitiveness – Towards an integrated approach. November 21, Brussels.

COM (2004) 274 Fostering structural change: an industrial policy for an enlarged Europe. April 20, Brussels.

COM (2005) 24 Working together for growth and jobs. A new start for the Lisbon strategy. February 2, Brussels.

COM (2007) 374 Mid-term review of industrial policy. A contribution to the EU's Growth and Jobs Strategy. July 4, Brussels.

COM (2008) 397 Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan.

COM (2008) 465 An industrial property rights strategy for Europe, Brussels.

COM (2008) 669 The raw material initiative – Meeting our critical needs for growth and jobs in Europe, Brussels.

COM (2008) 800: A European economy recovery plan. November 26, Brussels.

COM (2009) 34.2 Implementation of the Lisbon Strategy Structural Reforms in the context of the European Economic Recovery Plan – Annual country assessments. Volume I, Brussels.

COM (2009) 400 Mainstreaming sustainable development into EU Policy: 2009 review of the European Union Strategy for Sustainable Development. July 24, Brussels.

COM (2009) 519 Investing in the development of low-carbon technologies. October 7, Brussels.

COM (2009) 594 "ELECTRA". For a competitive and sustainable electric engineering industry in the European Union. October 29, Brussels.

COM (2009) 615 Mobilising private and public investment for recovery and long-term structural change: Developing Public Private Partnerships. November 19, Brussels.

COM (2009) 647/3 prov.: Consultation on the future "EU2020" Strategy. Brussels.

Competitive Council (2009) Meeting of the Competitiveness Council on industrial policy. May 26, Brussels.

COU (2007) Environment, 2785th Council Meeting. Press Release of the Council of the European Union. February 20, Brussels.

COU (2009a) An integrated approach to a competitive and sustainable industrial policy in the European Union. Draft Conclusion of the Council of the European Union. 9629/09. May 11, Brussels.

COU (2009b) Council Conclusion towards sustainability: Eco-efficient economy in the context of the post 2010 Lisbon Agenda and the EU Sustainable Development Strategy. 2968th Council Meeting. October 21, Luxembourg.

COU (2009c) Environment, 2968th Council Meeting. Press Release of the Council of the European Union. October 21, Luxembourg.

COU (2009d) Responding to the crisis in the European automotive industry. Cover note of the Council of the European Union, 7004/09. March 2, Brussels.

DG ENTER (2007) EU industrial structure 2007 – Challenges and opportunities.

DG ENTER (2009) High-Level Group on the competitiveness of the European chemical industry – Final Report.

DG ENV (2009) Green elements from member states' recovery plans. Paper for Council. March 3.

DGB (2008) Ökologische Industriepolitik. Nachhaltige Politikum für Innovation, Wachstum und Beschäftigung. Stellungnahme des Deutschen Gewerkschaftsbundes zum Diskussionspapier des Bundesministeriums für Umwelt, Naturschutz, Reaktorsicherheit. 22. September, Berlin.

DNR (2008) Ökologische Industriepolitik. Die Herausforderung in Europa, (autor: Rocholl, M.), Studie im Auftrag des Deutschen Naturschutzrings. Berlin.

Doemens (2009) "Guttenbergs Industriekonzept. Munition für den Wahlkampf". Frankfurter Rundschau. 27. August.

EC (2006) General principles of EU industrial policy. (Autor: Györffi, M.). September.

EC (2007a) "Engin Europe" – For a thriving European Mechanical Engineering industry in the 21st century. Report and recommendation of the "EnginEurope" High-level Discussion Group.

EC (2007b) Fifth report of the High-level Group of Competitiveness, Energy, and the Environment. November.

EC (2009) Towards greater corporate responsibility – Conclusions of EU-funded research. Brussels.

EMCEF & CEFIC "European chemical producers and chemical workers jointly support the development of a coherent EU industrial policy". News Release. March 10, Brussels.

EP (2006) A policy framework to strengthen EU manufacturing – Towards a more integrated approach for industrial policy. Final Report, A6 0206/2006. June 2, Brussels.

ETUC (2009) (2003) Resolution on the climate change, the new industrial policies and the ways out of the crisis adopted by the Executive Committee on October 21.

EU MET (2003) Eurometaux's opinion on the future EU industrial policy. March 10.

EU MET (2006) Building a sustainable future on metals. Why Europe needs a competitive non-ferrous industry. Brussels.

EUROSTAT (2007) Measuring progress towards a more sustainable Europe. 2007 monitoring report of the EU Sustainable Development Strategy. Luxembourg.

FES (2009a) Moderne Industriepolitik oder postmoderne Industriepolitiken, (Autor: Meyer-Stamer).

FES (2009b) Die ökologische Industriepolitik Deutschlands am Beispiel der Solar- und Windindustrie - Musterschüler oder Problemkind? (Autoren: Fischedick, M. & Bechberger, M.). Berlin.

Friends of the Earth Gone to waste. The valuable resources that European countries bury and burn. Executive Summary of report. October.

Galiana/Green (2009) Let the technology race begin. Nature 462, December 3.

