BMZ Federal Ministry for Economic Cooperation and Development

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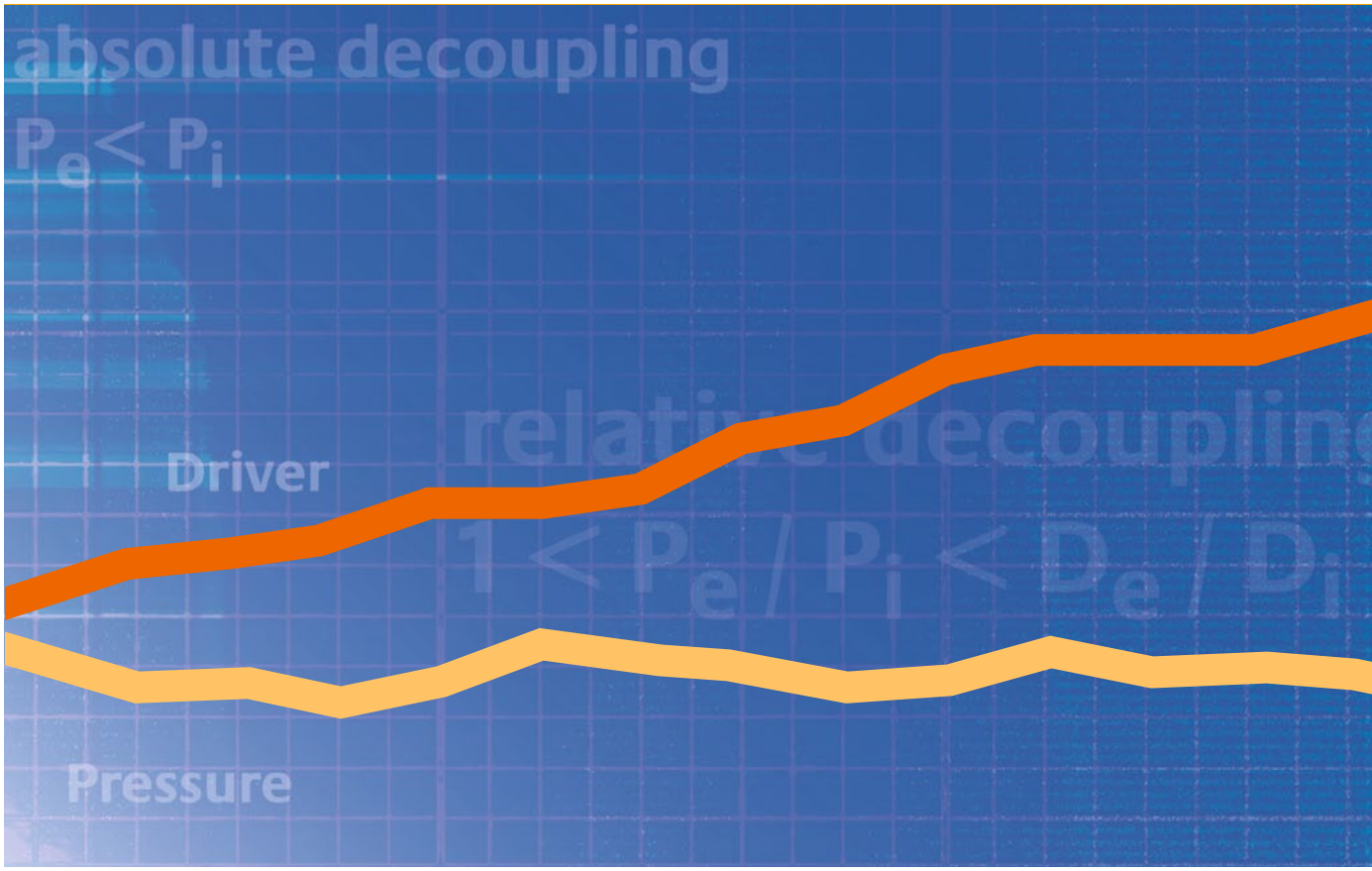
Resource Efficiency in Development Cooperation



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Preface

In the two decades since the Rio Conference in 1992, the world has experienced rapid economic growth, which has lifted a large proportion of the global population out of poverty. This is an impressive achievement. However, in ecological terms, it has been bought at a high price – greater environmental burdens and the growing exploitation of natural resources are widening the gap between sustainability and development. It is only rather recently that the urgent need to value ecosystem services (market and non-market elements) and to develop a greater understanding of natural accounting has been clearly recognized – also as the basis for a Green Economy and for transitioning to a global low carbon economy.

Increasing demand and competition for scarce resources is keeping raw material prices high. Some developing countries benefit from this trend, especially those with large deposits of mineral resources that can be used to supply manufacturing industries all over the world. However, other developing countries suffer because they are highly reliant on resource imports and have only limited capacity to keep pace with rising raw material prices. Under these circumstances, they must invest in resource efficiency in order to protect themselves against further price shocks and resource shortages.

However, resource efficiency is not only a response to economic challenges. Given the ever increasing quantities of raw materials and energy flowing through the global economy, decoupling economic growth from resource consumption is now an ecological imperative. Resource efficiency has therefore become a focus of both economic **and** environmental policies. The current global economic model and environmental governance systems are unlikely to reverse the current trends in the deterioration of the environment. The Rio+20 Conference will hopefully not only promote consensus and facilitate the mainstreaming of the environment into the economy but also more specifically clarify how more resource efficiency can be achieved in all countries.

