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Green Jobs: Impacts of a Green Economy on Employment

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Green Jobs: Impacts of a Green Economy on Employment*

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Translated from German by InPuzzle

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Index of abbreviations

AASA	The Association of Academies of Sciences in Asia
BAU	Business as usual
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMZ	German Federal Ministry for Economic Cooperation and Development
CDM	Clean Development Mechanism
CEDEFOP	European Centre for the Development of Vocational Training
CER	Certified Emissions Reduction
CGE	Computable General Equilibrium Model
CNG	Compressed Natural Gas
DBSA	Development Bank of Southern Africa
DC	Development cooperation
EMAS	Eco-Management and Audit Scheme
EU	European Union
FFU	Environmental Policy Research Centre, Freie Universität Berlin
GHK	GHK Holdings Limited
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GWC	Growth Without Constraints
IDC	Industrial Development Corporation
ILO	International Labour Organization
IOE	International Organization of Employers
ITUC	International Trade Union Confederation
LCEGS	Low Carbon Environmental Goods and Services
MENA	Middle East and North Africa
MW	Megawatt
MWh	Megawatt hour
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
PSIA	Poverty and Social Impact Analysis
R&D	Research and Development
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (EU regulation)
SEEA	System of Integrated Environmental and Economic Accounting
STEM	Science, Technology, Engineering and Mathematics
TIPS	Trade and Industrial Policy Strategies
TVET	Technical and Vocational Education and Training
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific

Executive Summary

Not only should the reduction of emissions and utilisation of resources be achieved by a green economy, but also an increase in employment in sectors based on sustainable resource management and protection. New employment that has been created in the area of environmental technologies and renewable energies in Germany and other Western industrial countries fuels this hope. But can this also be applied to the context of developing countries? Or do the extra costs of resource and emission-intensive economies, taken as a whole, outweigh and even compromise opportunities for development? The study from the literature presented here attempts to contribute to the debate by bringing together concepts, methods and findings for measuring and predicting the employment effects of a transition to a green economy. Recommendations for development cooperation are developed on this basis.

The study begins with an overview of the international debate on issues related to a green economy and the associated definitions, concepts and measurement approaches (Section 1). The role of the effects on employment in this context is then debated and various concepts of green jobs are introduced (Section 2). The subsequent section provides an overview of the central instruments for promoting a green economy and integrates them in an overall taxonomy (Section 3). More detail of the employment relevance of these instruments is given on this basis in section 4. Section 5 then discusses the role of the accompanying employment and labour market policy instruments. In section 6, the most important methods for identifying and assessing the impact of a green economy on employment are presented. The empirical studies in hand are presented on this basis and their important findings are then summarised (Section 7). A series of recommendations for action to promote employment within the framework of green economy strategies in the context of development cooperation are then discussed.

Green economy concepts

In recent years, a series of concepts of what constitutes a green economy have been developed by various

players. It is a matter of reconciling economic development and environmental sustainability, albeit with differences in emphasis. On the one hand, we can identify macroeconomic concepts that seek to record and improve the environmental performance of the whole economy, and on the other, concepts that focus on developing a sector for environmental goods or environmentally-friendly technologies.

Green jobs and employment effects of a green economy

Given the international debate on the green economy and green growth, there are different notions of how the employment effects of a green economy or the number of green jobs can be measured. The term 'green jobs' refers to jobs that are created in the context of the expansion of a green economy in definable environmental industries to improve environmental impact or ensure compliance with environmental standards in traditional sectors (e.g. environmental management). Accordingly, 'green jobs' refers to the sector-based understanding of a green economy and its existing jobs. In the context of developing green economy strategies, such studies could help to present the employment potential of individual green sectors and thereby legitimise sector-specific promotion.

In addition to demarcating and identifying employment in the area of environmental technologies and services, the macroeconomic employment effects brought about by environmental policy in the promotion of a green economy and associated structural change can also be taken into account. Here, the effects on all sectors are considered and distributive effects also come into focus. In the international debate, these employment effects are sometimes referred to as green jobs. For conceptual precision in this study, however, it is not the sector-based understanding of a green economy that is referred to, but the employment effects of the transition to a green economy.

Considerations of the number of green jobs or employment effects created are, after all, supplemented by taking into account the quality of employment

in a green economy. A distinction can be made here between two existing types of qualitative effects on employment. On the one hand, this concerns the change in employment profiles and the associated levels of skill and the requirements for them (green skills). In the process, qualitative changes in labour demand and the required training measures in the context of a transition to a green economy are placed at the forefront. A second approach refers to the quality of the particular job. The main interest here lies in addressing the impact of a green economy on working conditions, particularly in emerging and developing countries (decent work).

Economic and environmental policy instruments for structuring and managing the transition to a green economy

A variety of policy instruments have been discussed to promote the change to a green economy. A green economy should come about while markets, that is, supply, demand and the necessary infrastructures for environmentally-friendly goods, are developed. Various market-based instruments are recommended for this purpose. Market-based instruments are aimed at putting a price on emissions and the use of natural resources, or increasing this price and therefore providing incentives for protecting the environment. In addition, in this study, a second group of market-creating policy instruments is considered. These include regulations and incentive measures that generate the demand for environmentally-friendly products and services. These are generally complemented by supply-side instruments, i.e. by measures to promote technology and investment as part of a comprehensive industrial and innovation policy.

A further aspect for the promotion of a green economy is a sustainable infrastructure policy. With the development of public infrastructure, decisions with long-term effects are made with important implications for the development of economic structures and their associated technologies. Lastly, an effective green economy policy requires a continuously changing instrument mix in order to adapt the policy to changing market and technology developments. To this end, monitoring and evaluation mechanisms are important elements of green economy strategies.

Employment effects of a green economy policy: Concepts and action mechanisms

The following key findings have been derived from the literature on the innovation, market and employment effects of environmental policy:

- Short-term substitution effects are often analysed in the assessment of investment projects.
- Studies on the effect of environmental policy regulation increasingly take into account long-term innovation effects and in this context, identify increasingly positive inter-related effects.
- In the literature on the economic effects of an environmental tax reform, the potential of a so-called double dividend with simultaneous lowering of social security contributions is discussed. The different approaches and results make it clear that it is not possible to assess the employment effects of individual policy instruments without taking into account other factors of influence, particularly the capacities of a country. As a consequence, the impact of individual instruments on employment cannot be calculated, per se, but rather is the result of market conditions, the availability of skilled labour, the work intensity of technological alternatives, etc. Preconditions for assessing the impact on employment therefore include identifying the relevant factors of influence and analysing the action mechanisms expected in the particular context.
- There are indications that many environmentally-friendly technologies are associated with higher work intensity and as such, lead to an increase in employment compared to conventional technologies. Higher capital intensity is indicated for other technologies, with the result that the employment effects are negative.
- Employment effects of energy price increases are low unless the energy tax income is used to relieve labour costs. In this case, positive effects are to be expected.
- Labour market rigidities can delay positive employment effects.

- The innovation effects of environmental policy are the subject of controversy. On the one hand, there are opportunity costs that limit innovation activities, and on the other, environmental innovations are stimulated.
- Countries leading the way in environmental policy can gain economic advantages in world trade with environmentally-friendly technologies.
- The risk of polluting industries migrating to countries with less strict environmental regulations is, however, currently deemed to be low. However, the importance of this could increase if financial costs arise from environmental policy.
- Employment potential is seen in the management of natural resources and the valorisation of ecosystem services.

Employment promotion in the context of green economy strategies

Linked with the change to a green economy is economic structural change which also concerns the labour markets. Labour markets should be designed to be dynamic and efficient in order to enable this structural change to take place. In addition, a series of specific challenges for employment policy in the context of a transformation to a green economy has also been identified. An important challenge concerns the development and adaptation of education and further training programmes to the skill requirements of green sectors. Another challenge for the implementation of green economy strategies is how to deal with shrinking sectors and the associated job losses. These include for example offers of mediation and further training for the affected workers and the creation of public employment services.

Methods for the identification and assessment of employment effects

When identifying and assessing gross employment effects, a distinction is made between direct, indirect and induced employment effects. In most cases, direct employment effects refer exclusively to effects that are brought about directly by the measure concerned, or in a selected sector (e.g. renewable energies). Indirect employment effects are those that are brought about in

the upstream or downstream stages of the value chain. Induced employment effects are jobs that arise because workers that are employed in the relevant value chains or involved in an individual project spend part of their income on goods and services.

To calculate the direct employment effects of investment measures or the expansion of individual sectors, the so-called employment factor approach is used. To calculate indirect and induced employment effects, input-output tables are generally used.

To calculate net employment effects, the employment effects of a measure, policy or investment scenario are compared with a reference or business as usual (BAU) scenario. In addition, macroeconomic models are used, for example in the form of econometric models, equilibrium models (computable general equilibrium models, CGE) and system dynamics models.

Results of existing studies

Few empirical studies currently exist on the employment effects of a green economy in developing and emerging countries. Like in member countries of the Organisation for Economic Co-operation and Development (OECD), most of the existing studies are on the topic of renewable energies and energy efficiency. There is particular emphasis on the Middle East and North Africa (MENA) region. Most of the studies focus on direct employment effects. The employment potential determined varies considerably depending on the assumed expansion of local production capacities. Macroeconomic modelling on the employment effects of environmental policy measures do exist in developing and emerging countries. These studies do not form a uniform picture. Overall, the macroeconomic employment effects are estimated to be relatively small. Whether positive or negative effects predominate depends largely on supplementary measures such as the reinvestment of money from environmental taxes or sector-specific measures to mitigate negative effects.

Conclusions and recommendations

The measurement of green jobs is carried out by assessing the number of jobs in a green economy according to the sector-based understanding of the concept. The reception of such studies shows that the green economy agenda can be taken forward and

acceptance of more demanding environmental policies can be fostered. The transfer of these approaches to developing and emerging countries should, in principle, be possible, with the precondition that the technologies and sectors to be investigated are demarcated and customised for the particular country. These approaches could be used in particular for the assessment of sector-specific green economy policies.

Sector-based measurement approaches are increasingly supplemented by a complementary macroeconomic perspective. To increase the effects of such studies, it is necessary for dialogue to take place between scientific and political spheres and to ensure transparency of assumptions on causal chains. In addition, when modelling the economic and social consequences of environmental policy, the selection of reference scenarios is particularly crucial for assessing the findings. When a traditional industrialisation path is assumed in the modelling, without taking into account the national economic costs of environmental pollution and use of resources, a distorted picture of employment effects can arise, whereby the negative effects of environmental policy instruments are overestimated.

Designing green economy strategies

Policy instruments for the transition to a green economy cannot easily be transferred from one country to another, but must be adapted to the particular economic, institutional and social context. An important step in calculating different options for promoting labour demand in the context of a green strategy, is therefore to analyse the corresponding value chains and the associated potential for setting up a domestic supply chain. The existing economic structures should also be taken into account when introducing environmental taxes or other control instruments that have an impact on energy or resource prices. In addition, in priority areas of environmental policy action, innovation potentials can be opened which promotes employment and economic development. Economically feasible solutions to an environmental problem that also exists in other countries can potentially be translated into export success. However, this is only to be expected by focusing certain resources on areas of action of particular relevance in the domestic country.

Development of capacities for employment policy in a green economy

When developing country-specific green economy strategies, governments must make decisions about what industries should be burdened by new environmental regulations or which sectors should be promoted in priority. To do so, the state depends on the knowledge of external players from the private sector, civil society and scientific fields. In fact, only in this way can strategies be adapted to the existing potential and economic structures and be used for effective promotion of employment. To this end, institutions or platforms for close cooperation should be developed between the public sector and economic sectors with a focus on environmental and resource conservation.

Exchanging with stakeholders should be supplemented or linked by evidence-based approaches. By conducting an analysis of potential socio-economic and particularly budgetary and social consequences, acceptance of suggested policies can be increased and partners can be found in the government and in society. Analysis of distributional impacts plays a key role, particularly in the phase-out of environmentally-damaging industries, to cushion the social impacts of the corresponding measures and thereby minimise resistance.

Introduction

The transition to a green economy is a necessity, an opportunity and a challenge for sustainable development. A necessity in so far as the current use of resources and emissions from production and consumption exceeds the carrying capacity of natural systems. The overuse of land, soil, water and natural resources and the loss of biodiversity cannot be overlooked, even if the effects and scarcities are scattered unevenly from region to region. By the same token, emissions from greenhouse gases, contaminants and waste exceed the ecosystem's ability to regenerate itself. With an increasing population and growing income in many emerging countries, the situation is intensifying. Production and consumption are far from a sustainable economy and respecting planetary boundaries.

An economy that is geared towards preserving and using the natural environment in a sustainable way is not necessarily characterised by sacrifice and limitations. On the contrary, many examples of good practice show that an environmental focus and economic development opportunities can go hand in hand. The reasons for this are:

- **The avoidable costs of environmental degradation:** In many countries, a deteriorating environment is reflected in direct costs. Developing countries with a large agricultural sector are already being affected by water shortages and climate change. But soil, water and air pollution are also reflected in economically relevant costs, which can be at least partially avoided by adopting an environmental focus.
- **Economic opportunities from environmental technologies and environmentally-friendly business models:** Many studies show the growing demand for environmental technologies. Emerging countries also have an increasing share in these markets. Added to that are new environmentally and resource-efficient services. Particularly in developing countries, new business models for marketing environmental technologies and providing services adapted to the contexts in the particular countries, show considerable growth potential.

- **Economic development potential of natural resource management:** Numerous studies show that the valorisation of natural resources in the context of sustainable management approaches can launch a dynamic that can reconcile economic development with the protection of nature and the environment.

Linked with a green economy is the hope of an increase in employment in sectors based on sustainable resource management and resource protection respectively.

New employment that has been created in the area of environmental technologies and renewable energies in Germany and other Western industrial countries fuels this hope. But can this also be applied to the context of developing countries? Or do the extra costs compared to resource and emission-intensive economies, taken as a whole, outweigh and even compromise opportunities for development?

For agriculture and energy-intensive sectors of industry, the provision of natural resources at the lowest possible prices as input, so to speak, constitutes an important factor for competitiveness. In otherwise identical conditions, any change in access or prices will result in reduced profits or a weakened competitive position. At the same time, potential for innovation and efficiency is undervalued. Energy prices, widely differing by international comparison, result in significant differences in energy efficiency: Higher energy prices lead to investments in innovative, energy-saving solutions and ensure competitiveness (Newbery, 2003). A policy that would bring about structural change towards a green economy poses a challenge to many businesses and sectors. Sectors that see this as a threat to their foundations of their business, based on access to cheap (energy) resources, develop resistance. This is also reflected in conflicts between ministries of government, parties and regions. A policy that promotes a green economy will be considered legitimate if its long-term economic advantages can be easily demonstrated. These advantages include, crucially, employment potential.

But imputing or predicting effects on employment is a significant methodological challenge. There are no generally accepted definitions of green economy, environmental technologies or associated jobs. Policies and structural change do not only have direct effects but also indirect effects on upstream production stages, competing industries and in the form of opportunity costs. Measuring or even predicting effects on employment on the basis of model calculations is therefore a methodological prerequisite. Particularly in developing and emerging countries, a cost-benefit assessment is based centrally on the assumption that economic development would occur without the appropriate frameworks in place.

The study from the literature presented here contributes to this debate by collecting and analysing central concepts, methods and findings for measuring and predicting the effects of transitioning to a green economy on employment. Recommendations for action on development cooperation are subsequently established on this basis.

The study begins with an overview of the international debate on issues related to a green economy and the associated definitions, concepts and measurement approaches (Section 1). The role of the effects on employment in this context is then debated and various concepts of green jobs are envisaged (Section 2). The subsequent section provides an overview of the central instruments for promoting a green economy and integrates them into an overall system (Section 3). More detail of the employment relevance of these instruments is given on this basis in section 4. Section 5 then examines the role of the political instruments associated with the employment and labour market. In section 6 the most important methods for assessing the impact of a green economy on employment are presented. The empirical studies in hand are presented on this basis and their important findings are then summarised (Section 7). A series of recommendations for action to promote employment within the framework of green economy strategies in the context of development cooperation are then discussed.

1

Overview of green economy concepts

1.1

The international discourse on green economy

The international debate on the development of an environmentally and climate-friendly economy is characterised by a series of related concepts such as green economy, green growth and green development. These concepts share the opinion that modernisation and the development of economic activities cannot take place along previous paths of economic development, but rather the conservation of natural resources must be a key component of a sustainable economy. In this context, the concept of a green economy represents the vision of an environmentally sound economy where the environment and the economy are in harmony with one another. This said, it offers no alternative plan for the concept of sustainable development, but rather a definition of this concept at the intersection of economy and ecology. Basic assumptions are that:

- the Western model of resource- and emission-intensive production and consumption cannot be generalised nor sustained in the long term,
- economic growth and job creation are possible, even when the limitations of natural systems are taken into account.

These different approaches all agree that market mechanisms are suitable for initiating search processes toward an economy that is resource-efficient and prevents emissions, provided that appropriate conditions are put in place. Unlike growth-critical contributions, the fundamental compatibility of economic development and environmental sustainability is not called into question (see Box 1, p. 16).

In the context of development policies, the effects of climate change and environmental degradation, in particular, and the comparatively high dependence on natural resources such as water, land and soil, are perceived as risks to economic development and the

fight against poverty. In addition, the green economy concepts of Western industrial countries are viewed in a partially critical manner: It is feared that new environmental challenges may bring about a form of environmental protectionism that is closely associated not only with capital-intensive Western environmental technologies, but also with additional conditions which might impair the development path of emerging and developing countries. Developing and emerging countries recognise the need to fight against climate change, but also emphasise the principle of the common yet differentiated responsibilities, which implies that developed countries should have a higher obligation to combat climate change than developing countries (The Association of Academies of Sciences in Asia, 2011, p. 129f.; United Nations General Assembly, 2012, Section 15).

In its definition of a green economy, the United Nations Environment Programme (UNEP) emphasises that all the interactions between the economy, society and the environment must be considered, and that a balance between these three dimensions is essential (UNEP, 2011). The conservation of ecosystems thus functions as a condition for securing economic development and employment. This perspective is also shared by the German Federal Ministry for Economic Cooperation and Development (BMZ) (BMZ, 2011). The necessity of green growth strategies in particular is considered against the backdrop of these requirements, where 'existing economic processes are designed with the environment in mind and additional employment opportunities are created in new "green sectors"' (BMZ 2011, p. 8). The aim of green growth is also shared by the OECD in particular (OECD, 2011a). Here it is emphasised that the opportunities for economic growth are limited by the exhaustion of natural resources. In this context, it is necessary to integrate their conservation within the target system of economic activities. At the same time, it is recognised that this may result in undesired distribution effects and alleviation through socio-

political instruments may be necessary (OECD, 2013). In view of emerging and developing countries, some contributions emphasise the need for green economy or green growth strategies to recognise the particular vulnerability of certain populations, and the need for corresponding socio-political measures to ensure the population's acceptance of such strategies. (World Bank, 2012; ILO, 2013c). Central to this is the World Bank's study on Inclusive Green Growth, the economically and ecologically-sound concept does not differ fundamentally from the approaches previously mentioned. However, it addresses the particular concerns of emerging and developing countries in relation to natural disasters, the consequences of climate change and the associated need for climate adaptation in order to adopt green growth strategies (World Bank, 2012, p. 30). Besides this, it emphasises the often uneven distribution of gains from growth, which frequently does not benefit the poorer layers of the population. However, the report does not go into detail on exactly how the social inclusion of the poor would be achieved (see ILO, 2013c, p. 17).