GALLUP (2009) Europeans attitude towards the issue of sustainable consumption and production. Survey conducted at request of DG Environment. July.

GEF (2009a) A Green New Deal for Europe. Towards green modernization in the face of crisis. Green New Deal Series vol. 1. October, Brussels.

GEF (2009b) The European green collar economy. Achievements so far – forecasts for the future. Paper 1/2009, a meta-study by Jan Seifert. Februar, Brussels.

GEM (2006) Global Entrepreneurship Monitoring. Results (Bosma, N. & Harding, R.).

Jänicke (2004) Industrial transformation between ecological modernisation and structural change. In Governance for Industrial Transformation, edited by K. Jacop, M. Binder, and A. Wieczorek. Proceedings of the 2003 Berlin Conference on the Human Dimensions of the Global Environmental Change, Environmental Policy Research Centre. Berlin, pp. 201-07.

Jänicke (2007) "Umweltstaat" – eine neue Basisfunktion der Regierens. Umweltintegration am Beispiel Deutschlands. Politik und Umwelt – Politische Vierteljahresschrift, Sonderheft 39/2007; Verlag für Sozialwissenschaften. Wiesbaden.

Jänicke/Jacob (2009) A Third Industrial Revolution? – Solutions to the crisis of resource-intensive growth. FFU-report 02-2009. Berlin.

JRC (2009) Climate change impacts in Europe. Final report of the PESETA research project, (Ciscar, J.-C.).

KfW (2009) Perspektive Zukunftsfähigkeit am Beispiel Energieverbrauch und Energieeffizienz. Frankfurt am Main.

Kaiser (2009) Die industriepolitische Bedeutung der Lissabon-Strategie, Schriftenreihe Moderne Industriepolitik 5/2009. Berlin.

Klocker (2008) "Wettbewerbs- oder Industriepolitik als Leitbild der Wirtschaftspolitik". In Symposien, Instituts der deutschen Wirtschaft Köln (Hg.), S.46-56.

McKinsey (2008) Die öffentliche Beschaffung – ein Hebel für Klimaschutz und Zukunftsmärkte. Studie im Auftrag des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit, http://www.bmu.de/files/na/application/pdf/mckinseystudie.pdf

OECD (2007) Innovation and growth. Rationale for an innovation strategy.

Ott/Klatt (2009) "Aufbruch und Wandel: Regelwerke für einen Green New Deal", Manifest, Greifswald.

Öko-Institut+Forschungszentrum Jülich+Fraunhofer-Institut für Innovationsforschung (2009) Politikszenarien für den Klimaschutz V – auf dem Weg zum Strukturwandel. Treibhausgas-Emissionsszenarien bis zum Jahr 2030. Bericht im Auftrag des Umweltbundesamtes. Oktober.

PBL (2009) Adapting EU governance for a more sustainable future. Background paper to getting into the right lane for 2050. Netherlands Environmental Assessment Agency and Clingendael (van Schaik, L.; Kok, M. & Petersen, A.). Bilthoven, October.

PBL/SRC (2009) Getting into the right lane for 2050. A primer for EU debate. Bilthoven, October.

Pelkmans (2006) European industrial policy; Bruges European Economic Policy Briefings No 15. Bruges.

Porter/Linde (1999) Green and competitive, ending the stalemate. Journal of Business Administration and Policy (Annual 1999): p. 215.

Rifkin (2009) Leading the way to the Third Industrial Revolution and a New Social Europe in the 21st century. Rede in der Heinrich-Böll-Stiftung. 17. November.

Rodrik (2004) Industrial policy for the twenty-first century. September, Cambridge.

Rulff (2009) Totgesagte leben länger, Kommentar von Dieter Rulff. In TAZ, 20. April.

Sachs (2009) An industrial policy for climate change. McKinsey What Matters. February 23.

Schabert (2009) Konjunkturpakete: bedingt wirksam. Handelsblatt. 28. April.

Schmidt (2008) "Brauchen wir eine ökologische Industriepolitik?" Symposien, Institut der deutschen Wirtschaft Köln (Hg.), pp. 58–77.

SEC (2005) 1216 European industry: A sectoral overview. Commission Staff Working Document. October 5, Brussels.

SEC (2005) 16 final Sustainable Development Indicators to monitor the implementation of the EU Sustainable Development Strategy. Communication from Mr. Alumnia to the members of the commission. February 9, Brussels.

SEC (2007) 546/2 Mid-term review of the Sixth Community Environment Action Programme. Commission Staff Working Document. Brussels.

SEC (2007) 547 Accompanying document to mid-term review of the Sixth Community Environment Action Programme. Commission Staff Working Document, Brussels.

SEC (2008) 2111 final Zum Aktionsplan für Nachhaltigkeit in Produktion und Verbrauch und für eine nachhaltige Industriepolitik. Arbeitsdokument der Kommissionsdienststellen. 16. Juli, Brüssel.

SEC (2009) 1111 final European industry in a changing world – Updated sectoral overview 2009. Commission Staff Working Document. July 30, Brussels.