According to a research study recently published by the McKinsey Global Institute, 'up to 3 billion more middle-class consumers will emerge over the next 20 years', nearly all of whom will live in today's developing and emerging economies. It will be ecologically and economically impossible to meet the demand of these additional consumers unless global resource productivity is raised at rates and to levels which represent a real 'resource revolution' (this is the title of the study).

The German Federal Ministry for Economic Cooperation and Development (BMZ) is aware of this challenge as well as the need for more international cooperation. This publication is part of BMZ's efforts to establish a long-term development cooperation strategy for promoting resource efficiency in our partner countries.

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Introduction

Resource efficiency has become a hot topic in recent years. Politicians and business executives use the term as freely as scientists and environmentalists do. However, it is not just a topic of discourse. On the contrary, it stands for a political and economic practice that has become more and more important, starting in rich industrial countries and spreading to the rest of the world. One does not have to be a prophet to predict that resource efficiency, along with climate protection and conservation of biodiversity, is going to develop into a mega issue in the decades to come. Therefore, it is high time that those involved in development policy should address this concept, asking what relevance it currently has for development cooperation and should have in future. This publication attempts to provide some answers to these questions.

The aim of this publication is to present an overview of current approaches and instruments to promote resource efficiency in the production sector (especially in manufacturing industries) and to demonstrate through examples how they can be put into practice. Further, it will provide suggestions as to how resource efficiency can be taken into account during the design and implementation of corresponding cooperation activities. Here the focus is primarily on practitioners (professionals and executives) both from development cooperation agencies and their partner organizations, especially in the area of environmental management and private sector development.

Our starting point is the thesis that resource efficiency is not only relevant for 'high-income countries', i.e. for those countries whose prosperity has been accompanied by a constant increase in the consumption of resources, and who are now faced with the challenge of limiting this consumption radically in order to function on a more sustainable basis. Rather it is a subject that equally concerns developing countries, especially emerging 'middle-income countries'. In fact, it concerns them even more, because if they wish to catch up with wealthier countries and lead their populations away from poverty, they will not be able to do so without considerably increasing their share of globally consumed resources. Unfortunately, the conditions for this have become worse. The competition for raw materials has increased, conflicts over resources are escalating, and the 'price' to be paid for overexploiting nature and its related environmental impacts is getting ever higher. The days of traditional development models, in which economic growth and resource consumption seemed indissolubly linked, are definitely numbered. For both ecological and economic reasons, resource efficiency is therefore a necessity that even developing countries must face.

"The consumption of resources has already stretched the environmental burden to its limits. It is imperative that we gain and use our resources in as sparing and environmentally friendly a way as possible, so that they will continue to be available for future generations. Resource efficiency is the key qualification for sustainable future societies."

Norbert Röttgen, German Environment Minister, 2010

"It is no exaggeration to say that the competitive firms and economies in the future will be the ones that make most efficient use of energy and resources themselves, and develop and export the technologies and techniques to enable others to do so."

Paul Ekins, Professor of Energy and Environment Policy, University College London, 2010

“We need to make every dollar and euro, every rupee and peso work harder and on multiple fronts – that will really accelerate the transition towards a Green Economy that is here to stay, through decoupling and resource efficiency, getting more with less.”

Achim Steiner, UNEP Executive Director, 2009

But what exactly does *resource efficiency* mean? What is new about this concept? What are its strengths and where are its limits? And if the assumption that it belongs on the political agenda of developing countries is correct, several questions are raised: What is the role of development cooperation in this context? What possibilities are there for supporting partner countries on the pathway to greater resource efficiency? These questions will be explored in the first chapter.

The second chapter contains a description of different approaches that are most appropriate for the promotion of resource efficiency in business and that can be used either in the context of environmental and economic policy advice, private sector development, promotion of small and medium-sized enterprises or environmental management programs. The main focus is on those experiences that have been gained using such approaches in German technical cooperation. The chapter will be closed with considerations on how the current standing of resource efficiency on the development cooperation agenda could be raised in future.

The third chapter deals with the subject of resource efficiency indicators and their relevance in development cooperation. It starts with an overview of different types of micro-indicators utilized for assessing the environmental performance of enterprises, including products. This is followed by a quick glance at decoupling and material flow indicators used for environmental accounting and resource policies at national (macro) level. A short discussion on the challenge of using indicators for setting concrete resource efficiency policy targets wraps up the subject.

Finally, building on the three previous chapters, a cross-sectoral training concept for senior officials, experts, and decision makers from partner organizations is introduced. The training was developed with the aim of preparing key persons from relevant sectors for the challenge of drafting the basic elements of a resource efficiency program using a typical ‘middle-income country’ as a study case. This is a further development of a test run that was conducted in the GIZ headquarters in 2010.

“The industrialization of the emerging countries can only be coped with by the ecosystem if we all work towards a different, more efficient path of development. Environmental protection is a future-oriented business and a first class driver of growth. Siemens is at the forefront of the green revolution.”

Peter Loescher, CEO Siemens, 2009

“Our sustainability project ‘Efficiency Plus’ shows that it is possible to reconcile economic success with the preservation of natural resources for future generations. By increasing energy and material efficiency as well as the use of renewable sources of energy, the project does great service to environmental protection, generates growth and secures jobs.”

Martin Viessmann, Proprietor of Viessmann Werke, 2009

1 The Concept of Resource Effiency and its Importance for Development Cooperation

At first sight, resource efficiency seems to be a self-explanatory term with no need of any further explanation. However, a survey conducted among professionals of different GIZ departments proved that such assumptions are an illusion. As it turned out, there was great variation in their understanding of what resource efficiency really means. And the reason for this lay, quite obviously, in the fact that there are widely different perceptions of the term *resources*. Thus it seems there is a real need for clarification. In the following section, we will first check what technical literature has to say about this subject.