The debate focuses primarily on the industrial production – in the development policy context, Western lifestyle, consumption and growth models are also, exceptionally, called into question. Such an exception is the report by the Association of Academies of Sciences in Asia (AASA), which champions the concept of green development and sees in Asia in particular, the cultural foundations for a resource-efficient lifestyle (The Association of Academies of Sciences in Asia, 2011, xxiii).

All concepts share a set of environmental aims, even if they emphasise these differently. These include reducing greenhouse gas emissions, increasing resource efficiency, adapting the economy to climate change and conserving and regenerating ecosystems and ecosystem services.¹ At their core, all approaches share the notion of green growth, green economy or green development as a means to reconcile economic and environmental pillars, without ignoring social aspects (World Bank, 2012, S. 24). In this context, employment aspects are addressed under two separate themes:

¹ The term 'ecosystem services' designates the use that humans make of natural elements. For example, the provision of clean drinking water, climate regulation, pollination of plants, provision of natural resources and cultural services.

Box 1

Excursus on growth-critical positions

Some growth-critical contributions assess the green economy discourse as being an update to a growth-oriented economy. They urge – industrial countries at least – to turn away from growth as a key goal of political action (Seidl and Zahrnt, 2010; UK Sustainable Development Commission, 2009). This demand is justified on the one hand by the fact that economic growth in industrial countries leads only to a marginal improvement of the standard of living, and on the other, a reduction in growth and resource consumption in the global North could enable growth in developing countries, where it could actually benefit people (New Economics Foundation, 2009; Victor and Rosenbluth, 2007). The approaches also doubt whether an absolute reduction of resource consumption is actually possible in the context of a green economy, because gains in efficiency are again (over)compensated for by rebound effects (UK Sustainable Development Commission, 2009, p. 47ff.).

Growth criticism has as yet mainly been a debate in Western industrial countries. Practically all green economy concepts aspire to an alternative form of growth that respects environmental limits. The OECD and World Bank, in particular, hold fast to the necessity of (green, inclusive) growth. A move away from growth objectives in industrial countries is contrary to the apparent dependence on social security systems of sustained growth. In developing countries, furthermore, growth is understood as being the most important lever for reducing poverty. Other elements in the growth-critical discourse, such as the necessity of a cultural change and a move away from the Western model of consumption, have as yet only been found in the green development concept of The Association of Academies of Sciences in Asia (AASA) (2011, p. 62ff., 140).

- **Inclusiveness:** This dimension requires that growth and employment potential of a green economy should benefit all groups of society. This concerns, on the one hand, access to the labour market, to educational opportunities and employment. On the other, practically all concepts recognise that single green economy policies can have regressive distribution effects where the poorest are hardest hit, and require socio-political intervention for balance to be achieved (see AfDB et al., 2012; ILO, ILS, IOE, ITUC and UNEP, 2012; UNCSD Secretariat, 2011; World Bank, 2012).

- **Decent work:** The cross benefits between employment and the environment were already highlighted by the International Labour Organization (ILO) and the International Trade Union Confederation (ITUC) in particular at an early stage and 'two of the defining challenges of the 21st Century' identified: achieving environmental sustainability and turning the vision of decent work for all into a reality (ILO 2013c, p. xi; UNEP et al., 2008).

1.2 Demarcation and measurement of green economic sectors

The previously presented approaches deal with normative concepts which express the aim of a sustainable economy for national economies as a whole. They serve as models for the long-term transformation to an environmentally-sound economy and focus on synergies between environmental protection and economic development. These are to be distinguished from analytical concepts, which are geared towards determining and predicting the extent of environmental industries or their future growth. They are measured using sector-based classifications and data of goods and industries, and thus present the (growing) proportion of green economic sectors in a national economy. In the context of the public debate on green economy, this sector-based view also serves as an empirical illustration of the economic potential that can be exploited as part of the transition to a green economy. To demarcate the sectors in question, different classifications are presented below.

1.2.1 Environmental technologies in the strict sense of the term

Initial approaches to classification were developed in the first half of the 1990s by OECD and Eurostat. The aim was to define and classify an economic sector for environmental technologies to make it measurable by statistics. The concept defines the environmental goods and services industry as goods and activities that are designed to contribute to environmental protection – filtering, measuring, cleaning and recycling technologies, etc. (Eurostat and OECD, 1999). The classification is broadly applied by the European Union (EU) and OECD (e.g. Eurostat, 2009).

1.2.2

A broad understanding of environmental industries

Advanced understanding of environmental industries is linked with experimentation, covering not only environmental technologies in the strict sense, but also environmentally-friendly technologies or improving the environmental impact of existing industries. This includes more efficient cars, buildings, organic food, etc. The main purpose of these goods is not to improve the environment but they fulfil other functions, albeit with less harmful impact on the environment than comparable technologies. This would cover a vastly greater proportion of the national economy, but demarcating it is considerably more difficult and also varies according to technical advances (Jacob, 2009, p. 70f.).

The German Federal Ministry for the Environment's (BMU) GreenTech Atlas and the British study on Low Carbon Environmental Goods and Services (LCEGS) present two different approaches to cover the environmental sector according to this broad understanding in the particular countries.

The BMU's GreenTech Atlas identifies six so-called lead markets for environmental technology and resource efficiency: (1) Environment-friendly energies and energy conservation, (2) Energy efficiency, (3) Resource and material efficiency, (4) Sustainable mobility, (5) Recycling economy and (6) Sustainable water economy. The volume of these markets was determined by identifying technologies and surveying business representatives concerned by these technologies.

Similarly, the British study identifies goods and services in different sectors that are produced in a relatively environmentally-friendly way. This encompasses over 2,800 activities from manufacturing to assembly to Research and Development and training. The classification also includes companies which exclusively produce LCEGS or their primary products, and companies that provide primary products and services as part of the supply chain, when these constitute at least twenty percent of the company's² revenue (Department for Business, Innovation and Skills, 2012).

² In addition, the report points out the difficulties of measurement and the necessary exceptions to this 20% rule: 'exception to this 20% rule is for large companies where a small proportion of overall sales is a significant contribution to the UK LCEGS sector' (Department for Business, Innovation and Skills, 2012, p. 8).

1.3 Conclusion

The concept of a green economy has both a normative and an empirical dimension that complement each other in the context of the international debate.

The macroeconomic concepts of international organisations present different interpretations of a new concept of growth and the economy without questioning the fundamental compatibility of economic development and environmental sustainability. To supplement this, the sectoral concept of a green economy is used to demonstrate past successes and the economic potential of the corresponding green economy policy. Through regular inquiries, growth and changes in the area of environmental industry, environmental technologies and economic activities are being empirically proven. They serve as a basis for legitimising the promotion of these industries and as a database for more advanced, sector-specific analyses.

2

Concepts of green jobs and employment effects in a green economy

Regardless of the specific understanding of a green economy, all approaches emphasise the employment potential of a transition to a green economy or the development of individual environmental industries. The following section presents the most important concepts and their parallels to the previous discussion pertaining to a green economy. Here, a distinction is made between a sector-based approach to cover so-called green jobs and the overall impact of environmental policies on employment in an economy.

2.1

From the growth of environmental industries to the impact of green growth on employment

Given the international debate on green economy and green growth, there are different notions of how the impact of a green economy on employment can be conceptually defined and demarcated. The concept of green jobs refers to jobs that are created in the context of the expansion of a green economy in growing environmental industries, to improve environmental impact or ensure compliance with environmental standards in traditional sectors (e.g. environmental management), in other words, to the sectoral understanding of a green economy. Generally, only gross employment effects of expansion of this economic sector are considered here.

These positive effects on employment, however, result in a decline in employment losses in traditional sectors. The net employment effects of a transition to a green economy are the balance of gains and losses. These net effects are to be considered as playing a role primarily within the framework of an employment policy and national economic assessment of a green economy. The following section presents both approaches – green jobs in environmental sectors, on one hand,

and net employment effects of the transition to a green economy, on the other. In the literature on development policy, the term 'green jobs' is occasionally used for both concepts – employment in environmental industries and the net employment effects of the transition to a green economy (see also World Bank, 2012, p. 92-93). In the interests of differentiation and precision, the concept is only used in this study to refer to employment in environmental industries.

2.2

Green jobs: concepts and definitions

In the context of the sector-based approaches to green economy, the key conceptual challenge in considering effects on employment is to distinguish green jobs from other jobs. Crossovers between green and 'non-green' sectors are fluid, particularly given the broad understanding of environmental technologies which speaks of different 'shades of green'. Accordingly, there are no generally recognised statistics that would allow for comparisons to be drawn between sectors, countries or over time.

In order to distinguish between green jobs and other jobs, a distinction can be made between an output and a process perspective. From an output perspective, green jobs refer to the jobs in companies and sectors which produce goods and services that are either environmental goods in the strictest sense or relatively environmentally-friendly goods. From a process perspective, the definition goes beyond this and covers employment that seeks to improve the environmental impact of companies which do not produce environmental goods in one sense or another. (ILO et al., 2012). Both are difficult to operationalise and measure: From the output perspective, it is difficult to both demarcate environmental technologies from conventional technologies and acquire inputs. In definitions that refer to the process, the clear

demarcation of activities and services within a sector or a company poses a challenge.

The abovementioned OECD and Eurostat indicators for assessing environmental technologies focus on the output perspective. Here, green jobs are defined as employment in environmental industries which produce goods and services that reduce environmental risks, emissions and consumption of resources (Eurostat and OECD, 1999, p. 3; World Bank, 2012, p. 93).

In contrast, the U.S. Bureau of Labour Statistics extends the distinction of a process perspective and distinguishes 'jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources' from 'jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources' (Bruvold et al., 2012, p. 19).

UNEP, ILO, ITUC and the International Organization of Employers (IOE) use the broadest understanding of green jobs, which includes a vast number of activities in different sectors:

"We define green jobs as work in agricultural, manufacturing, R&D [Research and Development], administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reducing energy, materials, and water consumption through high-efficiency strategies; de-carbonising the economy; and minimising or altogether avoiding generation of all forms of waste and pollution" (UNEP et al., 2008, S. 3).

However, this definition does not include details of operationalisation and requires that individual countries substantiate the concept according to their own economic structures. A discussion sponsored by the ILO process is taking place in order to develop an internationally comparable basis for measurement. The current suggestion in this international debate involves a link between environmental activities in the context of the System of Environmental-Economic Accounting (SEEA) and the ILO's decent work indicators

(ILO 2012a, 22f.).³ Particularly in developing countries with scant resources for data collection and a large informal economy, a gradual introduction is offered which initially focuses data collection on key sectors where data is already available, or where there are no demarcation problems (ILO, 2012, p. 33f.).

2.3 Employment effects of the transition to a green economy

In contrast to this sector-based view of green jobs, there are a series of studies that assess the impact of a structural transformation to a green economy at a national economic level. In this case, the net effects of green economy policies on job creation are considered. Here, employment is considered separately from concrete jobs and the activities of individual workers and traditional sectors are incorporated. The goal is not to aggregate green job figures but to assess the effects on the implementation of measures whose aim is to improve the environmental impact of an economy or the associated structural economic transformation.

Methodical consideration of the net employment effects of green economy policies provides an advantage over sector-based approaches, eliminating the need to differentiate between green jobs and other jobs. Instead, it faces the challenge of separating the effects on employment of individual measures or packages of measures for the promotion of a green economy from other developments and trends. On the one hand, measures or packages of measures that serve to promote a green economy must therefore be defined and demarcated, and their effects should be assessed. On the other, a so-called reference scenario or business as usual (BAU) scenario must be defined, to reflect employment trends for maintaining existing political and economic framework conditions.

³ The definition for employment in environmental activities put forward by the ILO states: 'Employment in environmental activities comprises all employment in activities that lead to the production of environmental goods and services for consumption by other economic units or for consumption by the establishment in which the activity is performed. Environmental goods and services are the products of environmental activities as defined in the most recently updated version of the System of Environmental-Economic Accounting (SEEA). In addition to activities in the production of environmental goods and services, this includes activities that improve the establishment's processes in order to reduce or eliminate pressures on the environment or to make more efficient use of natural resources' (ILO, 2012a, p. 25).

Box 2:**Short, medium and long-term impact of a green economy on employment**

The time perspective selected plays a significant role in the calculation of the net employment impact of a transition to a green economy. In their contribution to the employment effects of climate policy, Fankhaeser et al. (2008) differentiate between short, medium- and long-term employment effects that are to be expected within the course of a long-term structural change to a climate-neutral economy.

Included in **short-term employment effects** are direct effects on growth and the demand for goods or services. If and when environment and climate policy aims at increasing the price of emissions or the use of resources, the negative impact must be calculated in the sectors affected. These could be offset in the short term through growth in other sectors which satisfy the same requirements of lower emissions or lower resource intensity. In many cases, this is associated with greater work intensity. Therefore, the short-term employment effects can be positive in the net balance despite losses in the sectors primarily addressed.

Medium-term employment effects occur after these direct effects have taken place. As part of behavioural changes and the further development of new industries and markets, further sectoral losses and growth arise along upstream value chains. Additional variables, such as rising energy prices or other price or budget effects resulting from restrictions regarding CO₂ emissions also play a role. Additional positive effects are expected through export opportunities of environmentally-friendly technologies, particularly when the environmental regulation is diffused abroad.

Finally, long-term employment effects are caused by basic adaptation processes, far-reaching innovations and technological change that are generated by inter-sectoral structural change. New sectors and growth potential arise and existing sectors can lose their importance or be transformed. Long-term employment effects are particularly far-reaching, but difficult to predict. The role of a so-called *skill bias* is often referred to with regard to labour market changes in the course of technological change in the recent past. The associated increases in productivity are attributed to positive welfare effects.

When these scenarios are based on a simple continuation of past economic development, an increase in the cost of emissions or the use of resources leads 'ceteris paribus' to a limitation of the previous economic activities and associated employment. Such simple extrapolation considers neither the effects of innovation nor the economic effects of increasing environmental pollution and shrinking resources. For this reason, integrated scenarios are increasingly being developed. These take into account environmental and resource consumption and technical progress in the area of environmentally-friendly technologies. Furthermore, the results from a national economic view are greatly dependent on a time perspective (Fankhaeser et al., 2008). In view of the above, it is important to distinguish between the short-, mid- and long-term effects of a transition to a green economy on employment.

2.4

Qualitative employment effects of a green economy

The quantitative approaches presented for evaluating green jobs are complemented by the consideration of employment quality in a green economy. A distinction can be made here between two existing types of qualitative effects on employment. This concerns the change in employment profiles and the associated levels of skill or skill profiles (green skills). Here, qualitative changes in labour demand and the required skill acquisition measures in the context of a transition to a green economy are placed at the forefront. A second approach refers to the quality of the particular job. The main interest here lies in addressing the impact of a green economy on working conditions, particularly in emerging and developing countries (decent work).

2.4.1

Green economy and green skills

Assessing the employment potential of the transition to a green economy often involves making assumptions about flexible labour markets and the availability of skilled labour, which do not correspond to the reality of the labour supply. ILO and the European Centre for the Development of Vocational Training (CEDEFOP) assume that even today, the change to an environmentally-

friendly economy is slowed by a lack of skilled labour (ILO and CEDEFOP, 2011). The new requirements of workers in a green economy are driven by four mutually reinforcing factors: Environmental change, environmental policy, new green technologies and innovations, including changing cultural values, related lifestyles and consumer behaviour. In industrialised countries, this change is strongly promoted by technology and consumer demand. In developing countries, however, the future demand for green skills is dominated by adaptation to changing environmental conditions and the requirements of a stable energy supply (ILO and CEDEFOP, 2011, S. 162).

Accurately estimating the demand for particular green skills is difficult and depends on the development of certain technologies and industries, as well as establishing whether certain green jobs require new skills (World Bank, 2012, p. 98f., see Table 1). Studies that estimate current and future green jobs, based on sectoral developments and trends, act as important inputs, providing a better answer to these questions, among other things.

Some key requirements of the policy on education and training are already being drafted based on the available data. These include the promotion of mathematics, computer science, natural sciences and technology (so-called STEM subjects), an integrated view of environmental, industrial and vocational training as well as employment policies and greater coordination between the political actors, social partners and educational institutions (ILO and CEDEFOP, 2011, p. 163). It is also proposed to include a basic knowledge of

environmental issues in all vocational training curricula and, where appropriate, to supplement this with job-related knowledge (Mertineit, 2013, p. 85). In some developing countries with a large share of informal economy, these approaches should be accompanied by further capacity-building measures - e.g. through the promotion of entrepreneurial skills and by initiating social dialogue involving existing NGOs to implement formal or informal training offers (ILO and CEDEFOP, 2011, p. 167). Specific approaches and instruments for the promotion of green skills are discussed in Section 5.

2.4.2

Green jobs and decent work

The impact of a green economy and green jobs on the quality of employment is the subject of debate of a number of international organisations. The definition of employment quality and its corresponding operationalisation are linked with a number of methodical challenges which complicate its measurement (see Box 3). So far, there is no internationally recognised indicator or index. In the context of the international debate on green jobs, ILO and ITUC demand that environmental concerns are connected with traditional workers' rights in the definition of green jobs (UNEP et al., 2008, p. 39). It should be noted that some employment in environmental industries is carried out in poor working conditions. A narrow focus on environmental improvements can therefore be in conflict with the concept of sustainable development.

As such, it is demanded that green jobs also be decent jobs. The concept of decent work has been championed by the ILO since the late 1990s and is based on four pillars:

Table 1: Changes in skills and occupations for green jobs

Degree of skill change	Occupational change	Typical skills response	Examples
None	None or only quantitative	None or increased training in existing occupation	Bus driver in compressed natural gas (CNG) buses; national park ranger
Low	Changing established occupation	On-the-job learning or short training courses	Welder in wind turbine production; organic farmer
Medium	Changing or emerging occupation	Short courses or longer continuous training	Energy consultant in building; car mechanic for electric or CNG cars
High	New and emerging occupation	Initial training, university degree or longer continuous training	Solar energy technician; eco-designer; biofuels technician

Based on: ILO and CEDEFOP (2011, p. 96)

1. The promotion of employment and its establishment at the core of economic and social policy;
2. The extension of social security to all workers and their families;
3. The implementation of core labour standards and
4. Social dialogue.