SEC (2009a) 1657 final European competitiveness report 2009. Commission Staff Working Document, Volume I. December 1, Brussels.

SEC (2009b) European competitiveness report 2009. Commission Staff Working Document, Volume II. December 1, Brussels.

SEC (2009c) 1657 final European competitiveness report 2009. Commission Staff Working Document, Volume III. December 1, Brussels.

SEI (2009) A European eco-efficient economy – Governing climate, energy and competitiveness. Report for the Swedish Presidency of the Council of the European Union.

SERI (2009) How to measure Europe's resource use. An analysis for Friends of the Earth Europe. (Giljum, S.; Hinterberger, F.; Lutter, S. & Polzin, C.). June, Wien.

SERI/Friends of the Earth (2009) Overconsumption? Our use of the world's natural resources. September.

Spring Alliance (2009) For a European Union that puts people and planet first. Manifesto. Brussels.

SRU (2008a) Umweltgutachten 2008. Umweltschutz im Zeichen des Klimawandels. Band 1. Juni.

SRU (2008b) Umweltgutachten 2008. Umweltschutz im Zeichen des Klimawandels. Band 2. Juni.

Steinmeier/Gabriel (2009) Eine Wachstumsstrategie für Deutschland. Neue Arbeit durch Investitio-nen in Energie und Umwelt. Strategiepapier anlässlich der IV. Innovationskonferenz. 22. Juni, Berlin.

Swedish Presidency of the European Union (2009a)
Eco-efficient growth in the age of globalisation. Swedish non-paper of the Lisbon strategy-post 2010.

Swedish Presidency of the European Union (2009b)
Eco-efficient economy – What's in it for us? Background material for the informal Meeting of Competitiveness Ministers. October 14-15, Umea.

Swedish Presidency of the European Union (2009c)
Time for transition to an eco-efficient economy. Press Release, July 24.

Touffut (2006) Renewing european industrial policy. A French perspective of theory and practice. Cournot Centre for Economic Studies. February 21.

UBA/BMU (2009) Ökologische Industriepolitik – Wirtschafts- und politikwissenschaftliche Perspektiven, (Autor: Jacob, K.), Dokumentation des Workshop. 18. April, Berlin.

UEAPME (2003) Debate on industrial policy is good, change in policy making approach is better. Position paper. January.

UNEP (2009) Global Green New Deal. An Update for the G20 Pittsburgh Summit. September.

UNEP-DTIE (2009) Global Green New Deal. Executive Summary of the report. (Author: Barbier, E.) February.

UNEP/TEBB (2009) The economics of ecosystems & biodiversity. For national and international policy makers. Summary: Responding to the value of nature.

UNFCCC (2007) Report on the analysis of existing and potential investment and financial flows relevant to the development of an effective and appropriate international response to climate change.

WSIS (2005) Tunis Commitment, November 18. http://www.itu.int/wsis/docs2/tunis/off/7.html

WVM (2008) Neue Wege für eine klima- und ressourcenschonende Industriepolitik. Perspektiven, Geschäftsbericht 2008/2009 der Wirtschaftsvereinigung Metalle.

WWF (2009) Modell Deutschland – Klimaschutz bis 2050 – Vom Ziel her denken. Berlin.

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Freiburg Head Office
P.O. Box 50 02 40
79028 Freiburg, Germany
Street Address
Merzhauser Str. 173
D-79100 Freiburg, Germany
Tel. +49 (0) 761 – 4 52 95-0
Fax +49 (0) 761 – 4 52 95-88

Darmstadt Office
Rheinstr. 95
D-64295 Darmstadt, Deutschland
Tel. +49 (0) 6151 – 81 91-0
Fax +49 (0) 6151 – 81 91-33

Berlin Office
Novalisstr. 10
D-10115 Berlin, Deutschland
Tel. +49 (0) 30 – 40 50 85-380
Fax +49 (0) 30 – 40 50 85-388

A call for Sustainable Industrial Policy for the Green Industrial Revolution

Industrialized production and consumption patterns lead the world to its ecological limits. Climate change, ongoing poverty, food and water shortages, and the global economic recession are all driving forces of the Green Industrial Revolution. In Europe a transformation process of all important "old" as well as "new" economic structures has begun with a high potential for social conflicts. Therefore, a new approach to industrial policy by governments is essential to manage this fundamental change. Sustainable Industrial Policy is the key policy field to actively shape the green transformation.

The close interdependence of economic, social, and environmental issues calls for a sustainable approach to industrial policy to steer the needed change of production and consumption patterns. To master these challenges, while providing room for the opportunities of the green transformation, it is essential to avoid disruptive, unpredictable changes as far as possible.

Ecological imperatives to combat climate change, protect natural resources, and conserve biodiversity critically limit the scope of possible political action in the next 40 years while at the same time requiring a structural transformation that exceeds only marginal improvements. Having no industrial policy is therefore not a political option.

GREEN EUROPEAN FOUNDATION

15 rue d'Arlon B-1050 Brussels
T +32 (2) 234 65 70 F +32 (2) 234 65 79
info@gef.eu www.gef.eu