Resource Efficiency, Natural Resources and Environment

What exactly is resource efficiency? We can simplify things for ourselves by using the generally accepted definition of efficiency as the relation between the result achieved and the means used and just replacing *means* with *resources*. That is what has been done in the *Resource Conservation Glossary* of the German Federal Environment Agency, where resource efficiency is defined as "the relation between a certain benefit or result and the resources used to achieve it".[1] Similarly, the Wuppertal Institute speaks of "the relation of a desired output of a process to the related resource requirement or input" (Wuppertal Institute/UBA 2008: 101 ▸).

While both definitions leave open what is meant by resources on the one hand and by *benefit, result* and *desired output* on the other hand, the EU commission is much more precise: "Resource efficiency or resource productivity can be defined as the efficiency with which we use **energy** and **materials** throughout the economy, i.e. the value added per unit of resource input" (EU-COM 2003: 9 ▸). According to this definition, the term *resource* includes energy and is not limited to raw materials, as the frequently-used expression 'resource and energy efficiency' suggests.

There is a direct connection between the input resources, *energy* and *material,* and natural resources (see Box 1). However, in order to actually become production inputs, natural resources have to first be turned into those. This generally involves various stages of treatment, transformation or processing – something that applies for renewable as well as for non-renewable resources. Strictly speaking, the above definition of resource efficiency does not refer to natural resources themselves, rather to the 'resources' produced and gained from them. Environmental economists make this difference clear by referring to natural resources as **stocks** and to the economically utilized resources as **flows** (see Figure 1).

This may also explain why in the case of resource efficiency only energy and materials are talked about,[2] and not resources in a broader sense. In a broader sense, natural resources are not just considered the **sources** for the manufacturing of products; rather they are equally seen as **sinks** for the absorption of emissions. In doing so, one refers to the ability

1 UBA: Resource Conservation Glossary (draft version May 2011, not yet published).
2 The term *material* is used here in a broad sense also including water.

of the environmental media – water, soil, air and living nature/biota – to absorb man-made emissions, degrade them and finally render them harmless. The reason why this ability can be defined as a natural resource is that, just like a raw material, it is finite in its availability and overexploitation can weaken or even destroy it.

What matters hence in using the term *natural resources* is not their form (material or energy, biotic or abiotic, renewable or non-renewable), rather the function that they fulfill for mankind.[3] Seen in this light, natural resources can be defined as components of nature that have a certain value for human beings, provide a benefit or perform a service. It is on this perception that most of the current definitions are based. A representative example of these is quoted below:

"Natural resources are all components of nature that provide a benefit for human beings, either directly through use or consumption or indirectly as inputs in the production of goods

Box 1: Definition of natural resources

... according to the EU Commission's Communication Towards a Thematic Strategy on the Sustainable Use of Natural Resources (EU-COM 2003: 8 ▸)

"Natural resources include:

(a) **Raw materials** such as minerals (including fossil energy carriers and metal ores) and biomass. Fossil energy carriers, metal ores and other minerals (e.g. gypsum, china clay) are non-renewable in the sense that they cannot be replenished within a human timeframe. Their stocks are finite and are diminishing because of the use by human activities. In contrast, biomass is in principle renewable within the human timeframe. It includes quickly renewable resources, for example agricultural crops and slowly renewable resources, such as timber. However, these biological resources used as raw materials can be exhausted if they are overexploited. This is an acute threat to certain commercially fished marine species, for example.

(b) **Environmental media** such as air, water and soil. These resources sustain life and produce biological resources. In contrast with raw materials it is their declining quality that causes concern. It is not a question of how much there is, but what state they are in. For example, the total quantities of air and water on earth do not change within human time scales, but because of pollution their quality is often poor. Moreover, the biological diversity of environmental resources is of vital importance.

(c) **Flow resources** such as wind, geothermal, tidal and solar energy. These resources cannot be depleted, but require other resources to exploit them. For example, energy, materials and space are needed to build wind turbines or solar cells.

(d) **Space**, as it is obvious that physical space is required to produce or sustain all the above-mentioned resources. Land-use for human settlements, infrastructure, industry, mineral extraction, agriculture and forestry are some examples."

3 „Natural Resources are those parts of nature that have an economic or cultural value to people." (GTZ 2004:8 ▸)

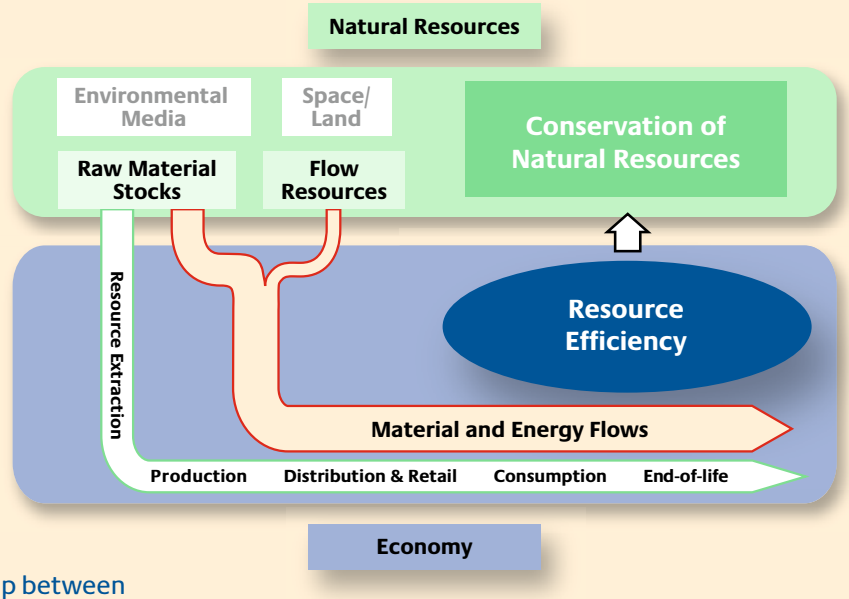


Figure 1: Relationship between resource efficiency and natural resource conservation