The German development policy also supports its partner countries through a plan based on all four pillars that seeks to implement decent work in their policies and at multilateral level supports the ILO Decent Work Country Programmes (GIZ and BMZ 2010, S. 140). Only forms of employment that meet the criteria of decent work set out by the ILO are to be recognised as green jobs (UNEP et al., 2008). In addition, it should be noted that these requirements are applicable to both formal employment and to the central category of informal employment for developing countries. Figure 1 shows how concepts of decent work are connected with different sector-based understandings of green jobs – on the one hand, from an output perspective; 'employment in green industries' and on the other, from a process perspective; as jobs in all sectors that contribute to improving the environment by their function ('green

Box 3:

Measuring employment quality

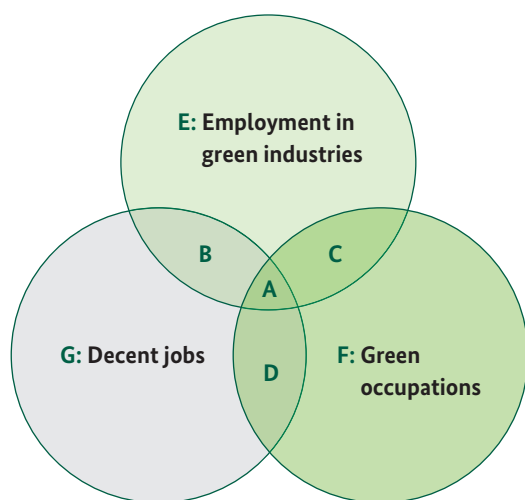
In a report on the measurement of employment quality carried out on behalf of the European Parliament, a distinction is made to this end between three general approaches (Munoz de Bustillo et al., 2009). The first approach is based on ascertaining the subjective satisfaction of employees and compares the quality of different working conditions on the basis of survey results. In the second approach, surveys are used to determine which aspects are considered by employees themselves as being important criteria for assessing the quality of employment. A third approach is based on dimensions of employment quality that have been defined in the context of various scientific disciplines. Emphasis is placed on very different aspects, depending on the scientific perspective (see Table 2). All three approaches have advantages and disadvantages. The fundamental problem remains that assessing qualitative employment aspects depends heavily on the sector, the cultural environment and other context-specific variables.

Table 2: Dimensions of job quality suggested by the different traditions of the social sciences

The orthodox approach: compensating differentials	The radical economic approach	Behavioural economic approaches	The traditional sociological approach: alienation and intrinsic quality of work	The institutional approach: segmentation and employment quality	Occupational medicine and health and safety literature: risks and impact of work on health	Work-life balance studies
Labour compensation: (1) Wages	Power relations: (2) Industrial democracy as a compensating power	(3) Participation	Objective strand: (4) Skills (5) Autonomy Subjective strand: (6) Powerlessness (7) Meaninglessness (8) Social isolation (9) Self-estrangement	(10) Contractual status and stability of employment (11) Opportunities for skills development and career progression	Conditions: (12) Physical risks (13) Psychosocial risks; Outcomes: (14) Perceived impact of work on health (15) Absenteeism	Working time: (16) Duration (17) Scheduling (18) Flexibility (19) Regularity (20) Clear boundaries Intensity: (21) Pace of work and workload (22) Stress and exhaustion

Source: Munoz de Bustillo et al. (2009, p. 13)

Figure 1:
The relationship between green jobs and decent jobs



Sources: ILO et al., 2012 and UNEP et al., 2008.

Green, but not decent Examples: ■ Electronics recycling without adequate occupational safety ■ Low-wage installers of solar panels ■ Exploited biofuels plantations days labourers	Green and decent Examples: ■ Unionized wind and solar power jobs ■ Green architects ■ Well-paid public transit employees
Neither green nor decent Examples: ■ Coal mining with adequate safety ■ Women workers in the cut flower industry in Africa and in Latin America ■ Hog slaughterhouse workers	Decent, but not green Examples: ■ Unionized car manufacturing workers ■ Chemical engineers ■ Airline pilots

Environment ↑

↓ Decent Work

occupations') (ILO, 2013c, S. 23). 'Green and decent jobs' are represented by subsets B, D and A in this approach.⁴ Other jobs are either environmentally-friendly activities or activities with good working conditions, but do not fulfil both requirements at the same time.⁵

Demonstrating the basic compatibility of an environmental outlook and maintaining social standards should mean mutual reinforcement of both concerns and an increased ability to come to an agreement. At the same time, the associated narrowing of the concept of green jobs means that the share of employment in green industries is no longer fully reflected. In related studies by UNEP and ILO, the integrated definition is used not exclusively, but in addition to another green job concept without social components. In this way, the employment potential of green economic sectors and their associated social challenges are presented.

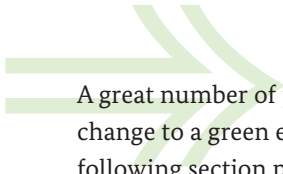
2.5 Conclusion

The difficulty in defining and apprehending green jobs lies in the challenge of making a clear distinction between environmental sectors and other sectors. Besides employment in environmental sectors, there are employees in other sectors which aim at improving environmental performance. Other challenges arise from the link with concepts to ensure or improve the quality of employment. In this area too, there is still no consensus on operational criteria and the corresponding indicators. In contrast to the sector-based concepts of environmental industries, national economic approaches seek to analyse net employment effects that are caused by environmental policy measures and a structural change to a green economy.

⁴ What's important here is the indication that the two subsets of green jobs, from an output and process perspective, cannot be simply added together, as there are overlaps between the two (ILO, 2012a, p. 21).

⁵ Particularly in developing countries, there can be a relatively large difference between the number of jobs in environmental industries and the jobs in this area that comply with the 'decent work' criteria. A study conducted by GHK on behalf of the ILO in Bangladesh estimates the former to be 3.5 million jobs, less than a quarter of which (800,000) can be classified as green and decent jobs (GHK, 2010, p. 2).

3 Economic and environmental policy instruments for structuring and managing the transition to a green economy



A great number of policies aiming to promote the change to a green economy have been discussed. The following section provides an overview of the central instruments in this context. It classifies them according to their respective function, with a view to promoting a green economy. For the most part, this concerns instruments that are used primarily in OECD countries. However, there are also examples of newer instruments, such as emissions trading systems and environmental taxes that are being used in emerging and developing countries.

In the discussion on political instruments and their effectiveness, it must be noted that for a green economy to be created, there is no one instrument capable of reliably inducing and designing the associated structural change. Instead, a policy mix is necessary (Blazejczak et al., 1999). Such an encompassing approach is needed to overcome various market failure mechanisms and to comply with the different innovation and development phases of a green economy. Coherence between individual policy fields and instruments must thereby be ensured. Otherwise it can lead to contradictory signals with respect to innovations and behavioural changes that would hinder the transition to a green economy.

3.1 Instruments for promoting a green economy

At the core of most strategic concepts for the promotion of a green economy, there are instruments aimed at internalising negative external environmental effects and giving the markets a suitable organisational framework. Above all, these are **market-based instruments**, which should correct the different forms of market failures that lead to misallocation. Market-based instruments are aimed at putting a price on emissions and the use of natural resources, or increasing

their price and therefore and thereby steering industry. Environmental economists are increasingly calling for such instruments, particularly to give incentive for continuous improvement. However, they are hard to enforce, as they meet with strong resistance from the sectors affected: While obligations and prohibitions are accepted when duly justified, and welcomed when in reference to planning security, it is argued that market-based instruments above all lead to higher costs, and their effects, if any, are difficult to measure. The use of market-based instruments is therefore often linked with compromise and leads only to a tendency control that is to be supplemented with more specific instruments (Jänicke, 2012).

A second group of policy instruments that is suited to such detailed control is designated here as a market-creating, environmental policy instrument. These include environmental standards for processes and products, and funding measures for environmentally-friendly technologies. The actual purpose of such instruments is to minimise emissions and risks, and thereby improve the quality of the environment whilst preventing damage. However, demand for environmentally friendly technologies is stimulated by such instruments. These are generally complemented by supply-side instruments, i.e. by measures to promote technology and investment as part of a comprehensive industrial and innovation policy.

A further aspect for the promotion of a green economy is a sustainable infrastructure policy. With the development of public infrastructure, decisions with long-term effects are made with important implications for the development of economic structures and their associated technologies. For example, the possibility of producing environmentally-friendly energy is largely dependent on the energy network infrastructure available. Lastly, an effective green economy policy requires a continuously changing instrument mix in order to adapt the policy to changing market and

technology developments. To this end, monitoring and evaluation mechanisms are important elements of green economy strategies.

The categorisation of environmental policy instruments proposed here distinguishes market-based instruments from market-creating instruments, which should promote the demand for environmental technologies. The distinction is not clear-cut and above all not solely based on the characteristics of the instruments. Market-based instruments, for example, emissions certificates or environmental taxes, create a demand for environmentally-friendly goods and also – at least, potentially – have a market-creating effect. The distinction refers instead to different operative requirements and motives linked with the instruments.

At their core, market-based policy instruments are aimed at setting up incentives for efficient handling of natural resources. Because environmental goods receive a price or the already existing prices or costs for their use are pre-set, costs can be reduced. Such efficiency potential can be opened up by existing technologies or incremental improvements. Since knowledge of such efficiency potentials is available decentrally from economic operators, market-based instruments appear best suited to translate environmental efficiency (achieving the most added value with minimal use of natural resources) into a logic of microeconomic cost-efficiency (lowest possible cost to achieve the most added value).

A distinction must be made here from approaches aimed at developing, pushing or expanding markets, that may meet the given requirements in a more resource-efficient manner than would be the case with conventional technologies. It is not a matter of merely saving costs while using fewer natural resources, but also of opening up markets for products and services that can replace the present technologies with high environmental impact. Such market-creating instruments can assess and stimulate demand, and even push through regulatory law and the promotion of the technology and service offers.

The summary table (Table 3, page 26) outlines the classification of these instruments, and provides an

initial approach to their possible aims and applications. The evaluation of the relevance in the particular field of application, just as the classification, is merely an example – the decisive factor is the concrete form.

3.2 Market-based instruments

Market-based environmental policy shall include taxes, charges and tradable rights or certificates. These instruments are aimed at internalising external production costs and consumption for environment and health domains, thereby giving the responsible party incentives for their prevention. Ideally, they can be distinguished from obligations and prohibitions that prescribe or forbid a particular behaviour. Such procedures and practices affect the prices of market-based instruments and assign a tax or charge that corresponds to the costs of harming the environment. In this way, negative external effects are internalised and environmental pollution is returned to an 'optimal' level (OECD, 2011a, S. 38).

The basic principles and advantages of market-based instruments for the promotion of a green economy are:

- The use of already scant resources and the release of emissions are made more expensive,
- Market players still have scope for decision-making in terms of how to reduce their use of resources or emissions,
- As part of this, knowledge, innovation and investment opportunities of the market players are used,
- Costs can be avoided by changing behaviours or making technical adjustments,
- Market-based instruments are dynamic and efficient, i.e. there is incentive for continuous improvements,
- The depth of intervention and the associated requirements for legitimacy is lesser than with obligations and prohibitions.

In the following section, the most important market-based instruments are presented as an example.

3.2.1

Tradable rights

Here an absolute upper limit for emissions is initially set, and emission rights within this framework are handed out among polluters. Companies who wish to exceed these emissions thus must acquire the rights to do so from other issuers. As result of this scheme, a prize for emission rights is found on the markets that in turn gives incentives for emission-reducing measures. Examples of tradable rights are:

- **Emissions certificates:** Emissions certificates are issued not only for CO₂ emissions but also those of other pollutants, e.g. for NO_x in the Netherlands and SO₂ in Slovakia and the USA. In the meantime, trading systems for CO₂ emission rights have also been introduced into several Chinese provinces. In addition, many projects in emerging and developing countries have benefitted from Clean Development Mechanism (CDM) and from trading the associated Certified Emissions Reduction (CER) certificates.
- **'Green' certificates:** In India, for example, there are tradable renewable energy certificates. Energy suppliers are obliged to generate a certain amount of their energy production from renewable energies. If

this is not reached, certificates must be acquired from other suppliers who can demonstrate a surplus.

- **'White' certificates:** Certificates for the consumption of energy through heating or household appliances are traded here. The manufacturers of these appliances can resell the certificates when they buy more efficient appliances.
- **Waste certificates:** In the United Kingdom, certificates for recycled packaging are issued that must be verified to be able to legally dispose of waste. In this way, the amount of waste deposited is limited.

For the system of tradable rights for emissions or the use of resources to work, it must to be determined how the rights will be created in the first place (e.g. quantitative limits through the State or through particular activities carried out by market players, such as the marketing or electricity from renewable energy), how these are issued (cost-free allocation or through auction) and what assessment basis is used for allocation (e.g. per capita, per added-value unit, market share, etc.). Other uses including land use: the application for limiting fertilisers and pesticides are also part of the public debate.

Table 3: Policy instruments for promoting a green economy and potential fields of application

	Prevention of emissions	Resource protection	Adaptation to environmental change	Industrial policy goals	Innovation promotion
<i>Market-based instruments</i>					
Tradable rights	+++	+		++	+
Environmental taxes	+++ ⁶	+++		++	++
Phase-out of subsidies	++	++		++	+
<i>Market-creating instruments (demand)</i>					
Direct promotion	+++				+++
Indirect promotion	+	+	+		+
Regulatory law	+++	++	++		+
Self-regulation	+	+	+	+	+
Payments for ecosystem services	+	+++	+	+	
Public procurement	+	+		++	+
Export promotion				+++	+
<i>Technology and investment promotion (Offers)</i>					
R&D funding				++	+++
Investment promotion			+	+++	+

Source: Own research. (+++) high relevance/ (++) medium relevance/ (+) low relevance.

⁶ Depending on how they are implemented, environmental taxes can address the issue of emissions or use of resources and achieve corresponding effects.

3.2.2

Environmental taxes, charges and deposit systems

Alongside the energy taxes, there are also further environmental taxes on air pollutants, pesticides and fertilisers, waste, water and construction materials. Extensive research has been carried out on the introduction and effectiveness of environmental taxes in OECD countries (Patuelli et al., 2005, p. 578ff.). Environmental taxes on a series of emissions and pollutants were also recently introduced in Vietnam and China (World Bank, 2011a). An overview of further cases of the use of environmental taxes in developing countries can be found in GIZ (2013). Higher emissions taxes on individual motorised traffic have been introduced, including at community level (e.g. London). Mandatory deposit systems that are used for packaging, cars or electrical⁷ appliances can also be arranged in this category.

3.2.3

Phase-out of environmentally-damaging subsidies

In many countries, including certain developing and emerging countries, the use of energy and natural resources is subsidised by aid and tax breaks.⁸ This not only benefits economic activities with high consumption of energy and resources, but also places sectors and companies that produce relatively environmentally-friendly goods at a disadvantage. Accordingly, almost all studies have called for the reduction of such subsidies as a component of the instrument mix (UNEP, 2011, p. 546ff.). Reducing these subsidies therefore not only eases the load on the national budget as a result, but also accelerates structural change benefitting environmentally-friendly products and means of production (Baer et al., 2011).

3.3

Market-creating environmental policy instruments

In addition to these market-based instruments, environmental measures can be used to create **markets** for environmentally-friendly products and **services** and thereby support market players in their search

and investment in the most efficient solutions. While market-based instruments encumber environmentally-intensive sectors and activities with negative environmental effects by means of the resources described, market-creating instruments, besides their main purpose of environmental protection, indirectly promote the demand for environmentally-friendly technologies (Baer and Jacob, 2013).

This should enable competition not only between providers of conventional and environmentally-friendly technologies, but also between different environmentally-friendly technologies themselves. Competition can be based on the best service and the lowest prices. A one-sided preference for a few providers must be avoided at all costs in order to develop markets that ensure effective competition between providers and their technologies. By supporting demand, learning effects and economies of scale can also be achieved and costs of environmentally technologies reduced.

A great number of instruments can be used to create markets.

3.3.1

Direct promotion of demand

Environmentally-friendly technologies are often linked with additional costs, especially when they are new on the market. To provide incentive for their purchase and use, there are many funding programmes to reduce costs. The following types can be distinguished:

- **Direct grants:** Here grants are paid directly to the buyers of environmentally-friendly products or services in order to create incentives for their purchase, e.g. grants for the purchase of electric cars in China or for the integration of particle filters in diesel cars in Germany.
- **Tax benefits:** Tax benefits can also create incentive for the purchase of environmentally-friendly products or services, e.g. tax discounts for low-emission cars in many countries.
- **Feed-in tariff:** This instrument has proven successful for introducing and developing renewable energies and has since spread to many developing countries. This involves paying a fixed rate tariff above the market price for the production of electricity from renewable energies that is fed into the existing

⁷ A deposit on electrical goods or cars should give incentives to bring these products back to the manufacturer to be recycled at their end-of-life.

⁸ The IEA database provides an overview of subsidies for fossil fuels: <http://www.iea.org/subsidy/index.html>

distribution grid. This model can be used where infrastructures are needed and are maintained by large market players but can also be used by comparatively environmentally-friendly providers. Feed-in tariffs assume regulation of the use of infrastructures.

■ **Tenders and competitive bidding procedures:**

To save costs, competitive bidding procedures are used in some emerging countries like China, India and Brazil to promote the development of renewable energies. As part of this, subsidies in the form of capital grants or feed-in tariffs are awarded to the project with the lowest subsidisation compared to the installed capacity or electricity fed into the grid.

The incentives for innovation and technology development are higher when competitive elements are included in the funding. Funding can depreciate and be limited in absolute value, thereby triggering a contest over resources (Greyhound Principle or other competitive mechanisms), and can be awarded according to the complementary private resources (for example auction of funds).

3.3.2

Indirect promotion of environmentally friendly technologies or economic sectors

The demand for environmentally-friendly technologies and services can be indirectly promoted through the provision of information and awareness measures. As such, the advantages of products and services are emphasised, information about these services is provided and expectations of market opportunities are coordinated. Examples are information campaigns, environmental labels and qualification measures. In developing countries, for example, certifications are used to promote a sustainable tourism business or sustainable agriculture. Access to international markets with corresponding certification also plays a partial role here. In addition, forecasts, scenario processes and sector and technology roadmaps can serve to guide and motivate manufacturers.

3.3.3

Regulation of demand

Demand for environmentally-friendly technologies can also be created or promoted through regulatory law, or obligations and prohibitions that regulate emissions or the use of resources. Search processes and investments, if any, are enforced. The subject of regulations is not only products or production processes, but also the relationship between market players.

The following starting points are conceivable:

- **Regulation of product characteristics or production processes:** This includes for example emissions norms, e.g. CO₂/km for cars or upper limits in the use of energy in the production process.
- **Regulation of product information:** An example of this is mandatory energy rating labels or standards for the labelling of organic products.
- **Regulation of product use:** This includes time and/or geographical limits on the use of products: for example cars in city centres (e.g. limiting car access in China) or bans on the use of pesticides in certain areas, which in turn create or support markets for organic farming (Bloomberg, 2013).
- **Obligations for the purchase of a product or service:** For example, insurance obligations covering liability for potential environmental damage (e.g. through contaminated sites, chemicals, products) lead to the development of new services that are subject to competition. In this case, insurance companies compete with one another to enable the regulated business or consumers to fulfil their insurance obligations.

A particular incentive comes from regulations where the standards are not specified but are dynamically adapted depending on the offer. The Japanese Top Runner Approach, whereby regulations of energy-consuming products from household appliances to cars are defined by the highest standard of energy efficiency offered on the market, is an example of this. There are also dynamic solutions in the EU's Eco-design Directive. But market-compliant design is important here too: Environmental policy standards must ensure that no monopoly exists, but rather that competition is still possible. Up to now, the innovation effects of environmental regulation have primarily played a role in OECD countries, whereas in developing and emerging countries, environmental

standards and the associated technologies used have been gradually aligned with the existing OECD standards.

3.3.4

Self-regulation of market players

Non-state actors such as environmental and business associations also develop norms and standards, especially in areas that escape national and supranational regulations and where there is no international agreement in effect. Here, decisions are made by market players in a decentralised manner.

These include:

- **Negotiated environmental policy aims:** e.g. voluntary commitments, covenants;
- **Environmental management systems:** e.g. ISO 14001; Eco-Management and Audit Scheme (EMAS);
- **Instruments to influence the value chain:** for example, codes of conduct in selected value chains (e.g. Common Code for the Coffee Community or Extractive Industries Transparency Initiative);
- **Data disclosure agreements:** e.g. emissions register.

The instruments vary in the concreteness of their objectives and subject area. However, they leave the addressees to attain the objectives. Instruments for self-regulation are only used if and when they promise an individual benefit (as well as monetary benefits). Such commitments are being increasingly elaborated in the context of so-called multi-stakeholder initiatives, to additionally legitimise or strengthen their content through collaborative efforts between companies and civil society. In many cases, a demand for sustainably produced products from developing countries has been generated through international action.

In some cases, hybrid **control forms** are proposed. These are complemented by self-regulation mechanisms around a regulatory core. Examples are the European chemicals regulation REACH and the biofuel sustainability regulation for biofuels imported into the EU (Hey et al., 2008). Data collection and disclosure mechanisms are motivated by the value chain through the basic principle of 'no data – no market'. Products for which no environmental information is available are denied admission to the particular market. In the USA, participation in voluntary programmes is

combined with the promise of facilitation of permits for installation and monitoring.

3.3.5

Payments for ecosystem services

In a growing number of countries, so-called payments for ecosystem services have been introduced. These are payments made to local companies or residents for the conservation of the local ecosystem and the resulting use and benefits (e.g. water conservation and clean air through protection of forest areas). The payments can come from the State or a company with an interest in conserving the ecosystem. This has resulted in a demand for environmentally friendly use of land and even restrictions on use. An example of this is Costa Rica, where since 1997, owners of the selected forest areas receive funding from a national fund sourced from revenue generated by a national fuel tax. Payments to European farmers in the context of the second pillar of the Common Agricultural Policy also constitute state contributions to conserving ecosystem services.

3.3.6

Public procurement

Environmentally-oriented public procurement can also be used to support the development of the market for environmentally-friendly goods. Economies of scale and learning effects are achieved, and the costs of environmentally-friendly technologies reduced through public demand. The practicability of technologies can also be demonstrated. The theme has also attracted a lot of attention as part of the promotion of environmentally-friendly innovations in Europe in recent years (Edler and Georghiou, 2007; Jacob et al., 2010). Approaches to green procurement have also been used in China.

3.3.7

Export promotion

A demand for environmentally-friendly products can be generated and supported not only nationally, but internationally. Additionally, all export promotion instruments can be used here, whether guarantees, trade agreements (especially the privileged status of environmentally-friendly products), market research or advice for exporters. However, the limits of international trade law are imposed on

these instruments. Furthermore, the spread of environmental policy instruments and standards constitutes support for the development of the demand for environmentally-friendly products and services. Bilateral cooperation and international processes are thus used (Jacob and Baer, 2014).

3.4 Technology and investment promotion measures in the context of an environmental industry policy

Complementary to the abovementioned demand-oriented market-creating instruments, the promotion of technology and investment also plays a role in the development of environmentally-friendly economic sectors. In OECD countries and a growing number of emerging countries, traditional instruments are used to promote research and development, as well as instruments for the development of regional innovation clusters.

In the context of developing countries, it is increasingly observed that the promotion of environmentally-friendly industries is more integrated into the overall promotion of the economy. For example, new industrial parks or export zones are being closely linked with a focus on developing environmental technology markets. The provision of investment and subsidies can be used for this purpose, as in the case of China. Complementary to this, trade policy instruments such as export subsidies or import restrictions are partially applied (AfDB et al., 2012). A further important approach is the promotion of green entrepreneurship in the context of private sector promotion. In the context of development cooperation, this is linked with and reinforced by the promotion of business models that simultaneously address the needs of poor populations or 'green and inclusive businesses'. Alongside the usual instruments used in private sector promotion, the promotion of partnership models and special financial mechanisms plays an important role in this context (Krämer and Herrndorf, 2012).

3.5 Sustainable infrastructure policy

Infrastructures are necessary to enable efficient division of work within a national economy. This includes technical infrastructures for the supply of energy and primary products, the disposal of waste and emissions, the exchange of information and the transport of goods to markets. In a broader sense, infrastructures could also refer to settlement structures which enable companies to be established, as well as educational institutions that are particularly important when it comes to professional qualifications in the context of a green economy.

In many cases, the provision of infrastructures is a public duty, because:

- the provision of public goods is frequently linked with this and network effects arise from this;
- this enables standards to be established (e.g. a particular track gauge or protocol for data transmission). Private sector players lack incentives for overall standardisation. For example, on a standardised rail network, competitors can, in principle, also offer their services – a private sector player would have the incentive to develop its own standards, for example with respect to the track gauge;
- Infrastructures can also lead to natural monopolies that limit competition.

Accordingly, infrastructure policy is initially focussed on its provision and maintenance, whether through construction activities or the establishment of basic conditions that create incentives for private investors. Furthermore, rules for the use of infrastructures are a key field of action.

In addition to these general reasons for public engagement in the provision and maintenance of infrastructures, their significance in enabling green technologies and economic activities is increasingly becoming the focus of attention. Infrastructures enable and promote certain technologies and the way they are used. For example, the current energy infrastructures in Western industrial countries are based on an electricity supply from centralised (fossil fuel or nuclear) power plants. However, production at decentralised power

plants on the basis of renewable energies in these infrastructures is relatively disadvantaged. Other examples are the housing development and transport infrastructures that benefit motorised transport but disadvantage environmentally-friendly local and long-distance transportation.

The construction of infrastructures gives rise to path dependencies or lock-in effects that reduce costs for established technologies on the one hand, but limit competition with new technologies on the other. By the same token, infrastructures also have enormous potential to accelerate structural change. For example, the development of smart grids, used to transport not only electricity, but also data, can reduce power peaks and facilitate the integration of renewable energies into the electricity grid (Baer and Jacob 2013, p. 262). The need to establish and expand infrastructures is emphasised in the UNEP Green Economy Report and the Inclusive Green Growth Report by the World Bank, which attribute a central role in particular to the public financing of infrastructure as a driver of environmental innovations (UNEP, 2011, p. 546ff; World Bank, 2012).

The fields of action and instruments of an infrastructure policy (see also Jacob et al., 2010) are:

- The planning, coordination and evaluation (particularly environmental impact assessments) of infrastructures;
- The direct provisioning of funds from the public budget for the financing and maintenance of infrastructures;
- The creation of incentives for private investors to invest or participate in the development of infrastructures, e.g. as part of public-private partnerships;
- The regulation of access to infrastructures in order to prevent natural monopolies whilst maintaining incentives for private investments.

As part of these tasks, the State can have a substantial influence on the design of the infrastructure. As such, aspects of technological bias and path dependencies in favour of established technologies and their respective environmental impact must be considered.

3.6 Monitoring and evaluation

The transition to a green economy requires the continuous evaluation and adaptation of developments. This includes the provision of appropriate basic knowledge and the institutional safeguarding of its use. Knowledge of undesirable developments and potential opportunities is key to the legitimacy of environmental and industrial policy intervention in economic processes. However, the provision of knowledge and data is not enough in itself. In addition to this, processes must be defined and institutions created to ensure that they are taken into account. Policy impact assessment, in particular, offers a framework to take environmental aspects into account in decision-making (Jacob et al., 2011; in the context of developing countries, particularly Ferretti et al., 2012).

Included in this set of tools are:

- **Environmental monitoring:** Ideally, this includes continual or recurrent collection of data on emissions, resources and environmental status. Particularly important here is data that also demonstrates the economic relevance of emissions and resource use, and that can be collected through statistical offices; for example, as part of environmental economic accounts.
- **Innovation monitoring:** This includes the collection and monitoring of innovation and market processes, ideally in combination with the collection of labour market effects of environmental technologies.
- **Environmental impact or sustainability assessments:** Through ex ante assessment of the environmental impact of policies, programmes, infrastructure and investment projects, undesired effects can be prevented and options compared with regard to reaching environmental or sustainability goals. The project and programme design can also be influenced by subsequent assessments or studied for further developments. The obligation to carry out such assessments can also be transferred to private collaborators.
- **Independent evaluation and assessment:** Basic knowledge and its consideration in decision-making processes can be further strengthened by appointing independent advisory bodies with members from scientific and civil society, who are given the mandate to assess and advise governmental policy.

3.7 Conclusion

To design a transition to a green economy, a policy mix is required that directs investment and innovation processes towards the development of resource-saving, low-emission production processes and products through conditions suited to the markets. Market-based instruments influence prices, while market-creating instruments influence the demand for these goods. The selective promotion of technologies and investments is aimed towards the offer, and infrastructures enable particular scale and network effects. Monitoring and evaluation enable continuous adaptation of the supporting instruments.

4

Employment effects of a green economy policy: concepts and action mechanisms

The effectiveness of a strategy for the transition to a green economy depends not only on the selected instruments described in the previous chapter, but essentially on the framework conditions and capacities in a particular country. The particular economic structure and its dependency on the use of energy and resources, prevailing energy prices and environmentally relevant subsidies, the political system and strength of players as well as the potential for innovation and availability of skilled labour are some of the key factors that can promote or hinder a transition to a green economy.

It is therefore not possible to assess the impact of individual policy instruments on employment without taking these diverse factors into account. In particular, country-specific preconditions and the use of complementary measures determine how individual instruments affect economic development and employment. As a consequence, the impact of individual instruments on employment cannot be expressed in words, per se, but rather is the result of market conditions, the availability of skilled labour, the work intensity of technological alternatives, etc. (World Bank, 2012, p. 96).⁹ Preconditions for assessing the impact on employment therefore include identifying the relevant factors of influence and analysing the action mechanisms expected in the particular context. Furthermore, other aspects such as the time horizon considered or the scope of the considered impact must also be taken into account.

The following section outlines the most important action mechanisms and causal links discussed within the context of a transition to a green economy regarding their associated effects on employment.

The concepts are based on theoretical and empirical works on environmental innovation and international competitiveness, the economic effects of environmental regulation and general principles of economic and employment policy.

4.1 Substitution effects, intensity of labour and labour productivity

In assessing the impact on employment of investments in environmentally-friendly technologies or infrastructure projects, the central issue is the number of jobs created compared to an alternative allocation of funding. The impact on employment therefore depends on which alternative investment opportunities are not realised and what type of substitution effects are assigned. Strand and Toman (2010) point out that the short-term effects of environmentally-friendly investment programmes on employment are lower than for alternative investments due to high capital intensity in some areas. For example, in the short-term, the construction of rail infrastructures has lower effects on employment than classic road construction. In the long-term, however, in addition to the positive environmental effects, gains in economic efficiency and the associated additional economic growth are likely.

In other areas, such as energy efficiency measures, Strand and Toman (2010) also see potential for short-term employment gains. It has also been pointed out many times in studies on renewable energies that the various technologies in the sector boast higher work intensity than the traditional energy economy. This applies in particular to the area of production and installation (Kammen et al., 2004). This statement implies that the development of renewable energies is linked with positive effects on employment. However, critics point out that higher intensity of labour, by the

⁹ The World Bank has to this end compiled a set of vivid examples that illustrate how the employment impact of individual policy instruments is dependent on specific contexts (World Bank, 2012, p. 97).

same token, means that these technologies have lower labour productivity. These are linked with economic efficiency losses that are expressed, for example, in the form of higher energy prices or an increase in the state subsidy rate (Bowen, 2012).

It is certainly to be expected that economic efficiency losses in developing and emerging countries carry less weight, since it is a matter of creating additional energy production and not primarily the substitution of fossil fuel sources (IRENA, 2011). Additionally, depending on the provision of resources and other conditions of the regional energy system, renewable energies can also generate savings compared to the construction of conventional power plants. This is often the case where no connection to the existing distribution network is yet available. Lastly, a distinction must be made between short and long-term effects. In the longer term, economic efficiency gains from the use of renewable energies would be expected, especially with rising prices of fossil fuels.

It should not least be taken into account that renewable energies are not only more labour-intensive, but are also more human-capital-intensive than conventional technologies. Higher-skilled workers, under otherwise similar conditions, improve labour productivity. When more or even better-skilled workers per unit of energy output are deployed, both effects offset labour productivity, making the net effect unclear at the outset.

4.2 Energy prices, economic growth and employment

Not only the development of renewable energies but also market-based control mechanisms such as CO₂ taxes, awarding emissions certificates and reducing subsidies can have an impact on energy prices. Therefore, the connection between energy prices and economic growth is one of the key mechanisms for assessing the impact of the transition to a green economy on employment. Oral et al. (2012) point out that studies on this topic are relatively rare. The main finding of the studies available is that the effects of energy or CO₂ taxes on employment are rather insignificant. In addition, they depend on how the income generated from energy or CO₂ taxes is used.

When they contribute to reducing non-wage labour costs or other taxes with a distorting effect, the possibility of a so-called double dividend is discussed (see Box 4). The same applies to the reduction of energy subsidies.

Box 4: Double dividend through environmental taxes?

The hypothesis of double dividend states that the introduction of environmental taxes or pollution taxes leads to an internalisation of negative external effects and can also lead to more employment (the so-called double dividend). This would apply on condition that the income collected from taxes or contributions is used to lower non-wage labour costs with the result that labour is relatively cheaper and capital relatively more expensive. Therefore, the environmental tax would not only be cost-neutral, but could also contribute to lessening the existing distortional burden on labour. This could additionally cause positive employment effects that would benefit workers with low incomes in particular (OECD, 2012, p. 92).

The empirical evidence on this topic comes from OECD countries, for the vast majority, and reveals in most cases a slightly positive picture in both the short and long term (e.g. Patuelli et al., 2005, p. 578–581). However, it can also be observed in individual cases that the positive employment effects have negative repercussions on the anticipated environmental goals. The anticipated environmental effects are not achieved in absolute terms through additional growth and employment. Lastly, it must be emphasised that labour markets in many developing countries are fundamentally different from the labour markets studied, as they have a surplus capacity of low-skilled labour, skilled workers are few and far between and new green jobs could have a slight crowding-out effect (World Bank, 2012, p. 95). This means that skilled labour could be deducted from other sectors that would, at least in the short term, result in higher growth and associated higher employment.

The economic effects of energy price increases have also been examined in the past in the context of exogenous price shocks, for example in the case of an increase in oil prices. One finding of these studies implies

that the intensity of effects on employment depends on the situation in the particular country. Oral et al. (2012) explain that these differences result from how adaptable or vulnerable different countries are to the negative effects of energy price increases. Vulnerability arises from the degree to which the country's economy depends on energy-intensive sectors. In countries where these sectors do not carry great weight, lower effects on employment are to be expected. Adaptability is defined by a series of social, economic and labour market policy factors. Countries with high labour market flexibility, an active employment policy, efficient security systems for the unemployed and high availability of training programmes are, according to this definition, better placed to turn new employment potential in energy-efficient sectors into jobs.

4.3 Labour market rigidities

The concept of adaptability outlined by Oral et al. (2012) is essentially an inversion of the concept of labour market rigidities. Many studies point out that adaptability processes as part of a transition to a green economy can be hindered or delayed by labour market rigidities. These include for example wage rigidities or transaction costs that can delay the adaptation processes through inter-sectoral shifts in labour demand (Bowen, 2012). These delays can be reduced by a flexible labour market, but cannot be eliminated completely. That means that in the context of economic adaptation processes, a certain proportion of temporary unemployment is unavoidable and brings with it associated negative effects on employment. However, in most quantitative studies on the impact of environmental investment or policy measures on employment, these labour market rigidities are not taken into account.

4.4 Environmental regulation, innovation and productivity

Another important question refers to the effects of environmental and climate policy on innovation and productivity. In the different reports published by international organisations such as UNEP, OECD and the World Bank, it is assumed that the development of

a green economy will be accompanied by far-reaching innovations and technological change. These innovation processes form the basis for the creation of future economic growth and employment.

The innovation effects of environmental regulation have been the subject of controversial debate in scientific literature for many years. Econometric studies on the effect of environmental regulation on innovation and productivity have shown widely varying results. A series of older studies have identified primarily negative effects on the productivity of the affected sectors, while in the more recent past, increases in productivity have also been noted (Ambec et al., 2013; Jaffe et al., 2004; Lanoie et al., 2008; Wagner, 2001). The conclusion drawn from these studies is therefore that the innovation effects of environmental regulation are neither conclusively positive or negative. They depend significantly on the form of policy instruments and their embedding in a series of other contextual factors. Above all, the affected industries must have the capacity available to develop and make use of the corresponding technical solutions. However, studies on the conditions for the success of environmental innovations show that these cannot be explained by a single policy instrument, but by a policy mix which, in addition to instruments, includes the configuration of actors and policy style (Jänicke and Lindemann, 2010; Jänicke, 2000).

4.5 Growth opportunities in new markets of the green economy

In addition, various authors have stated that the abovementioned econometric studies have a very limited scope. They only take into account innovation effects in the sectors directly affected by the particular environmental regulations. The emergence of new sectors and environmental technology fields such as renewable energies or the recycling economy are not taken into account (Quitzw, 2013). But these new growth markets and the associated export opportunities constitute an important potential for the creation of new jobs in a green economy. In their influential article on the relationship between environmental regulation and economic competitiveness, Porter and Van der Linde (1999) explain in their 'Porter hypothesis' that the early introduction of ambitious environmental

regulation can create what are known as first-mover advantages for the companies affected. Whether these advantages are turned into economic success depends on a series of additional factors of influence. Not only country-specific innovation potential and technical success, but also environmental and industrial policy strategies and parallel developments in other countries influence the long-term effects on employment of a corresponding environmental policy (Jänicke and Jacob, 2004; Quitzow, 2013).