and services (non-renewable raw materials, fossil fuels, renewable raw materials, genetic resources, constantly flowing resources – solar energy, wind and water –, soil). In addition to these relatively easily definable elements, we need to include those services that nature indirectly provides in a much more comprehensive way: the uptake of emissions (sink function) and the maintenance of ecological-biogeochemical systems, biodiversity, global material cycles as well as the atmospheric radiation balance." (UBA 2002: 341)

Instead of *natural resources*, environmental economists often also speak of *environmental assets* by which they mean the same, namely "naturally occurring entities that provide environmental functions or services". According to the OECD "such environmental services comprise **resource services** (provision of natural resources such as timber, minerals, subsoil resources), **sink functions** (reception of wastes, reception of emissions to air, water and soils) and **other service functions** (flood prevention, scenery, landscape, etc." (OECD 2010: 9).

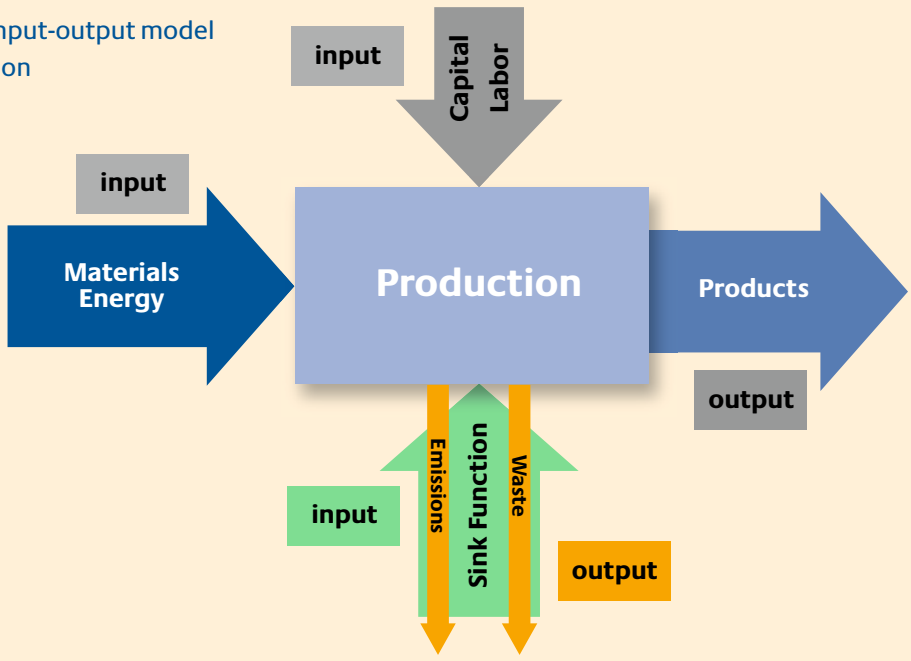
Based on this, the OECD introduces the term *environmental efficiency*. This is explained as follows: "Traditionally, the set of inputs comprises services from produced capital such as machinery and equipment, labor, and intermediate consumption (goods and services that are used up during the production process). Energy is a good example of an intermediate input. (...) To address environmental efficiency in production, this is insufficient and account must also be taken of the environmental services that nature provides. Resource services and sink services are particularly relevant from a production perspective. The flow of these services has to be added as an input into the production function, even if there is no or no meaningful market price for this input." (OECD 2010: 12)

According to this logic, resource efficiency refers only to the *intermediate goods,* material and energy, whereas the term environmental efficiency refers to *primary goods*, or in other words, the natural resources themselves. Although this differentiation seems illuminating at first glance, it nevertheless raises a couple of questions.

First: Can one really – as has happened here - assume that the terms *natural resources* and *environment* are equivalent? This is not something that everyone agrees on. Essential for the concept of *environment* is the idea that there are goods to be protected, and one of the most important protected goods is man himself or, to be more precise, his health. It is exactly this idea that is totally missing in the *resource* term. This means that while humans are made a part of the environment by using the concept of protected goods, they are put into a relationship of mere appropriation towards nature as soon as the environment is looked at as a natural resource. On the other hand, the term *resource* goes beyond *environment* in that it also includes such components of nature that are of value to man as sources of raw materials and energy, yet not as protected goods. Therefore, both terms have a blind spot and cannot be used interchangeably without a loss of meaning.

Secondly: From a production perspective, does it really make sense to treat environmental services as an input, even if there is no or no meaningful market price for this input? The strength of the input-oriented point of view lies without doubt in that every type of use of natural resources, including the sink function, is placed on the same level as the use of production factors such as capital, labor, etc.; this is contrary to the material-flow logic, according to which emissions and waste belong to outputs or better to the undesired part of outputs (see Figure 2). Admittedly, this logic is not of

Figure 2: Input-output model of production



practical relevance unless an enterprise incurs considerable costs through the utilization of these resources or environmental services. Companies will only be motivated to be more careful in their use of natural resources and to reduce the burden on the environment if they are forced to internalize the external effects of resource consumption as production cost.