Particularly in poorer developing countries, the potential of pioneer strategies to develop and market new environmental technologies is lower due to a lack of technological capacities. Alternatively, strategies for adapting to existing technologies and the targeted cost reduction are also conceivable (World Bank, 2012). Further potential emerges from growing demand in OECD countries for products that have been produced in compliance with specific environmental criteria. Here too, the early positioning of a country by building supply relationships can lead to competitive advantages. Tiwari et al. (2013) and Jänicke (2013) see a further opportunity for a leading role in frugal innovations,¹⁰ which are tailored to the framework conditions and purchasing power in emerging and developing countries. However, the environmental performance of these products is not necessarily prioritised, and rebound effects may occur.

4.6 Migration risk of polluting industries

The first-mover advantages of an ambitious environmental and climate policy are offset by the risk of polluting industries migrating to countries with less strict environmental regulations or the loss of savings compared to competitors. This is often referred to as 'pollution leakage' or 'carbon leakage' in this context. However, a series of studies show that this aspect has no substantial influence on company location decisions (World Bank, 2012, p. 32-34). On the other hand, progressive diffusion of climate and environmental measures can be observed (Jänicke and Jacob, 2004).

Nevertheless, it is conceivable that instruments in individual industries could be assigned more weight or a very high CO₂ tax in this respect. In this case, however, complementary trade and industrial measures are conceivable to counteract the negative economic effects. In other words, the strength of a leakage effect depends not only on the particular environmental regulation, but on a wider instrument mix. Furthermore, the size of the regulated market and other competitive position in the respective industry also plays a role (Fankhaeser et al., 2008).

4.7 Management of natural resources, ecosystem services and employment

Particularly in developing and emerging countries, a large proportion of employment depends directly on the use of natural resources (including agriculture and forestry). In this context, there is therefore a direct link between sustainable management of natural resources and the mid- to long-term security of this employment. The influence of measures for conserving natural resources on the local economy and employment depends on how they are concretely structured. For example, the payment of ecosystem services, on the one hand, can provide additional employment opportunities for the local population. On the other hand, corresponding programmes can also bring disadvantages for certain types of economic activity in the form of factors such as increasing land prices, difficult access to agricultural productive land, the freely available natural resources or the departure from labour-intensive agriculture (UNESCAP, 2009). In order to assess the net employment effects of corresponding programmes, it is also necessary to gather specific knowledge on impacts at a local level.

¹⁰ Frugal innovations are robust technologies that focus on the most important functions and therefore have cost benefits over technologies from Western industrial countries.

4.8 Conclusion

The debate surrounding the various action mechanisms explains that impact on employment largely depends on the design of particular policy instruments to promote a green economy, and how it is adapted to the national context. It should be emphasised that the instruments used in the framework of a green economy strategy promote competition between market players, and therefore should give incentives for innovations and cost reductions. In this way, the transition to a green economy can be reconciled with goals of economic development and the promotion of employment.

5

Employment promotion in the context of green economy strategies

The integrated approach to employment promotion of German development cooperation has three pillars:

- Creating jobs by promoting a competitive private sector;
- Ensuring employability through professional training and skills; and
- Improving coordination mechanisms on the labour market (GIZ and BMZ, 2010, p. 80).

The instruments presented in chapter 3 for the transition to a green economy are aimed at setting up new, green economic activities that promote innovative companies and the creation of jobs in these sectors. This constitutes the first pillar of the integrated approach to promoting employment in the context of a green economy.

In the following section, the role of the two remaining pillars in the integrated approach to promoting employment is discussed, and opportunities to secure employment as part of the structural change are examined in the context of green economy strategies. Employment and labour market policy measures play an important role in promoting the transition to a green economy for the following reasons:

- From a macroeconomic perspective, it is important for the transition to a green economy that labour can be employed in a flexible and efficient manner in a national economy to ensure optimal allocation of resources and a high level of employment.
- The transition to a green economy is linked with the growth of new, green economic sectors and the shrinking of old, environmentally-intensive economic sectors. To enable the transition to a green economy, a change in qualification requirements and demand for skilled labour must be accompanied by active training and qualification measures (ILO, 2011b).
- The potential phase-out of polluting economic sectors goes hand in hand with the loss of jobs, which leads to resistance among the affected

workers. Overcoming this structural change and the corresponding resistance in a socially acceptable way is another key task for labour market and social policy.

5.1 Measures to improve coordination mechanisms on the labour market

The change to a green economy is linked with a multitude of changes. Resources are used in new ways, new technologies come into being, and economic activities are shifted from old to new companies and sectors. The same goes for labour forces, who change activity or must switch to a new economic sector. The associated challenges for the labour market are not fundamentally new: It should be dynamic and inclusive (OECD, 2006). Traditional instruments for improving labour market information and the access to training programmes and jobs are therefore of the utmost importance for the transition to a green economy (GIZ and BMZ, 2010, p. 93). Traditional approaches to labour market policy are not elaborated on here. Instead, the specific challenges for labour market and employment policy in the context of a transformation to a green economy are discussed in the following sections.

5.2 Adapting technical and vocational education and training and skills

In the context of the integrated approach to employment promotion of the German development cooperation (DC), it is emphasised that the area of technical and vocational education and training (TVET) and skills concerns not just TVET in the strict sense. It also encompasses basic school education and approaches to life-long learning and continuous

professional development (GIZ and BMZ, 2010, p. 90). In the context of a green economy, this also involves the political management task of monitoring the skill requirements of growing green economic sectors and integrating this knowledge into demand-oriented education and further training programmes as well as courses of study (OECD, 2011b, p. 20). Since the required skills could often be met by professions that already exist, the improvement of existing professional skills is more important than developing new green professions. Specifying country-specific training requirements should thus be an important part of green economy strategies. The key significance of these aspects for promoting a structural change and maximising positive effects on employment is also underlined in a great number of contributions to the topic of green skills with a focus on OECD countries (see for example CEDEFOP and ILO, 2010; CEDEFOP, 2009; GHK, 2009; ILO and EU, 2011a, 2011b; ILO, 2009; Martinez-Fernandez et al., 2010).

5.3 Employment policy measures to facilitate the structural change

An important challenge for the implementation of green economy strategies is how to deal with shrinking sectors and the associated job losses. This certainly also concerns high-emission and resource companies and sectors, such as the energy sector and heavy industry in developing and emerging countries. In light of the associated social consequences and the resulting political resistance, labour market and employment measures play a key role. These include for example offers of mediation and further training for the affected workers. The organisation of public employment services can also substantially reduce the costs of job losses and finding new employment and thereby help to promote efficiency and fairness in the context of structural change (OECD, 2012, p. 81).

5.3.1

Income transfers and security systems for unemployed people

The linking of conditioned income-supporting measures for the poor with green economy goals, particularly in developing countries, can contribute to the promotion of a socially acceptable transition to a green economy. Examples from India, South Africa, Brazil and the Dominican Republic demonstrate how income transfers to poor populations are interlinked with their employment and the maintenance and improvement of the ecosystem and can simultaneously strengthen rural regions (ILO et al., 2012, p. xi). Equally, social security systems for the unemployed can promote structural change while changes on the labour market are socially cushioned (ILO, 2013a, p. 122). It must be emphasised here, however, that a considerable proportion of employment in developing countries takes place in the informal economy, and many countries, particularly in Africa, have no security systems for the unemployed (ILO, 2010, chapter 5).

5.3.2

Specific employment programmes for green jobs

In response to the global economic and financial crisis in 2008 in particular, counter-cyclical investment programmes introduced in many countries were linked with the goal of transformation to a green economy (the Green New Deal). This included, among others, the United States, China, South Korea and France (Barbier, 2009). In some cases, the investments made in this context promised huge job potential. An initial evaluation by the OECD warns against too much optimism that this can make a significant contribution to the long-term transformation to a green economy. It indicates above all, the necessity for such investments to be embedded in a comprehensive overall strategy, which at the same time could stand in a certain trade-off relationship with the requirements¹¹ of an effective job stimulus programme (OECD, 2012, p. 95). Thus, investments in eco-innovations in the context of stimulus programmes frequently have no positive effect on employment in the short term, since the labour forces with the necessary skills are often not unemployed.

¹¹ The following criteria were identified: timely – employment potential must be available relatively quickly; targeted – these available posts must be able to be filled by people currently unemployed; temporary – the fiscal incentives are scaled back when economic recovery begins (OECD, 2012, p. 95).

There is great employment potential in investment in infrastructure and the maintenance and protection of eco-systems.

5.4 Coordination between government, companies and civil society and coherence of green economy policies

In the context of a transformation to a green economy, a key challenge for employment policy measures lies in ensuring coordination with other environmental and economic policy measures so that enough labour forces have the right skills at the right time (OECD, 2012, p. 97). Coordinating government departments, social partners (trade unions and employers' organisations), companies and education and training institutions can prevent employment potential not being tapped because the corresponding skilled labour is not available (ILO and CEDEFOP, 2011, p. 30ff.).

In some OECD member states specific committees have been set up which draw up measures in the context of a green economy and coordinate between government and private stakeholders. For example, the Presidential Committee on Green Growth in South Korea brings together representatives from government and civil society (OECD, 2012, 97). In Australia, a debate on the implementation of green economy measures is taking place between governments at all levels within the Council of Australian Governments, which amongst other things, was involved in drawing up a green skills agreement (Council of Australian Governments, 2009). A further example of successful coordination of government and private players in the context of national green economy policy is Austria's Klima:aktiv programme. The education and further training of the labour force, which aligns universities, technical colleges, companies, chambers of commerce and other educational institutions, constitutes an important part of an overall strategy for the transformation to a green economy (OECD, 2012, p. 99). The German National

Platform for Electromobility has adopted a similar approach whereby the activities of a multitude of stakeholders from economic, scientific and political arenas are coordinated. As part of a working group on education and skills, specific recommendations for education and further training, courses of study and further training measures were drawn up to synchronise these with market development.

It is of key importance that policies for green economy strategies are coherent and contain a combination of social and employment policies, including the promotion of education and further training and an active labour market policy (ILO, 2013c, p. 86ff.). For the DC, this also means that sustainability strategies have much higher professional training requirements and that strategies for creating the necessary skills should be drawn up. Conferences with the relevant actors (state, professional training bodies, business organisations, trade unions) can help substantiate these requirements (Mertineit, 2013, p. 82f.).

5.5 Conclusion

As noted above, the promotion of employment fulfils an important role from both an economic and social policy perspective in the context of green economy strategies. For a start, an active labour market policy and the promotion of green skills are important to support and accompany the development of growing environmental industries. At the same time, labour market and social policy instruments are required in order to socially cushion job losses in shrinking sectors and thereby ensure the political legitimacy of green economy strategies. Lastly, a corresponding employment policy should be geared to dynamic developments in the context of the transition to a green economy. Achieving this requires the capacity to involve and coordinate players concerned from the private sector, civil society and scientific fields.

6

Concepts and methods for identifying and assessing employment effects

Following the discussion on the potential impact on employment of the transition to a green economy and the key policy instruments in this context, the following section examines the most important concepts and methodical approaches to identifying and assessing impact on employment (Section 6). The empirical results of the available studies are then presented (Section 7).

As shown in Section 2, a fundamental difference exists between sector-based analyses which determine the gross employment effect of expanding green economic sectors and activities, and macroeconomic studies on the net employment effects of green economy policies. The corresponding methodical procedures are presented briefly in the next section. However, as shown in the following section, in practice, these methods and analytical procedures are linked and combined with one another in different ways. There is thus a fluid crossover between the approaches outlined here. In most cases, there is no explicit dispute over the term 'green jobs'. If the concept is used, it is mostly used in a general way without an explicit definition of the methods used in this regard.

6.1 Gross employment effects

6.1.1 Direct, indirect and induced employment effects

When identifying and assessing gross employment effects, a distinction is made between direct, indirect and induced employment effects.¹² The respective reach of the aforementioned effects depends on how they are defined in the context of the particular studies. In many cases, direct employment effects refer exclusively to

effects that are brought about directly by the measure concerned, or in a selected economic sector. In terms of promoting the expansion of renewable energies, direct employment effects refer mostly to jobs that come into being in relation to production, installation and operation of systems for the production of renewable energies. Other jobs that generally arise in auxiliary industries that are not directly attributable to the renewable energy sector are not taken into account here (Breitschopf et al., 2011; Kammen et al., 2004).

These additional employment effects that occur in the upstream or downstream stages of the value chain are then referred to as indirect employment effects. For example, employment in the steel industry, which is brought about by newly-created demand in the wind power industry, could by this definition be referred to as an indirect employment effect. Other effects arising from other types of intermediate input from the corresponding auxiliary industry are added to this and recorded in the analysis as different cycles of demand. In the context of input-output models, this is also called a multiplier effect.¹³ The so-called first-round or initial effect in this process can, however, be counted towards direct employment effects. Indirect employment effects refer in this case only to the following rounds of the multiplier effect (Koschel, 2013). No matter what the exact distinction between direct and indirect employment effects, it concerns jobs that come about exclusively within the value chain of the economic sector in question. Whether the jobs that are brought about by these indirect employment effects are considered to be green jobs, depends on the definition used (ILO, 2012a, p. 28). Induced employment effects, on the other hand, refer to jobs that can additionally arise because workers that are employed in the relevant value

¹² Direct, indirect and induced employment effects generally refer exclusively to positive gross effects. In studies on net employment effects, however, it has been observed that where there are negative employment effects in sectors that report a drop in growth, a distinction can be made between direct, indirect and induced employment effects (Breitschopf et al., 2012).

¹³ Multiplier effects in the context of input-output models have similarities with the concept of macroeconomic multiplier effects in Keynesian economic theory, but are calculated in a different way, and unlike Keynesian multiplier effects, they do not take into account any changes in consumer behaviour that may arise as a result of a change in income.

chains or involved in an individual project spend part of their income on goods and services. The additional demand that arises in this way induces employment effects that go beyond the scope of the relevant value chain. As with indirect effects, this new demand sparks off a multiplier effect, which can contribute to the creation of other jobs in several rounds. Although gross employment effects of green economic activities are concerned here, the additional jobs brought about by these induced effects are not defined as green jobs by the ILO (ILO, 2012a, p. 28).

6.1.2

Employment factor approach

To calculate the direct employment effects of investment measures or the development of individual economic sectors, the so-called employment factor approach is used. This approach has been used in many studies on the direct employment effects of the expansion of renewable energies (Breitschopf et al., 2011). In these studies, the data for the expansion of renewable energies, given in megawatts (MW) or megawatt hours (MWh), is multiplied by the calculated averages of associated labour used. In studies on the employment effects of energy efficiency measures, average employment figures are often determined in relation to investment volumes (e.g. years of employment/million euros).

These estimates are referred to in the literature as employment factors (Breitschopf et al., 2011). In an ex-post analysis, this approach enables an estimate to be made of jobs created through a measure or the development of an economic sector. In ex-ante analyses, the expected direct employment effects of different proposals or different investment or expansion scenarios can be compared in this way. Similar approaches are occasionally used in studies for the analysis of direct employment effects along entire value chains (Breitschopf et al., 2011; IRENA, 2011). The direct employment effects that are determined at the upstream stages of the value chain can also be defined as indirect employment effects in relation to the end product.

A key aspect of this approach is the method that is used to determine the relevant employment factors. In the energy sector, these are determined using surveys and power plant models. Studies about emerging and developing countries, in particular, often draw on

existing calculations that have been carried out for other countries or regions. To adapt these to the local situation, differences in average labour productivity are partially taken into account. In practice, very high variation in the employment factors determined has led to the resilience of the results being questioned (Breitschopf et al., 2011).

Another important aspect in the use of employment factors is the unit of measurement in which the resulting economic performance is presented. In the energy sector, employment factors are widely expressed as the number of jobs per MW¹⁴ of installed capacity. However, it must be taken into account that activities relating to the production, installation and operation of power plants emerge over different time periods. Therefore, presenting the performance in person-years per MW is a more exact expression (Kammen et al., 2004). Presenting the performance in this way enables the direct employment effects of the expansion of renewable energies to be estimated. However, this is not suitable for calculating the net employment effects expected from changing the available energy mix. This is based on the fact that the amount of electricity per MW produced varies considerably from one technology to another. What is decisive, therefore, is not the installed capacity in MW, but the number of jobs in relation to the available energy (in MWh) (Kammen et al., 2004).

6.1.3

Input-output models and employment multipliers

To calculate indirect and induced employment effects, input-output tables are generally used. An input-output table records the macroeconomic structure of a country. It shows a country's different economic sectors and their interdependencies. So-called input-output coefficients record the goods and service flows in an economy that are generated by the input relationships between different sectors. In addition, they contain so-called employment multipliers, which show the average indirect and induced employment effects in different demand categories and sectors.

¹⁴ Elsewhere, particularly in the area of solar energy, the more precise term 'megawatt peak' is used. This demonstrates that the concept of installed capacity refers to a theoretically possible capacity that is to be expected under a set of standard conditions. The capacity produced, however, varies depending on the particular circumstances, for example weather conditions.

These multipliers vary due to different variables, such as the commodity structure of demand and the import quotas of different economic sectors.

Using input-output tables, it is possible to calculate direct, indirect and induced employment effects that are triggered by additional demand for goods and services (Breitschopf et al., 2011). When it comes to calculating the employment effects of environmentally-compatible economic sectors, standardised input-output tables have the serious disadvantage of not showing these sectors separately. A key task in the calculation of green jobs is therefore to define new sectors and the associated coefficients in the input-output tables used (Jarvis et al., 2011). A further disadvantage of input-output tables is that the established coefficients are given as static values. That means that important changes such as the further development of relevant technologies, price changes and suchlike cannot be taken into account in the context of ex-ante studies. Since the data stored in input-output tables is mostly a few years old, this also leads to inaccuracies in ex-post analyses. In developing countries, work with input-output tables is hampered by the fact that the high number of informal economic activities is only partially included in official statistics. Furthermore, input-output tables are available for some countries only, e.g. for 48 countries in OECD statistics (www.oecd.org/trade/input-outputtables.htm) or for 40 countries in the World Input-Output Database (www.wiod.org/).

6.2 Macroeconomic models for the calculation of net employment effects

To calculate the net employment effects of a measure or a defined scenario, macroeconomic models that can show processes of change in the economy are used in most cases. Distinctions can be made here between so-called econometric models, computable general equilibrium models (CGE), and system dynamics models. Each of these model types is based on a series of assumptions about action mechanisms and contexts within the economic system, which increase the complexity and economic requirements of their use compared to the approaches previously described. At the same time, it is harder for outsiders to comprehend the results and their associated assumptions.

CGE and econometric models supplement static input-output tables in that they show relationships within the economic system using behavioural equations. Unlike input-output tables, these models allow for the substitution of goods and model adaptations depending on different values, for example price relationships or restrictions on quantity. In a CGE model, equations based on the assumptions of neoclassical economic theory are traditionally used. However, CGE models are also increasingly developed on the basis of New Keynesian economic theory. In econometric models, parameters are statistically estimated and tested using linear equations that are extended by stochastic equation errors. In addition, econometric and theoretically derived equations can also be combined as hybrid models. In system dynamics models, the emphasis lies on modelling the system's own momentum. They involve so-called feedback loops that can strengthen or weaken initial effects with a certain time delay (see Table 4).

6.3 The methodical ILO guide for assessing green jobs in developing countries

A key approach to analysing the employment effects of a green economy is the calculation of the direct, indirect and induced employment effects of green economic sectors and the estimation of the number of green jobs (based on the sector-based definition of the concept). A joint report published by UNEP, ILO, IOE and ITUC provides an overview of available estimations in the areas of renewable energy, agriculture and industry as well as in the construction, transport and forestry sectors. The report explains that at the time of carrying out the study, only isolated estimates of the employment figures in green sectors in developing and emerging countries were available. In the years following this, the development and pilot testing of methods for the estimation of existing and future employment in green economic sectors in developing countries was an important part of the Green Jobs initiative jointly launched by ILO, UNEP, IOE and ITUC.

The ILO guide to 'Assessing Green Jobs Potentials in Developing Countries' (Jarvis et al., 2011) presents a stepwise approach to the quantitative calculation and qualitative assessment of green jobs in developing

countries, as well as the associated methods (see Figure 2 in the appendix). A significant challenge for the analysis is the creation of the necessary data basis for calculating the number of green jobs in the developing country context. Therefore, an inventory of the country's existing economic activities should firstly be conducted. Economic activities that are environment-related can then be identified within this. Although the report specifies potential indicators for limiting environment-related sectors, it should be noted that respective definitions should be determined on the basis of national circumstances. Criteria for environmentally compliant construction, for example, can vary considerably due to climate conditions or technical circumstances. A further challenge, of particular relevance to the developing country context, is the consideration of the informal labour market. The report presents a series of methods and approaches to include the informal economy in the calculation of direct and

indirect employment. Finally, the report contains tips and indicators for the assessment of jobs on the basis of decent job criteria in order to determine the number of green jobs in the context of the ILO and UNEP definition (see Section 2.4.2).

Estimates of the number of existing green jobs can be carried out on the basis of the sectors identified using this method. Ordinary methods for calculating employment effects are used here. To calculate indirect or induced effects using input-output tables, the sectors identified must be integrated in the tables and given their own coefficients. The report describes a series of approaches to making these changes to the input-output tables. Finally, the guide describes how, using the amended input-output tables, simple model calculations of hypothetical changes to the production structure (e.g. reducing energy demand by investing in energy efficiency technologies) can be carried out.

Table 4: Methodical approaches to calculating employment effects

	Employment factor approach	Input-output models	Macroeconomic models
Key features	• Approach to calculating direct employment effects of sectoral expansion scenarios • Determining employment factors is key here	• Tables that illustrate static links in an economic system • Can be used to statistically calculate direct, indirect and induced employment effects	• Illustrates processes of economic change from a macroeconomic perspective • Illustrates economic relationships through a system of behavioural equations • Mostly based on an input-output table or a social accounting matrix
Advantages	• Relatively easy to carry out • Does not require macroeconomic statistics • Easy to interpret	• Standardised tables that are drawn up according to international rules • Identifying direct, indirect and induced effects	• Dynamic and macroeconomic effects can be taken into account
Disadvantages	• Limited to direct effects • Huge variation in the employment factors determined	• Not available in individual developing countries • Informal economic activities not completely taken into account • Must be adapted to include green economic sectors • Does not take dynamic or macroeconomic effects into account	• Model structures and approaches used are difficult for outsiders to understand • Requires a high level of data and scientific knowledge • Assumes availability of an input-output table/social accounting matrix

Source: Own research.

6.4 Conclusion

As mentioned above, the methods presented provide 'ideal' descriptions which can, in practice, be combined and adapted in different ways. In all cases, the use of these methods and approaches in a developing country context is particularly challenging due to data availability. In employment factor approaches, reference values from OECD countries are often used that are adapted on the basis of assumptions to the country's average labour productivity. In input-output models, which simultaneously constitute the basis of many macroeconomic models, the challenge lies in forming an accurate representation of environmental technology sectors and informal employment in developing countries. The ILO guide (Jarvis et al., 2011) outlines a systematic approach to adapting input-output tables in this way.

7

Empirical results

7.1

Green jobs estimates:
Employment in green sectors

7.1.1

Empirical studies by the ILO

The ILO's methodical guide has been used by a series of developing countries in recent years. Its key methods and results are summarised in Table 5: ILO Green Jobs Studies. The most comprehensive works were carried out in Bangladesh (GHK, 2010). This entails a study that focuses on identifying and quantifying green jobs in the area of land and forest use and a study for calculating and estimating the general employment effects of environmentally-friendly economic activities. The UNEP/ILO definition of Green Jobs was used here in connection with the decent jobs concept. Contrasting with this narrow definition of the concept is the notion of environment-related employment, where no social aspects are taken into account. In addition, a distinction is made between core environment-related employment or the direct employment effects of environment-related economic activities, and the resulting indirect and induced employment effects.

Environment-related economic activities and the resulting direct employment effects (core environment-related employment) were identified and calculated on the basis of interviews with experts and qualitative company surveys. Input-output tables were adapted for the calculation of indirect employment effects of environment-related economic activities. For the qualitative assessment of green jobs, individual assessment criteria were determined and estimated for all environment-related economic activities due to data availability. For some sectors, the proportion of informal jobs was determined on the basis of a labour force survey. Lastly, using input-output tables, investment scenarios were carried out within individual sectors with a focus on environment-related and conventional economic activities.

Further studies were carried out in Mauritius (ILO, 2013b), Gaza (ILO, 2012b), Lebanon (ILO, 2011b) and China (Institute for Labor Studies, 2010). Here, no distinction is made between green jobs and environment-related employment. While the Mauritius study comprises a comprehensive assessment of green jobs in the economy as a whole, the other studies are limited to green jobs in selected sectors. The Gaza study is an explorative study on the potential for creating green jobs in the energy, water and construction sector without attempting to quantify the latter. Potential areas of employment and the associated job profiles are discussed. In the Lebanon study, finally, rough estimates of the green job potential in the areas of energy, agriculture, construction and waste disposal are presented on the basis of data already available. In the China study, the qualitative employment effects of developing the wind power industry are examined above all (see further details in Section 7.4.1).

7.1.2

Other studies on the employment potential
of green sectors

A similar overview study of the state of green jobs in China was published by the Worldwatch Institute (Pan et al., 2011) in 2011. This study also contains rough estimates of green jobs and green job potential in a series of sectors. It does not claim to be complete and does not make use of a uniform approach to limiting and calculating green jobs. The study contains estimates of employment in the areas of renewable energies, public transport, electric vehicles, forestry and tourism in forest areas. In South Africa, a research team formed by the Industrial Development Corporation (IDC), the Development Bank of Southern Africa (DBSA) and Trade & Industrial Policy Strategies (TIPS) used an employment-factor approach to determine potential direct employment effects in selected sectors of a future green economy (IDC et al., 2011). The short, mid and long-term employment potential of a total of 26

Table 5: ILO Green Jobs studies				
	Bangladesh (GHK, 2010)	Mauritius (ILO, 2013b)	Libanon (ILO, 2011b)	Gaza (ILO, 2012b)
Objective	- To calculate and qualitatively assess green jobs in the whole economy - Static comparison of investment scenarios	- Calculation of green jobs in the whole economy - Static comparison of investment scenarios	Initial assessment of the potential of green jobs	- Initial assessment of green jobs - Potential with focus on the construction sector
Approach	ILO guides	ILO guides with limitations on qualitative assessment	Exploratory	Exploratory
Results	7% of employment in green economic sectors 2% green jobs according to ILO - employment factor in sustainable agriculture and transport industry is lower than in the sectors in general	6.3% of employment in green economic sectors - employment factors are higher in green sectors	Additional jobs could be created through investment in the areas of photovoltaic and solar thermal energies, organic farming, energy-efficient construction and recycling; Net employment effects would be generally positive	- There is potential for a sustainable construction industry to improve material, energy and water efficiency. - State regulation must be expanded to cover this. - A sustainable construction industry could create new jobs by increasing local added value - Training programmes would be needed to fully exploit the employment potential.

Source: Own research based on Bangladesh (GHK, 2010), Mauritius (ILO, 2013b), Lebanon (ILO, 2011b) and Gaza (ILO, 2012b).

technology fields was determined on the basis of various expansion scenarios.

For each technology field, employment factors were determined using the available data. Due to incompleteness and potential trade-offs between sectors, it was decided to express the sectoral results as an aggregate value.

7.2 Employment effects of the expansion of renewable energies

The majority of existing studies on the calculation of green jobs in developing and OECD countries focus on the employment effects of expanding renewable energies. In most cases, it is a matter of assessing gross employment effects. Only some studies with an EU focus include assessments of net employment effects.

7.2.1

Gross employment effects

Studies on gross employment effects can ideally be divided into three categories. Here it is a matter of assessing:

- 1) the direct employment effects of the expansion scenarios of individual technologies/sectors (e.g. expansion of wind power) or projects (e.g. an individual hydropower station);
- 2) direct, indirect and induced employment effects of sectoral expansion scenarios or individual projects (e.g. an individual hydropower station);
- 3) direct employment effects of integrated expansion scenarios

1) Direct employment effects of expansion scenarios of individual technologies/sectors

Employment factor approaches, described in Section 6.1.2, are mostly used to calculate the direct employment effects of individual projects or sectors. This type of analysis can be used to assess, on the one hand, the estimated employment effects of the actual expansion of renewable energies, and, on the other, the direct employment potential of the previously defined expansion scenarios. A particularly elaborate ex-post analysis estimating the employment effects of various programmes for the promotion of energy efficiency and renewable energies was carried out in Tunisia (Lehr et al., 2012). Employment factors are partly created on the basis of company surveys. Table 6 provides an overview of the results where jobs can be distinguished on the basis of the level of the value chain. As the table shows, the majority of jobs arose in installation. In the context of local production of stations, the only other jobs created were in the area of energy management equipment and in a programme for the promotion of solar-thermal hot water systems.¹⁵ In the ex-ante assessment of employment potential, employment factors and the defined expansion

scenarios influence the results of the studies. In an analysis by Upadhyay and Pahuja (2010) on the employment potential in India's wind and solar power sector, it is assumed that all the necessary jobs will be created within the country. In other words, it starts from the premise that the Indian economy is self-sufficient. In other studies, the proportion of local value added is taken into account in the determination of employment factors. A study conducted on behalf of the Moroccan government, for example, differentiates between employment factors with or without trade measures for increasing local added value (Royaume du Maroc, 2011). In a study carried out on behalf of the World Bank (World Bank, 2011b) on the employment potential of the expansion of large-scale solar-thermal power plants in five north African countries, various regional expansion scenarios were linked to different domestic market shares and export scenarios. In addition, employment factors were calculated in a complex process on the basis of the expected value added for the country. Table 7 provides an overview of the methodical approaches and assumptions used in the aforementioned studies and shows some results of calculations by way of example.

Table 6: Results of the study 'Renewable energy and energy efficiency in Tunisia – employment, qualification and economic effects – number of jobs created in 2005 – 2010'

Profession → Programme ↓	Trials & tests	Engineering & development	Supply	Installation	Operation & maintenance	Support & management	'Total jobs 2005-2010'
Energy Efficiency	30	161	210	425	129		956
Energy audits and programme contracts	–	152	–	–	–		30
Energy efficiency in buildings	25	–	–	36	–		61
ESCO	–	9	–	–	–		9
Cogeneration	–	1	–	35	24		60
Diagnostics stations	–	–	–	4	105		109
Energy management equipment	5	–	210	350	–		565
Renewable Energy	15	10	374	1,159	14	–	1,572
PROSOL Residential	15	–	374	1,100	–		1,489
PROSOL Tertiary		4		19	4		27
PROSOL Elec	–	–	38		2		40
Rural electrification	–	–					
Wind power	–	6	–	2	8		16
Total EE & RE	45	172	584	1,584	143	–	2,528

Source: Lehr et al. (2011), S. 55.

¹⁵ This table refers to estimated permanent jobs.

2) Direct, indirect and induced employment effects for sectoral expansion scenarios

Input-output models and a combination of input-output models and an employment factor approach can be used to calculate direct, indirect and induced employment effects of individual projects or the development of individual sectors. Without the use

of the employment factor approach, employment effects are determined in several iterative steps using the input-output model and the employment coefficients contained therein. This is the case, for example, in a study on the employment effects of a hydropower station in India (Koschel, 2013). Due to the high level of aggregation in the input-output

Table 7: Ex-ante studies on assessing the employment potential of renewable energies

Title	Low Carbon Employment Potential in India	MENA Region Assessment of the Local Manufacturing Potential for Concentrated Solar Power Projects	Etude pour la spécification des besoins en compétences dans le secteur des énergies renouvelables
Authors	Upadhyay and Pahuja (2010)	World Bank (2011b)	Royaume de Maroc (2011)
Objective	Ex-ante assessment of the direct employment effects of the expansion of a wind and solar energy sector (photovoltaics only) in India for the years 2020, 2030 and 2050	Ex-ante assessment of the direct employment effects of the expansion of solar thermal power stations (concentrated solar power) in Egypt, Algeria, Jordan, Morocco and Tunisia	Ex-ante assessment of the direct employment effects of the expansion of solar thermal power stations, photovoltaic and wind plants, small-scale and micro-hydropower stations and investments in energy efficiency measures
Employment factors/ Assumptions	- Calculated on the basis of three different employment factors from existing studies - No international value chain	- Calculation of direct and indirect employment effects along the value chain - Taking local and international added value into account - Employment factors for the value chain and reference power station are adopted from the European context and multiplied by a factor 2 (assumption of lower labour productivity)	- Calculation of direct and indirect employment effects along the value chain - Taking local and international added value into account - Employment factors based on calculations for Europe, partially multiplied by a factor of 1.5 to 2
Scenarios	Three simple expansion scenarios (high, medium, low growth) with assumptions for the rate of expansion	Differentiated scenarios taking into account the development of the proportion of local value added and export potential depending on the growth of the regional market	Scenarios partially taking into account: - high and low proportions of local added value - different expansion levels
Results	Wind energy High growth: Additional jobs by: 2020: 11,929 - 243,225 2030: 9039 - 225,975 2050: 9039 - 225,975 Solar energy High growth: Additional jobs by: 2020: 13,085 - 234,350 2030: 427,400 - 4,214,000 2050: 665,000 - 2,150,000	Additional jobs by 2020: High growth: 180,000 Medium growth: 33,000 Low growth: < 1,000	Additional jobs by 2020: - Wind energy, high proportion of local added value: approx. 4,000 - Concentrated solar power, medium expansion level: 4,714 - Photovoltaic medium expansion level, high proportion of local added value: 7,160 - Small-scale hydropower station, medium expansion level: 79 - Investments in energy efficiency measures with over 8% annual savings: 27.906 person-years

Source: Own research based on Upadhyay and Pahuja (2010), World Bank (2011b), Royaume du Maroc (2011).

model, the results of the study constitute only a rough estimate of the direct, indirect and induced employment effects. Since the indirect and induced effects are expected to be higher than the direct effects, a higher degree of accuracy which could be obtained through the employment factor approach is deemed unnecessary.

A partial attempt is made to achieve a more accurate estimate of the direct employment effects by additionally using the employment factor approach in combination with an input-output model. In their study on the socio-economic effects of biofuels in Thailand, Silalertruksa et al. (2012) refer to this approach as a 'hybrid method'. As a first step in the study, employment effects along the value chains of selected biofuels (including the production of agricultural products) were calculated on the basis of employment factors. The effects identified were defined in the study as direct employment effects. Secondly, indirect effects for each step along the value chain were also determined using input-output tables. That means that not only final demand, but rather every single step in the value chain triggers a separate multiplier effect. In isolated cases, employment multipliers for calculating indirect employment effects have instead been integrated in the employment factor approach (Wei et al., 2010). Compared to input-output models, this has the disadvantage of being able to determine effects once only, and not in several rounds (see 6.1.3 on input-output models).

3) Direct employment effects of integrated expansion scenarios

The employment factor approach can also be used to compare the direct employment effects of integrated expansion scenarios. To this end, expansion scenarios with various proportions in energy technologies are firstly defined. In other words, several sectoral expansion scenarios are aggregated. Secondly, the expected direct employment effects are calculated for each development scenario. In order to do so, employment factors must be determined on the basis of comparable units for all energy technologies in question. In this way, the direct employment effects of individual technologies can be combined to form an aggregate effect. An often-cited international example of this approach is the Kammen et al. (2004) study on the employment effects of expansion scenarios with different proportions of fossil fuels and renewable

energies in the USA. The employment factors used in this study are based on the averages of existing studies. Future efficiency improvements and other technical improvements are not taken into account.

Similar studies have been carried out sporadically in developing and emerging countries as well as at a global level. A Greenpeace study compared the expected employment effects of a reference scenario on the basis of projections by the International Energy Agency (IEA) with an 'Energy revolution' scenario. In the revolution scenario, through the expansion of renewable energies and investments in energy efficiency measures, greenhouse gas emissions are expected to be reduced by 50% by 2050. The direct employment effects of the scenarios are determined for the years 2010, 2020 and 2030. To assess the global employment effects, regional employment factors were determined, taking into account local value chains. In addition, a decrease in employment factors was assumed due to efficiency gains over time. The principal result of the study is increasing growth of employment in the revolution scenario. By 2030, around 2.7 million more jobs than in the reference scenario should come into being (Rutovitz and Atherton, 2009). In a second study, Greenpeace compared three expansion scenarios in South Africa (Rutovitz, 2010). In addition to the reference scenario and revolution scenario, a third scenario was introduced without energy efficiency improvements or notable investments in renewable energies. The result shows the highest employment growth for the revolution scenario and the lowest growth for the scenario shaped by fossil fuel energy (see overview of results in Table 8).

7.2.2

Net employment effects

Calculations of the net employment effects of the expansion of renewable energies have been carried out for Europe and individual European countries using macroeconomic models. In these studies, the macroeconomic employment effects of sector-specific expansion scenarios were investigated. A particularly elaborate hybrid model was developed for EU countries in the EmployRES EU research project. In Germany, as part of studies carried out on behalf of BMU, the econometric model PANTA RHEI was used to determine the employment effects of the sector (for more details, see Box 5).

No comparable modelling approaches exist for emerging or developing countries. The results of the studies on the employment effects of different expansion scenarios can alternatively be presented as net employment effects. In this case, the net employment effects of an expansion scenario are calculated as the difference from the expected employment figures of a reference scenario (often referred to as a BAU scenario).

This is the case in two studies about China's energy sector. Cai et al. (2011) compare the employment effects of a reference scenario where the expected additional capacity exists in the form of coal-fired power plants with a scenario where renewable energies are developed instead. Like Silalertuska et al. (2012), they combine an employment factor approach with an input-output model in the analysis in order to take into account both direct and indirect effects. The net employment effects are defined as the difference between the two scenarios.