On the other hand, the previously quoted, considerably narrower definitions of resource efficiency or resource productivity have the disadvantage that they do not take into account the impact that the utilization of resources has on the environment, or at least they do not mention them explicitly. We don't have to go so far as to declare the reduction of environmental impacts the actual target of *resource efficiency* [4], or as also happens, to simply assume that resource efficiency and environmental protection are basically two sides of the same coin. However, if the aim is to avoid conflicting goals (trade-offs) and, at the same time, treat *resources* as inputs and not as identical with natural resources, then it is advisable to make the mitigation of environmental impacts an additional condition. This is precisely what we have done when faced by the question of how to define resource efficiency in the context of development cooperation:

Resource efficiency comprises all kinds of activities which aim at improving the input-output-relation of material and energy consuming or transforming processes, while contributing to the mitigation of impacts on the environment caused by these processes.

This allows, for example, considering the return of waste into the economic cycle, (i.e. the substitution of primary raw materials with secondary raw materials) an effective way of increasing resource efficiency. A prerequisite, however, is - and this is what we mean by trade-offs - that the **environmental relief** achieved, on the one hand, through the multiple use of raw materials, is not counteracted or annulled on the other hand by an **environmental burden** caused by dirty recycling methods.

The statement that circular waste management helps to increase the resource efficiency of an economy is confirmed by the manner in which the raw material productivity indicator is defined by the statistical offices today. Here the secondary raw materials are not taken into account thus meaning that an increase in their share of total raw material consumption automatically leads to higher raw material productivity.

Resource Efficiency: A Political Response to Non-Sustainability

From around the turn of the 21st century, resource efficiency has started achieving ever greater political significance. It is primarily ecological reasons that account for this increasing importance. All experts agree on this, and hardly anyone active in politics, business or civil society organizations would dare to deny that the current level of worldwide resource consumption is unsustainable in the long term. This is so, firstly, because of the looming shortage of raw materials and the consequential supply bottlenecks and security risks and, secondly, because of the serious environmental pollution and damage that are connected with the extraction of raw materials and their use. Not least of

4 "Resource efficiency means reducing the environmental impact of the consumption and production of goods and services over their full life cycle." (UNEP 2009: 654 ▸)

these is climate change caused by greenhouse gas emissions.

It is no wonder, therefore, that resource efficiency occupies a key position in all development concepts that are supposed to lead mankind out of the dead end street of non-sustainability. This is regardless of the name they carry, whether *Sustainable Consumption* and *Production*, *Circular Economy*, *Low-Carbon Economy* or *Green Economy*. The same is true for the development strategies and programs that are based on these concepts (see Box 2).

In such statements, resource efficiency is always mentioned in the same breath as **decoupling**. This makes absolute sense as there is plenty of empirical evidence to support the claim that by increasing resource efficiency, it is possible to decouple economic growth from resource con-

Box 2: Resource Efficiency as a key element in international and national policies

One of the goals of the *10-year program* to boost sustainable consumption and production patterns to which the United Nations, as part of the Marrakesh Process, has made a commitment reads as follows: "Decouple economic growth from environmental degradation, e.g., increase resource and energy efficiency, change unsustainable consumption and production patterns, dematerialize, move to a low-carbon economy".

The UNEP, which along with UNDESA has taken overall control for the *Marrakesh Process*, formulates its goal similarly: "The overarching aim of UNEP's work on RE/SCP is to decouple economic growth from resource use and environmental degradation. Towards this end, UNEP focuses on enhancing resource efficiency, reducing the environmental impacts of producing, processing and using goods and services, while also meeting human needs and improving wellbeing."

Resource-efficient Europe is one of the seven flagship initiatives of the EU as part of its Europe 2020 Strategy: "This flagship initiative aims to create a framework for policies to support the shift towards a resource-efficient and low-carbon economy which will help us to: i) boost economic performance while reducing resource use; ii) identify and create new opportunities for economic growth and greater innovation and boost the EU's competitiveness; iii) ensure security of supply of essential resources; iv) fight against climate change and limit the environmental impacts of resource use."

Parallel to this, several European countries have started similar initiatives on the national level. Germany belongs to this group of pioneering countries: "The goal of the *German Resource Efficiency Program (ProgRess)* is to reduce the consumption of resources required for human needs and the related environmental impacts as much as possible, and thus ensure prosperity for the generations to come. The Federal Government of Germany strives towards a decoupling of resource consumption from economic growth and the absolute decrease of resource consumption and its related environmental burden. Our resource-efficiency policy is meant to contribute to the commitment of global responsibility for the ecological and social consequences of resource utilization in Germany, and to ensure the future and long-term competitiveness of the German economy."

sumption. On the other hand, statistics show that an increased rate of resource efficiency can rarely keep up with the growth of the economy. This leads to the consequence that resource consumption in absolute numbers continues to rise unabatedly in most countries and, therefore, worldwide as well. In general, what happens is that the decoupling is only relative and not absolute. This is where the dilemma is found: Whereas the production of goods and services as well as the individual products (e.g. means of transport) are becoming increasingly resource-efficient, through increased consumption, greater mobility, etc., there is a rebound effect that cancels out these gains in efficiency – at least in part.