The same approach is used by Wang et al. (2013) to assess the employment effects of projects in the context of CDM in China's energy sector. As a reference scenario, however, they define the capacity expansion to the same extent in the unchanged energy mix. Both studies show positive net employment effects through the expansion of renewable energies (see Table 9).

7.3 Employment effects of environment and climate policy

7.3.1 Global models

Studies on the employment effects of environment and climate policy are usually carried out using economic models. Particularly elaborate modelling approaches have been developed by the OECD and UNEP. Both

Table 8: Greenpeace: Energy Sector Jobs to 2030 – Global studies and studies for South Africa

Objective	Comparison of employment effects of different energy expansion scenarios by 2030, taking energy efficiency measures into account		
Methodical approach	Calculating employment effects using technology-specific employment factors		
Employment factors/ Assumptions	Global study: • Employment factors on the basis of OECD values and regional adaptations on the basis of the estimated labour productivity; • Includes assumptions of increases in labour productivity; • Regional allocation of employment on the basis of estimated export and local proportions of added value South Africa: • Partially employment factors on the basis of local reference values, partially adaptation on the basis of OECD values; • Taking into account local proportions of added value and increases in labour productivity		
Scenarios	• IEA reference scenario: Development path on the basis of existing IEA projections • Revolution scenario: Development path to achieve a 50% reduction of greenhouse gases by 2050 Also in South Africa: • 'Growth without constraints (GWC)' scenario: Development path without climate protection measures and without limitations on fossil fuel reserves		
Results	2010	2020	2030
Global	200,000 additional jobs in the revolution scenario	2 million additional jobs in the revolution scenario	2.7 million additional jobs in the revolution scenario
South Africa	When compared to the IEA or GWC scenario, there are 0 and 8,000 additional jobs in the revolution scenario respectively	When compared to the IEA or GWC scenario, there are 28,400 and 32,900 additional jobs in the revolution scenario respectively	When compared to the IEA or GWC scenario, there are 31,900 and 6,700 additional jobs in the revolution scenario respectively

Source: Own research based on Rutovitz and Atherton (2009) and Rutovitz (2010).

Box 5:

Modelling the net employment effects of renewable energies in Europe and Germany

In the EmployRES project (Ragwitz et al., 2009) a series of economic models were used to determine both the direct and indirect gross employment effects of the expansion of renewable energies in the 27 EU member states (ex-post), as well as the net employment effects of different expansion and policy scenarios (ex-ante). Different model types were interlinked in a progressive analytical approach. To calculate the gross employment effects, data relating to the cost and production structures and the expansion of renewable energies in the member states was firstly entered into a static input-output model (MULTIREG). Secondly, using a partial equilibrium model (GREEN-X), consistent scenarios were designed for policy, expansion, production and export developments in the energy sector by 2030. A scenario without promotion of renewable energies was compared with two scenarios with constant promotion and two scenarios with increasing promotion. The scenarios with promotion were linked with moderate and optimistic export shares respectively. Here, so-called first-mover advantages and the associated export shares, among other things, were taken into account in higher expansion figures.

The results of these scenarios form the data basis for the subsequent modelling of net employment effects in two different macroeconomic models – an econometric model

(NEMESIS) and a system dynamics model (ASTRA). These models take into account both the relevant economic effects and inter-connections, for example price, substitution and budget effects. Both models result in increasingly positive employment effects in the increasing promotion of renewable energies. However, these positive effects are reduced over time in the system dynamics model, while in the econometric model, they further increase.

In the PANTA RHEI model that was used for economic modelling of the net employment effects of the expansion of renewable energies in Germany (Lehr et al., 2011), an econometric model is used with particular focus on the energy sector. It distinguishes between investment effect, operation effect, budget effect, dynamic effect and foreign trade effect. For the dynamic effect, for example changes in economic structure and productivity are integrated into the model using econometric estimates. Four expansion scenarios with two price change paths and four export development paths were linked with the scenarios. Positive net employment effects by 2030 were determined in all scenarios. In the lowest of the four export paths, partially negative employment effects were ascertained for the period 2010 to 2025.

have developed global models. The OECD-ENV-Linkages Model is a dynamic general equilibrium model that takes a disaggregated view of OECD countries (OECD, 2012). The UNEP Threshold 21 World Model is based on a system dynamics approach and therefore contains a variety of endogenous feedback loops (UNEP, 2011). Geographical units are not included in the UNEP model. A key difference between the models is the consideration of environmental change. In the UNEP model, economic development processes are shaped among other things by ecological conditions. In the OECD model, however, environmental change has no effect on economic processes. Finally, in the OECD model, comparisons are drawn between various policy scenarios, while the UNEP scenarios are compared with and without increased investment in an environmentally-compliant economy. Unlike the above-mentioned expansion scenarios for renewable energy technologies, these investment scenarios include not

only a wider range of environmental technology sectors, but also investment in the protection of natural resources. Table 10 provides an overview of the most important parts and assumptions of the two models.

The results of the modelling also differ in relation to predicted trends. The UNEP model results in a short-term decrease in growth and employment, but shows growth in the mid and long-term. The OECD model, on the other hand, also shows a slight decrease in economic growth in the mid and long-term and a decrease in labour demand compared to the reference scenario. However, it is pointed out that these negative effects could be offset by using income from emissions trading to lower income tax.

The OECD model also points out that no significant change is expected in economic structure in terms of the shares of individual sectors. The UNEP model also

Table 9: Studies on the net employment effects of the expansion of renewable energy in China

	Green economy and green jobs: myth or reality?	Employment impacts of CDM projects in China's power sector
Authors	Cai et al. (2011)	Wang et al. (2013)
Objective	Calculating the net employment effects of expanding renewable energies and replacing smaller, less efficient power plants with larger, more efficient plants over the period 2006 to 2010	Estimating the net employment effects of 1384 CDM projects registered by 2011 in China
Methodical approach	Combination of employment factor approaches (direct effects) and an enhanced input-output model to take different energy technologies into account	
Employment factors	Calculating employment factors on the basis of Chinese reference power stations and secondary literature about China	Calculating employment factors on the basis of CDM project reports and secondary literature
Scenarios	• Reference scenario: Expanding efficient coal-fired power plants without decommissioning inefficient power plants • Efficiency scenario: Expanding additional efficient power plants and simultaneously decommissioning inefficient power plants while maintaining the same output • Renewable energy scenario: Expanding efficient coal-fired power plants and renewable energies while maintaining the same output	• Reference scenarios: Expanding installed capacity while maintaining the existing energy mix • CDM scenario: Expanding installed capacity to the same extent in the form of the registered CDM projects
Results	• In the efficiency scenario, 559,000 fewer jobs were needed compared to the reference scenario • In the renewable energy scenario, 76,000 more jobs were needed compared to the reference scenario	• Direct employment effects compared to the reference scenario are negative regardless of the technology used for all CDM projects, and correspond to a loss of 99,000 jobs • Indirect employment effects are positive in all CDM projects with the exception of hydropower, and correspond to the creation of over 3 million jobs • When both direct and indirect employment effects are taken into account, the net employment effects are positive and correspond to the creation of just under 3 million jobs

Source: Own research based on Cai, Wang, Chen, Wang (2011) and Wang, Zhang, Cai, Xie (2013).

does not indicate considerable inter-sectoral shifts. Above all, the changes must be discussed accordingly within individual sectors (transport, agriculture, energy, etc.).

7.3.2

Studies in developing and emerging countries

Macroeconomic models are increasingly also being used to assess environment and climate policy in developing and emerging countries, particularly China. However, up to now, these studies have only taken into account employment effects in individual

cases. In addition, in these studies, a traditional neoclassical equilibrium model is used without significantly enhancements or supplements for better consideration of environmental aspects or structural change. Furthermore, in many cases, no time-defined scenarios are developed and compared, but rather, single adaptations are simulated. Exceptions are the aforementioned Threshold 21 model that can also be used for individual countries, and an equilibrium model developed by the World Bank called ENVISAGE. Both take into account climate change and other environmental aspects. However, these models have

not yet been used for the specific consideration of the employment effects of climate and environmental policy in individual countries.

Examples of the use of equilibrium models for determining employment effects are studies by Telli et al. (2008) on the effects of climate protection measures in Turkey; Willenbockel (2011) on the effects of environmental tax reform in Vietnam; and Lin and Jiang (2011) on the effects of phasing out energy subsidies in China (see overview in Table 11). Only Telli et al. (2008) include a time dimension in their scenarios. In the context of a macroeconomic model, they compare

five climate policy scenarios (respectively subdivided into further partial scenarios) with a reference scenario for the period 2006 - 2020. In so doing, they identify negative environmental effects, with one exception – the external funding of climate protection investments by international donors. The associated employment effects of individual scenarios are also quantified. The general assumption of full employment is replaced by a fixed income and the associated unemployment.

The study on environmental tax reform in Vietnam carried out by Willenbockel (2011) uses an equilibrium model with enhancements of the production function

Table 10: Global models for assessing the employment effects of environment and climate policy

	OECD ENV-linkages model (OECD, 2012)	Threshold 21 World model (UNEP, 2011)
Model type	CGE model	System dynamics model with econometric equations and technical learning curves
Key assumptions	• Difference between individual OECD countries and the rest of the world • Natural resources are not taken into account as a means of production • Greenhouse gas emissions are taken into account • Technological change is exogenic • Energy technologies are taken into account in detail • Adjustments primarily made via optimisation in response to price changes	• No difference made between geographical units • Natural resources are taken into account as a means of production • Endogenous feedback loops between environment and economy • Greenhouse gas emissions and their economic effects (exogenic) are taken into account • Technological change is exogenic • Adjustments made using different equations (econometric, neoclassical and other theoretical backgrounds)
Green economy concept	• Low-carbon economy • Greenhouse gas emissions reduced by 50% by 2050	• Green Economy • Continuous investment in environmental goods and green economic activities as a basis for economic development • Detailed description of green investment areas
Scenarios	Policy-based scenarios • No emissions trading • No country-specific emissions trading system, but a single emissions trading system for OECD countries • Worldwide emissions trading system	Investment scenarios • 1% of global GDP is invested in green sectors • 2% of global GDP is invested in green sectors • BAU 1: 1% additional investment divided amongst the available sectors • BAU 2: 2% additional investment divided amongst the available sectors
Calculating employment effects	• Employment level is exogenously defined (OECD estimates) • Employment effect is expressed through the changed wage level	• Employment is an endogenous part of the model • Employment effect is expressed through the number of jobs
Empirical results	• Negative short to long-term employment effects (drop in labour demand causes lower wage level)	• Negative short-term employment effects • Positive medium- to long-term employment effects

Source: Own research based on OECD (2012) and UNEP (2011).

for better consideration of the possibilities for the substitution of various energy technologies. It analyses the effects of high and low taxation of energy and resources by simultaneously reinvesting additional tax income. The results are neutral where macroeconomic growth is concerned. Positive and negative employment effects are indicated for individual sectors only. Lastly, Lin and Jiang (2011) compare three scenarios for reducing energy subsidies in China using a reference scenario. The modelling results show negative employment effects for a phase-out scenario when the money saved is not reinvested, and increasingly positive employment effects with increased reinvestment of money. However, CO₂ savings decrease at the same time. The exact assumptions in respect to employment are not indicated in the article. The expansion of renewable energies and the associated technical progress are also not taken into account in the model.

7.4

Calculating qualitative employment effects

An evaluation of the qualitative employment effects of the transition to a green economy is carried out only occasionally in studies. These include the ILO Green Jobs studies and the study on the employment potential of renewable energies in Morocco. While the studies in Bangladesh and China focus primarily on working conditions in green economic sectors, the studies in Gaza, Lebanon and Mauritius go into detail on the skill requirements in green growth sectors. The results of the individual studies are presented briefly in the following section.

7.4.1

Working conditions and green jobs

As part of the China study (Institute for Labor Studies, 2010) a comparison was drawn between working

Table 11: Studies on assessing the employment effects of environment and climate policy in developing countries

Title	Economics of environmental policy in Turkey	Estimates of energy subsidies in China and impact of energy subsidy reform	Environmental tax reform in Vietnam
Authors	Telli et al. (2008)	Lin and Jiang (2011)	Willenbockel (2011)
Objective	Simulation of economic effects of climate protection policy scenarios in Turkey	Simulation of economic effects of abolishing traditional energy subsidies	Simulation of economic effects of environmental tax reform in Vietnam
Model type	CGE model	CGE model taking the conventional energy economy in particular into account/ without taking renewable energies into account	CGE model with capital, labour, material and energy as production factors/ without taking renewable energies into account
Scenarios	Climate policy scenarios for 2005–2020: - Limiting the economy's CO₂ emissions - Energy tax in the area of production - Investments in CO₂ savings from various financial sources	Subsidy phase-out scenarios without a time dimension: - without reinvesting the money saved - A 35% reinvestment of the money saved - A 50% reinvestment of the money saved	Scenarios without a time dimension: - No environmental tax - Environmental tax with a high tax rate - Environmental tax with a low tax rate
Results	- Negative employment effects except through external financing (e.g. donors) - Lowest negative employment effects in the taxation of output	- Negative employment effects in the scenario without reinvestment - Positive employment effects in the scenario with reinvestment	- Macroeconomic results are employment-neutral - Positive employment effects in the textile sector - Negative employment effects in transport, fishing and the energy sector

Source: Own research based on Telli et al. (2008), Lin and Jiang (2011), Willenbockel (2011).

conditions in the wind power industry and the conventional energy sector. To this end, qualitative surveys and focus group discussions were carried out in eight companies. The important conclusions of the studies are that jobs in the wind power industry offer, on average, better working conditions than in the rest of the energy economy. In addition, in the conventional energy economy, a link was established between environmental measures and improved working conditions. In Bangladesh, an assessment of the quantity of jobs created in environment-related economic activities was carried out in addition to an assessment of their quality.

The following criteria were used to this end:

- Informal employment
- Child and youth labour
- Level of income
- Proportion of men and women employed
- Working hours
- Working conditions, including safety at the workplace, physical working conditions, health-related aspects and social services
- Representation in trade unions or other associations
- Poverty of workers

These criteria were used for the qualitative assessment of jobs in the areas identified. In addition, data from the national labour market survey, collected for the whole sector (e.g. agriculture) was consulted, and partially ascertained through qualitative interviews in individual partial sub-areas (e.g. organic farming). In addition to a qualitative examination of individual sector-specific aspects, the report also specifies, for four of the eight environment-related economic areas, the number of green jobs that comply with the ILO's decent work criteria. Here the proportion of informal employment is primarily taken into account. In the area of sustainable transport, renewable energies and sustainable manufacturing, all employment is formal, so all jobs meet these criteria. On the basis of a qualitative study, it is estimated that 30 to 45% of jobs in the construction sector comply with the decent work criteria.

7.4.2

Skill requirements of green growth sectors

The ILO studies about Lebanon (ILO, 2011b), Gaza (ILO, 2012b) and Mauritius (ILO, 2013b) contain explorative studies of the skill requirements in sectors that would

be particularly affected in the context of a transition to a green economy. In Mauritius, particularly with regard to the construction industry, concrete skill requirements for the development of sustainable organisation of the sector were identified as part of stakeholder surveys. The studies in Lebanon and Gaza contain initial estimations of new employment profiles that could arise in the green growth sectors identified. The study on the employment potential of renewable energies in Morocco contains the most systematic analysis of current and future employment profiles. In a company survey, existing employment profiles in the renewable energies sector in Morocco were identified and systematised. Typical skill requirements were described for the identified profiles respectively. Lastly, not only was the potential number of jobs calculated for the scenarios in individual sectors, employment profiles were also identified in the context of different steps along the value chain.

7.4.3

Modelling qualitative employment effects

Up to now, qualitative employment effects have only been modelled for the European context. This was done in a study on the employment effects of the EU's goals of reducing greenhouse gases and energy consumption and expanding renewable energies (Cambridge Econometrics et al., 2011). Firstly, the econometric model E3ME was used to determine the effects not only on the number of jobs, but also on the profile of these jobs. To enable this, the model contains data about the employment profiles within individual sectors (e.g. technical jobs, management, sales staff, etc.). An initial analysis was conducted of how the employment profiles could change as part of a transition to more environmentally-friendly economic structure. Secondly, data from the European labour force survey on the connection between employment profiles and various aspects of employment quality was then consulted. The main finding is that, on average, a higher level of skill and a higher level of employment quality are to be expected in a transition to a green economy. At the same time, however, a certain loss of high-grade jobs in the areas of administration and agriculture is expected.

7.5 Conclusion

As noted above, as yet there have been few empirical studies on the impact of a green economy on employment in developing and emerging countries. Like in OECD countries, the most sophisticated studies lie in the area of renewable energies and energy efficiency, with particular emphasis on the MENA region. The focus is on the assessment of direct employment effects. Some studies emphasise that the employment effects depend strongly on the development of local value chains. The employment potential determined varies considerably depending on the assumed use and expansion of local production capacities. Up to now, studies on net employment effects have been sporadic at best. The existing studies view as positive the employment effects of changing the energy supply into renewable energies and saving energy through energy efficiency measures. An exception is the study of the replacement of small, inefficient coal-fired power plants with larger, more efficient power plants in China. However, no macroeconomic effects, such as changes in energy prices, are taken into account in these studies. Modelling in Europe and Germany, however, also show positive employment effects, at least for the mid- to long-term, when these effects are taken into account.

Simple macroeconomic models on the employment effects of environmental policy measures do exist in developing and emerging countries. However, these studies do not form a uniform picture. Overall, however, the macroeconomic employment effects are estimated to be relatively small. Whether positive or negative effects predominate depends largely on supplementary measures, such as the reinvestment of money from environmental taxes or sector-specific measures to mitigate negative effects.

8

Conclusions and recommendations

The desk study comprises the results of the studies on the overall employment potential of a green economy policy. The majority of empirical studies tend to show positive employment effects of a green economy policy or note important potential in this context. This is particularly true from the long-term perspective. However, it must be emphasised that as yet, relatively few empirical evidence is available for developing countries. The question thus remains, whether positive examples from OECD countries can be transferred to developing and emerging countries. Nevertheless, some starting points and insight for the promotion of employment can be identified in the context of a transition to a green economy. In this final section, conclusions and recommendations for development cooperation are presented on this basis.

8.1 Measuring green jobs

As noted above, two significant concepts of a green economy can be distinguished from one another: On the one hand, there is a sector-based understanding, where a green economy refers to the proportion of economic activities and environmental technology sectors in a national economy, and on the other, there is a macroeconomic perspective, where the transition to a green economy is equated with the environmental balance of a national economy.

The measurement of green jobs in a green economy is carried out according to the sector-based understanding of the concept. This leads to limitation problems, particularly when it includes not only environmental technologies in the strict sense, like recycling or so-called 'end-of-pipe' technologies, but also environmentally-friendly technologies that fulfil other requirements than directly improving the state of the environment, but which use fewer resources or emissions than reference technologies. In the strict

sense, there are precise definitions of environmental technologies that also enable statistical demarcation. This is not the case for environmentally-friendly technologies. The demarcation is greatly dependent on the particular classification and varies according to the state of technology.