However, if instead of material and energy consumption, we focus on the related environmental impacts, then the picture lightens a little bit. At least in some countries it is possible to see not just a relative, but even an absolute decoupling from economic growth for some pressure indicators – mainly in the areas of air and water quality (UBA et al. 2007 ▸). Germany belongs to the few countries where this is also valid for CO_2 emissions. Since 1990 these have decreased by about 20% with a matching GDP growth of approx. 20%. This development can be primarily attributed to the increased substitution of fossil fuels with renewable energies as well as the shutting down or relocation of energy-intensive industries (especially in the years after the reunification). Another effect which, however, is difficult to quantify resulted from the increased material efficiency of the economy. This is due to the fact that CO_2 emissions can be decreased not only through energy efficiency but also through material efficiency measures, i.e. by avoiding unnecessary material losses in the production, and either recycling raw materials with high energy content (*embedded energy*) or by replacing them with less energy-intensive materials.[5]

The assumption that resource efficiency alone will not be sufficient in the long run for making the breakthrough to an absolute reduction of resource consumption is expressed in the concept of **sustainable consumption and production** (SCP). In contrast to resource efficiency, this concept addresses the question of human needs and lifestyle. A frequently heard argument says that 'more with less' is not enough. Instead *efficiency* must be supplemented by *sufficiency*. So that this isn't interpreted as a call for sacrifice, the motto is converted into 'better with less'. Whether such an appeal is suitable for developing countries is, however, questionable. In any case, *sufficiency* is certainly not a subject of interest for the 'have-nots' of this world; it applies rather to the middle and upper classes, regardless of whether they live in developed of developing countries.

Despite this, the two concepts (SCP and resource efficiency) complement each other. Similar to SCP, *resource efficiency* can be applied to the whole value chain (or lifecycle) of goods and services. The fact that its application is often limited to the production sector does not necessarily mean that this is where the greatest efficiency potential is to be found. Rather, this has to do with the fact that resource-efficient production, because of rising raw material, energy and environmental costs, has become an issue of international competition for global market shares and investments. That is why politicians and businessmen traditionally place the most importance on this sector.

5 „Materials efficiency refers to the reduction of energy use by the appropriate choice of materials and recycling." (IPPC 2007: 459 ▸)

Another term quite frequently used in connection with resource efficiency is **circular economy**. This term was originally introduced in the context of waste management, but today it is increasingly used for all kinds of resources that can be fed back into the economic cycle such as raw materials, water and land/space. Strictly speaking, these resources are not consumed; rather they are merely used, processed or refined. Reusing or recycling them, therefore, goes hand in hand with an increase of overall resource efficiency.

Circular economy, however, means more than just feeding back into the cycle. It is based on the 3R principle (reduce, reuse, recycle), according to which reduction has priority over reuse, and reuse in turn has priority over recycling. Furthermore, especially in the case of material cycles, two problems can occur. First, there is the problem of *dissipation*, i.e. after a certain point, the recovery of materials reaches limits which can only be overcome, if at all, at high costs and by a disproportionate input of energy. Second, there is the issue of *down-cycling*. This means that in some cases (e.g. plastics and paper), the recycling process can lead to a loss of quality in the products gained from secondary materials.

Down-cycling also determines the use of energy sources, although with the difference that these are actually consumed in the true sense of the word. Thus, there are physical limits to the increase of energy efficiency. This is of particular importance in the case of fossil energy carriers. Their excessive consumption and future depletion can only be avoided by replacing them with renewable sources of energy. For that reason alone *circular economy* cannot be a real alternative to concepts such as **low-carbon economy** or **green economy**, which express the necessity – and the possibility – of a fundamental economic and technological transformation that respects ecological limits in a more direct and comprehensive way.

The urgent need for action, to which all aforementioned concepts attempt to provide a response, has expanded or even shifted the traditional focus of environmental policy. Whereas in the past, the focus was on the side effects of resource consumption, today environmental policy has ultimately started taking a much closer look at itself. And while in the beginning it was almost exclusively concerned with the improvement of environmental quality, today the focus has been broadened to conservation of resources, especially those that are finite and in danger of running out. This is done by increasing efforts in promoting material and energy efficiency, in addition to substituting non-renewable resources with renewable ones.

Thus, environmental policy is increasingly taking on the characteristics of **resource policy**. Basically, this follows an economic trend that environmental policy itself initiated, namely, that of making environmental protection an integral part of production. In this way, it is possible not only to save on clean-up and energy costs at the *end of the pipe*, but simultaneously tap the potential for higher productivity. The concept of resource efficiency picks up on this trend and tries to give it a new impetus by appealing more to the economic rationality of business leaders than to their ecological responsibility. The message is that "resource efficiency pays", and that is not only true for individual companies, but for entire industries and, ultimately, for the whole economy.

“ Forcing oneself to be thriftier in the use of materials is a type of constraint that releases creativity. ”