The precise measurement of employment in these sectors is further hindered by the fact that the value chain and employment are spread out over many different sectors. A statistical analysis of employment effects in the context of the sector-based understanding of a green economy therefore entails considerable methodical problems and significant effort. However, the reception of such studies shows that the green economy agenda can be taken forward and acceptance of more demanding environmental policies is being fostered. In addition, it enables the empirical assessment of growth and changes in environmental sectors. In the last decade, a series of studies was published and partially updated to this end, demonstrating the growth and employment potential of these technologies for individual industrial countries. The transfer of these approaches to developing and emerging countries should, in principle, be possible, with the precondition that the technologies and sectors to be investigated are demarcated and customised for the particular country. These studies could be used in particular for the assessment of sector-specific green economy policies.

These country-based approaches should be supplemented by internationally comparable classifications, such as those that exist for the OECD. Such classifications must necessarily reduce the area of environment-related economic activities to generally applicable categories and make them narrower than at national level. This means that individual technologies or activities are not taken into account. Nevertheless, uniform assessments have added value in that they enable international comparisons to be drawn between different countries or groups of countries. To this end,

the development of an internationally recognised classification (in addition to the OECD) and its gradual introduction in developing countries make sense.

A clear statistical definition of the term 'green jobs', as suggested by the ILO (ILO, 2012a), is not, however, recommended. Due to the broad use of the term in political contexts, consistent use on the basis of clearly defined criteria can hardly be expected. Therefore, the differing technical concepts – at national and international level – should have their own names. In empirical studies, the definition of the term 'green jobs' does not play an important role either, and is in most cases simply understood as a political concept. Despite the ILO's efforts, it is not expected that the concept will be given an internationally recognised definition in the future.

Regardless of the exact definition of the term 'green jobs', the ILO's methodical guide on assessing environment-related employment could serve as an important contribution to the international discussion on this topic. The systematic use of the methodical guide in more developing countries might create a data base to assess the employment potential of a green economy in developing countries, and thus create a better foundation for the development of country-specific green economy strategies. Secondly, the guide could be further developed on the basis of the experience gained.

In this context, the value of defining the 'green jobs' concept should be discussed in particular, taking into account the quality of work in the sense of the 'decent work' concept. Demonstrating the fundamental compatibility of an environmental orientation and adherence to social standards should mean mutual reinforcement and greater levels of acceptance of both matters. However, it is also made clear in the analysis of the literature that such a link can be problematic in the context of studies on employment in green sectors. This may lead to only a small proportion of environment-related economic activities being determined, particularly in developing countries with a high proportion of informal employment.

8.2

Measuring the employment effects of a green economy policy

Sector-based measurement approaches are to be distinguished from macroeconomic analyses. The latter considers measures for improving the environmental balance of a national economy, the structural change thereby initiated, and its net employment effects. The economic advantages and disadvantages expected in the long term from investments and other measures for the protection of the environment and resources can be shown on the basis of modelling results. In most cases, such studies show only marginal or long-term positive employment effects.

In this way, the transition to a green economy can also be given legitimacy by studies that adopt a macroeconomic perspective. At international level, the Stern report generated such an effect in the area of environmental protection by exposing the economic advantages of climate policy (Stern, 2007). However, it is important that the models or the developers of the models are accepted by decision makers. To increase the effects of such studies, it is necessary for dialogue to take place between scientific and political spheres and to ensure transparency of assumptions and action mechanisms. Due to their high level of aggregation, these studies however, may not always present the cause-effect relationships in as comprehensible a way as would be required for the development and structuring of concrete policies. To this end, narrowly defined impact assessments are required, whereby individual action mechanisms are addressed. In this context, issues surrounding data availability and its quality, particularly in developing and emerging countries, pose a challenge. However, desk studies combined with qualitative data collection can also bring considerably added value.

8.3

Evidence-based policies and the involvement of stakeholders

To increase the impact of studies on the measurement of green jobs or the employment effect of a green economy, exchanging with stakeholders is highly recommended. By conducting a transparent analysis of potential socio-economic and particularly budgetary and social consequences, acceptance of suggested

policies can be increased and partners can be found in the government and in society. Differentiated analysis of the expected sectoral employment effects plays a key role, particularly in the phase-out of environmentally-damaging industries, to cushion the social impact of the corresponding measures and thereby minimise resistance (see for example Dani et al., 2006). However, not just the results of the analysis, but also the whole analysis process thereby provide an important contribution to decision-making.

Assumptions made about causal chains or causalities, the calculation of employment factors, the development of future scenarios for modelling employment effects etc. do not just lead to new scientific findings, but rather, form the basis for ensuring the legitimacy of the analysis results. For example, calculating employment factors or the expected proportions of domestic added value can provide important insights for comparing or designing the structure of different promotion strategies. At the same time, these calculations must be transparent so that they are seen by decision-makers as a legitimate basis for decision-making.

When modelling the economic and social consequences of environmental policy, the selection of BAU scenarios is particularly crucial for the evaluation of the findings in the context of developing countries. When a traditional industrialisation path is assumed in the modelling, without taking into account the national economic costs of environmental pollution and use of resources, the overall result of the balance of a green economy scenario can be negative, where interventions in environmental policy lead to an increase in the price of natural resources. However, when the economic effects of a decrease in ecosystem services and shortage of resources in the baseline scenario are included, a corresponding policy can receive entirely positive feedback. Therefore, in the development of scenarios, there must be utmost transparency of the assumptions made. Stakeholders should be involved and their expectations should be taken into account, particularly in the development of BAU scenarios, to increase acceptance of such studies and, ultimately, their relevance in the political discourse of the country.

8.4

Necessity of substantiation and contextualisation

Policy instruments for the transition to a green economy cannot easily be transferred from one country to another, but must be adapted to the particular economic, institutional and social context. Furthermore, the employment effect depends not on the use of individual instruments, but on the interaction and coordination of a variety of different instruments and measures. Experience with instruments aimed at promoting markets for environmental technologies or a structural change towards environmentally-friendly technologies and sectors is available for the most part from industrial countries. To be transferred to the context of developing and emerging countries, the following aspects in particular must be taken into account:

- **Weak administrative capacities:** Weak administrative capacities often hinder implementation above all at local level, in particular when it comes to environmental standards.
- **Weak political representation of environmental interests at government level:** Environment ministries are comparatively weak at pursuing political debates compared to other ministries and sub-national units.
- **Unstable budgets:** Tight budget resources hinder the promotion of environmental innovations and also investments in environmental technologies.
- **Environmentally-damaging subsidies:** Despite the budgetary situation, environmentally-damaging subsidies are widespread, particularly in the energy sector.
- **Households with a low ability to pay:** The ability of most households to pay for environmentally-friendly goods is extremely limited.
- **Lower proportion of industry:** In many countries, the share of industrial production in the net product is low, whereas the primary sector (agriculture, mining) and the tertiary sector have high shares.

The above-mentioned aspects in particular must be taken into account in order to adapt environmental policy instruments from the OECD context to the conditions in developing and emerging countries. A country-specific portfolio can thus be derived in combination with the strengths and opportunities of

the particular country. On this basis, approaches can be identified that seem particularly appropriate in the context of development cooperation to reconcile a green economy policy with economic and employment policy objectives:

A potential double dividend

In the context of developing countries, where a high priority is placed on economic and social development, it is particularly difficult to justify environmental policy instruments that aim at generating industrial structural change and raise the cost of using natural resources.

In Western industrial countries, the argument of a double dividend is often cited: The burden on labour can be relieved by the increase in price of natural resources, e.g. the revenue from environmental taxes is used for social security, as is the case in Germany. This means that additional incentives are given for increased employment. This connection has also been empirically proven by now. In developing countries, there is often a lack of such starting points. Labour relations are often organised informally, taxes from employment income are collected only exceptionally and there is a lack of social security systems. In view of the above, environmental taxes and the phase-out of environmentally-damaging subsidies could therefore also make sense from a socio-economic perspective, because in the first place, they would generate revenue for the state budget and enable social security systems to be put in place. The tax revenue can also be used in the employment promotion programme, for example in the form of measures to promote the private sector or social cushioning of the structural change. Thus, environmental taxes have the fundamental potential to generate positive employment effects in developing countries too.

Considering the available economic structures, local resources and environmental challenges

The necessity to contextualise and adapt policy approaches plays an important role not only in the context of a green economy policy. Current debates on the promotion of growth and economic development reflect the belief that there are no generally applicable solutions or recipes for success for implementing a successful economic policy (Commission on Growth and Development, 2008). Instead, development strategies should be built on existing economic structures and further develop these (Rodrik, 2008). This is also true for

the promotion of employment in environmentally-friendly economic sectors. An important step in calculating different options for promoting labour demand in the context of a green economy strategy is therefore to analyse the corresponding value chains and the associated potential for setting up a domestic supply chain. Studies conducted on behalf of the World Bank and GIZ on the employment potential of renewable energies in the MENA region are good examples of the possibilities of such analyses (Lehr et al., 2012; World Bank, 2011b).

When introducing environmental taxes or other control instruments that have an impact on energy or resource prices, the existing economic structures should be taken into account. Impact on economic development and employment is highly dependent on the energy and resource intensity of the existing economic structure (Oral et al., 2012). To prevent negative consequences for the economy and employment, strategies should therefore be developed with integrated approaches for dealing with heavily impacted sectors. To this end, a tried-and-trusted approach is to carry out Poverty and Social Impact Analyses (PSIA) in the framework of policy development in cooperation with governments and affected stakeholders in partner countries (World Bank, 2003). In this way, potential social consequences and sector-specific employment effects can be recognised at an early stage and suitable accompanying measures developed.

In addition to economic structures, the available natural resources and environmental challenges should also be taken into account in developing a strategy. The availability of the necessary resources is a key factor for the economy and the employment effects of the particular technologies, especially in the area of renewable energies. Accordingly, the promotion of renewable energies should also take into account where the country offers comparative cost benefits for energy production. The same is true for the introduction of regulations to improve environmental quality. Due to tight state budgets and limited implementation capacities, regulations can only be introduced and tightened on a gradual basis. Against this background, particularly serious environmental problems should be dealt with as a priority. This not only helps to generally improve quality of life in the short term, but it also avoids significant economic costs in the medium-term.

Potential of an environmental innovation policy in developing countries

In addition, in such priority areas of environmental policy action, innovation potential can be opened up for the promotion of the economy and employment. As presented in the Porter hypothesis (see Section 4.5 on growth opportunities in new markets of a green economy), economic solutions to an environmental problem that also exists in other countries can potentially be translated into export success. However, this is only to be expected by focusing certain resources on areas of action of particular relevance in the domestic country. For example, a country that suffers from water shortages is particularly suited to developing innovative solutions for saving water. As such, particularly strict regulations could be an advantage in this area. In a different area of action, however, such as forestry or fishery policy, no potential impulses for innovation would be expected in the same country and it would therefore be recommended to learn from other frontrunner countries.

The question of how much potential can be generated by this type of environmental innovation policy for the promotion of the economy and employment in the developing country context still remains open. However, examples of so-called 'frugal innovations' (Radjou et al., 2012; Tiwari and Herstatt, 2012), originating increasingly in emerging or developing countries, have been used beyond the context of the home country in the meantime. These refer to technologies that have been adapted to consumers in developing and emerging countries in terms of their requirements and ability to pay. The concept of frugal innovations could become a model for environmental innovation policy in developing countries: robust technologies that focus on the most important functions and therefore have cost benefits over technologies from Western industrial countries. On this basis, export markets can also be opened up in other countries with a comparable level of development. To optimise such technologies in terms of their environmental impact, they must be embedded within a state environmental and innovation policy. A targeted economic and industrial policy for the promotion of frugal environmental innovations has, however, not yet existed in practice. In most countries, the focus is turned towards Western markets and technologies. Development cooperation could thus

make an important contribution to establishing examples of success by promoting corresponding niche markets.

8.5 The role of labour market and social policy instruments

As yet, there have been few experiences with labour market policy instruments in the development of markets for environmentally-friendly technologies or in the context of the structural change associated with the transition to a green economy. In principle, all instruments can be used for the environmental structural change, from skilled labour to the improvement of labour market services. What is particularly important here is the development of green skills that are experiencing heightened demand in the context of growing environmental industries or adapting existing skill profiles to the challenge of an environmentally-friendly economy.

As described in Section 5, labour market and social policy instruments also play an important role in the general promotion and social cushioning of the transition to a green economy. They enable the expansion of green economic sectors by preparing labour for an activity in these new sectors. At the same time, they create the basis for the necessary phase-out of 'brown' sectors by creating new employment perspectives or providing social security for temporary phases of unemployment. In this way they finally gain the necessary political legitimacy and reduce potential resistance to a structural change.

8.6 Developing capacities for employment policy in a green economy

When developing country-specific green economy strategies, governments must make decisions about what industries should be burdened by new environmental regulations or which sectors should be promoted in priority. This includes among other things assessing the potential of individual technology fields to promote the domestic economy and the associated employment effects. In many cases, however, the knowledge necessary for being able to make such

decisions is not available to the responsible authorities. In the past, it was often concluded that governments should therefore avoid making targeted interventions in economic processes. However, this possibility is not an option in the context of a green economy policy. The promotion of new environmentally-friendly technologies and the targeted burdening of existing dirty industries is a key lever for promoting a green economy, which requires corresponding State stipulations. The decision not to carry out any environmental policy interventions in individual areas involves drawing up a definition with impact on employment and the sectoral distribution of economic activities in the country.

Examples of successful economic catch-up processes have shown that active structuring of economic processes constitutes an important factor for the success of economic development. However, the success of state intervention depends on the institutional structures available (Rodrik, 2008). It should be noted in particular that state players require mechanisms to use knowledge from the private sector, civil society and scientific field in the context of policy development. In fact, only in this way can strategies be adapted to the existing potential and economic structures and be used for effective promotion of employment. Setting up institutions for collaboration (Porter et al., 2007) or public-private sector interfaces (OECD, 2005) with a focus on environment and resource-efficient economic sectors is an important basis for the successful promotion of a private sector in the context of a green economy policy. The Presidential Committee on Green Growth, established by the Korean government, is an example of one such institution.

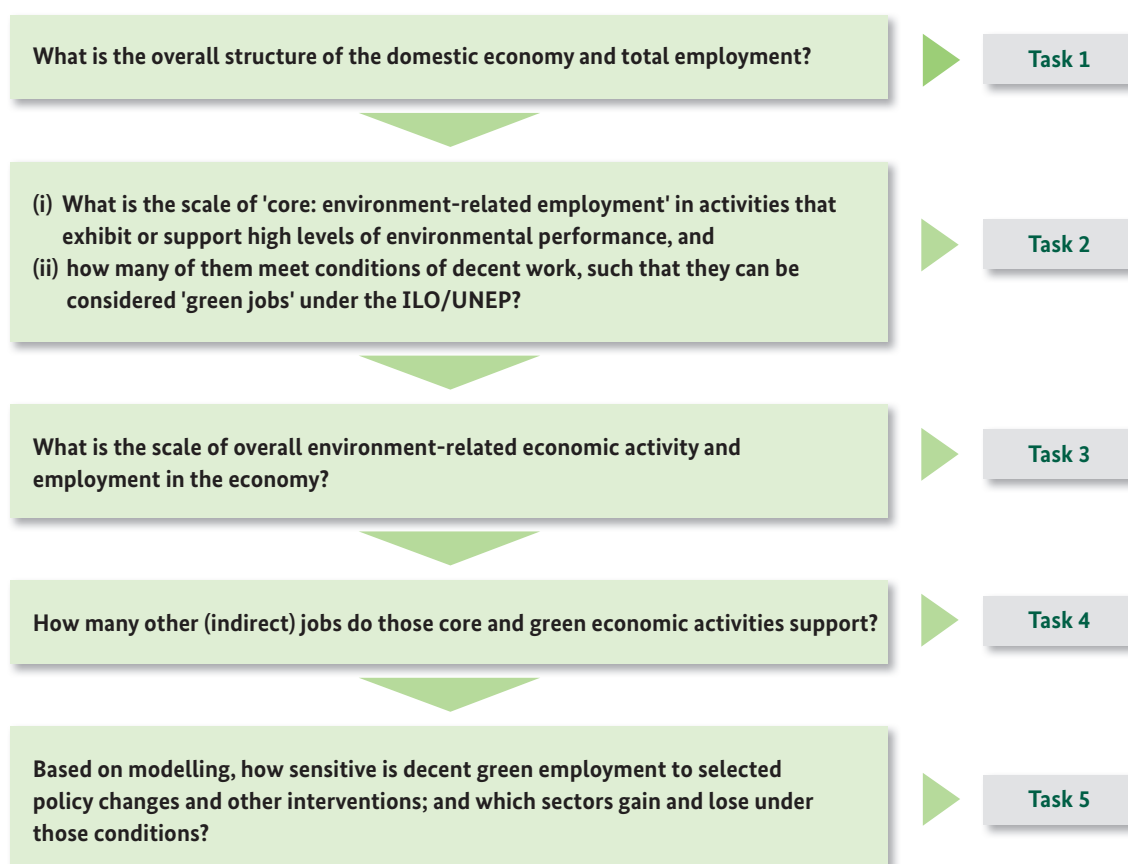
Appendix

Table 12: Overview of definitions of general and sectoral concepts

General concepts	
UNEP	'[Green Economy] results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities . In its simplest expression, a green economy is low carbon, resource efficient, and socially inclusive. [...] In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services.' (UNEP, 2011, p. 16)
OECD	'Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities.' (OECD, 2011a)
World Bank	'Green Growth – that is, growth that is efficient in its use of natural resources, clean in that it minimises pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters.' (World Bank, 2012, p. 30)
AASA	'>[...] to adjust the energy and economic structures , gradually transform the extensive economic growth model, establish a moderate consumption model and environment-friendly and equal trading pattern through technological change and innovation, so as to address sustainability issues in terms of resources, energy, environment and poverty reduction, to mitigate and adapt to climate change, and to ultimately achieve sustainable industrialization, urbanization and modernization in Asia.' (The Association of Academies of Sciences of Asia, 2011, S. xxii)
Sectoral concepts	
Eurostat & OECD	'The environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use.' (Eurostat and OECD, 1999, p. 9)
BMU	'To characterise and demarcate the sector, environmental technology and resource efficiency are defined here not in terms of products, but of lead markets. [...] Lead markets play a crucial role in satisfying basic human needs and in the conservation of the ecosystem.' (BMU, 2012, p. 25)
UK	'In the strictest sense it is not a "sector" but a flexible construct or "umbrella" term for capturing a range of activities spread across many existing sectors such as transport, construction, energy etc. but with a common purpose- to reduce environmental impact.' (Department for Business, Innovation and Skills, 2012, p. 7)

Source: Own research.

Figure 2:
ILO guide 'Approaching the five tasks'



Source: Jarvis et al., 2011, p. 37

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