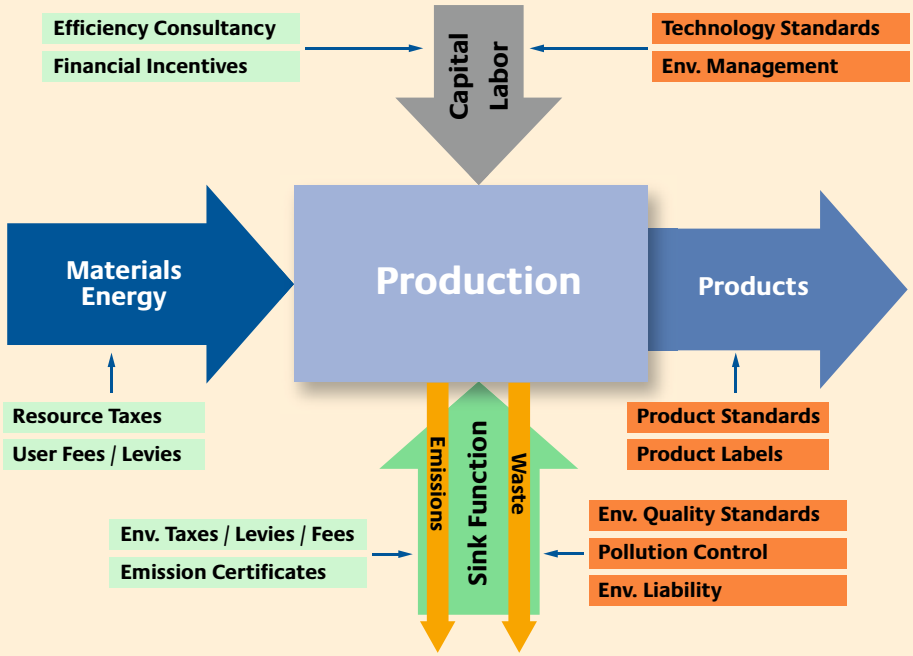
Pablo Picasso

This message is supported by the fact that energy and material costs account for the largest share of all production costs (up to 50%) that most manufacturers incur and based on the experience that investments in measures to increase energy and material efficiency pay off in a relatively short time. This is especially valid if energy and raw material prices continue to rise, as is the case now and most likely in the future as well. According to expert estimates, just through material efficiency measures it would be possible for German industry to save around EUR 200 billion or 20% of its total expenditure on materials. It is expected that tapping this potential will release new energies and synergies and substantially boost German economic performance.

However, experience also teaches us that developing a more resource-efficient economy is not going to happen on its own and cannot be left to market forces alone. Companies need additional incentives, whether in the form of rules and regulations (e.g. environmental and efficiency standards for production processes and products) or in the form of economic instruments that, depending on the type, make resource consumption either more expensive (by charging taxes, duties, or tradable emission rights) or cheaper (through tax deductions and subsidized promotion programs). The following diagram (see Figure 3) shows how the various types of incentives can be related to the Input-Output model of production.

As the remarks above show, the concept of resource efficiency has a number of strengths. It functions as a link between ecological challenges on a global and local level and may even be able to bridge environmental-political and

Figure 3: Economic (green) and regulatory (red) instruments targeting at production inputs and outputs



economic-political targets. Some authors even go so far as to claim that resource efficiency is the key to resolving the old contradiction between ecology and economy.

What is also obvious is that through resource efficiency or more responsible management of natural resources, we will be contributing to inter-generational equity (preserving resources for future generations). Less obvious, on the other hand, is that resource efficiency, as has been claimed by some, also contributes to intra-generational equity, i.e. to more socially equitable access and benefit sharing. From our point of view, such impacts do not occur automatically. Rather, additional political interventions and institutional mechanisms are required, so that efficiency gains can also benefit the disadvantaged.

Challenges and Opportunities for Development Cooperation

A German Federal Environment Agency publication states: "Worldwide about 60 billion tons of raw material are consumed annually. That is 50% more than 30 years ago, and the trend is set to rise. The main drivers for the ever increasing raw material consumption are the growing world population and the growth in the emerging economies. In Europe 43 kilograms of raw material are consumed per person, per day. As a comparison, in North America, the figure is 88 kilograms and in Africa 10 kilogram." (UBA 2010: 2 ▸) At the same time, the raw material productivity is clearly higher in the rich countries than in the poorer countries. According to a SERI study, African countries need almost 7 kilograms of domestic raw materials to earn USD 1 of GDP whereas the worldwide average is 1.4 kilograms per USD 1 (SERI et al. 2009: 23 ▸).

Even if such numbers have to be treated with caution, the picture they present of the current situation is by and large correct. Above all, the figures show that the industrialized countries (and increasingly emerging countries as well) are responsible for the over-exploitation of the world's resources and therefore also bear a global responsibility for its containment. More and more countries, including Germany, are accepting this responsibility, as, for example, this extract from the National Resource Efficiency Program (ProgRess) emphasizes:

"Germany strives to assume an exemplary role internationally by showing how resource consumption can be reduced without a loss of prosperity. Germany encourages the transfer of environment- and resource-protecting technologies to developing and emerging countries and helps them to follow its example by promoting more innovation-friendly framework conditions. (...) Despite all efforts towards greater resource efficiency, Germany will continue to be dependent on the import of many raw materials. Therefore, it also bears special responsibility for the ecological and social consequences of this raw material demand abroad. (...) Germany wants to contribute to the reduction of the 'ecological backpack' caused by its imports from developing and emerging countries and to help avoid the negative effects of production relocation and waste export (burden shifting)."

It goes without saying that this results in obligations for development policy as well. These are not new, as the following target statement on

the homepage of the German Federal Ministry for Economic Cooperation and Development (BMZ) confirms: "Development policy is global structural policy. It serves to promote global public goods such as climate protection, the conservation of environmental resources, and security." (see BMZ website ▸) This means that environmental problems in developing countries are no longer regarded as merely local, regional or national; rather they are increasingly perceived as global challenges. In other words: "Environmental problems, don't stop at national borders. The high consumption of fossil fuels and the resulting burden on the atmosphere through CO_2 emissions affect the climate worldwide. Development cooperation that promotes environmental protection, environmentally-friendly production methods, and the use of renewable energy sources in partner countries contributes to global environmental protection." (see BMZ website ▸)

This is why the implementing organizations are commissioned with the task of establishing an effective link between local and global challenges in concrete development policy practice even though its impact range in individual cases may be limited. The framework for this is created primarily by the international conventions. These, however, cover only a part of the environmental problems that are caused by global material and capital flows in exporting and importing countries. Thus, through the relocation of material- and energy-intensive industries or the export of end-of-life products, a (real) **burden shifting** from developed countries to the developing countries takes place. And, on the other hand, a (virtual) **impact shifting** in the opposite direction occurs through the trade of resource-intensive raw materials and products. In this way, a part of the environmental burden caused in developing countries is, to some extent, passed on as an *ecological backpack* to developed countries.

The following diagram (see Figure 4) reflects these interrelationships – although admittedly in a very simplified way – and shows at the same time (again only schematically) the possibilities for action offered to development policy in this context (see also Box 3).

In order to reduce the shifting of burdens, development cooperation can, for example, promote the transfer of more resource-efficient (environment- and climate-friendly) technologies, offer help in the introduction and tightening of environmental standards, or cooperate in the implementation of CSR initiatives. This last point applies especially to companies that realize a part of their added value in developing countries. Furthermore, to decrease the weight of the *ecological backpacks* of imported raw materials and products, development cooperation can promote the introduction of efficiency standards for products, advise small and medium sized enterprises in the implementation of environmental management systems, assist in setting up a secondary raw material economy or support CSR initiatives of retailers that receive their products via international supply chains from low-wage countries.

Resource efficiency gains made in this way (upstream and downstream) can benefit both sides and can help to reduce the pressure on natural resources on a global as well as on a local scale.

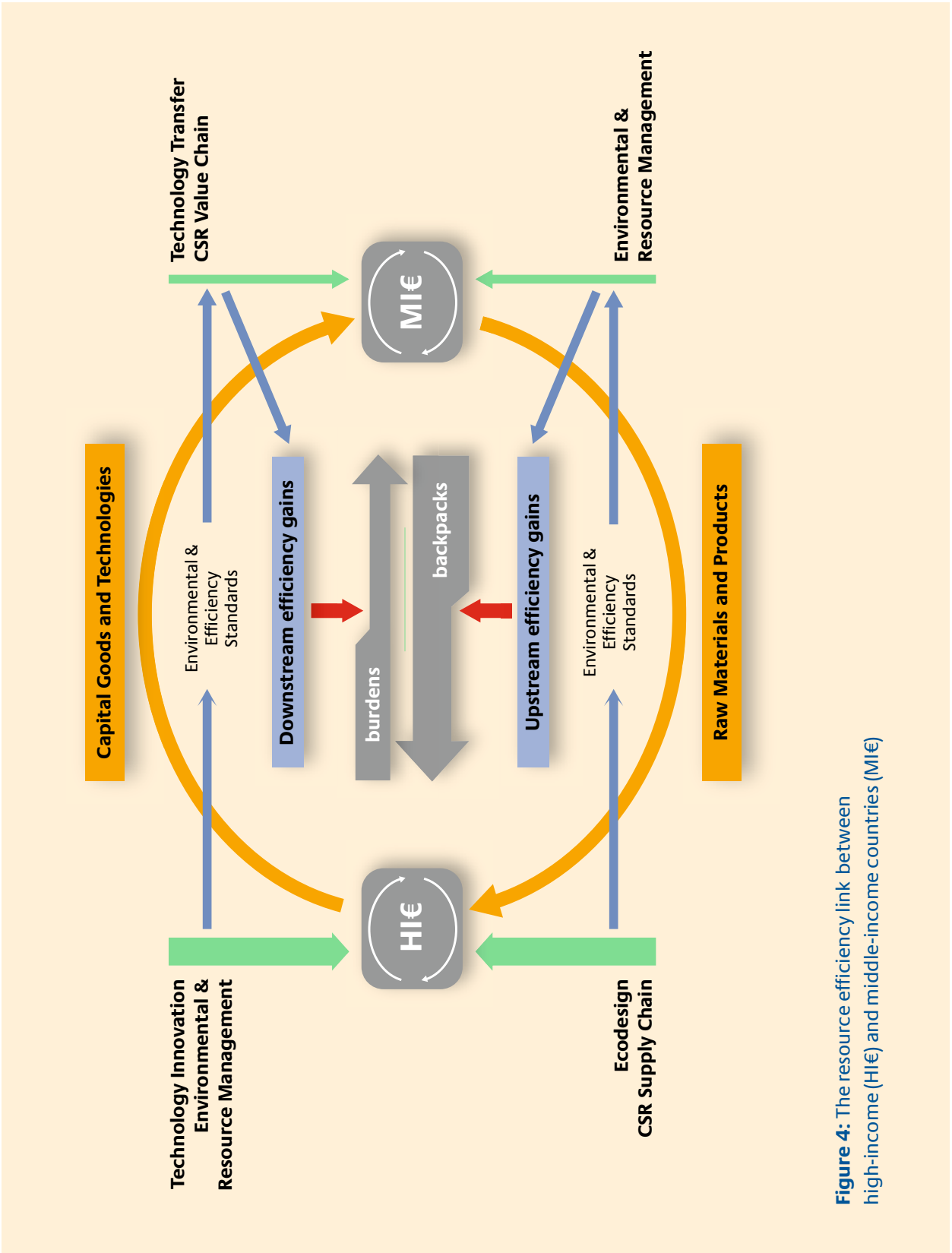


Figure 4: The resource efficiency link between high-income (HI€) and middle-income countries (MI€)

Box 3: Extract from the National Resource Efficiency Program (ProgRess) of the German Federal Government

"The conservation and sustainable use of natural resources as well as climate protection are important targets of German development policy. Among the activities that have a direct connection with the subject, the guiding principles and goals of this program, the following are especially noteworthy:

- In several developing and emerging countries, cooperation projects on environmental policy and urban-industrial environmental management have been and are being supported. The common aim of these projects that are executed jointly with governmental and non-governmental stakeholders is to build up the institutional framework and capacities needed for promoting environment-friendly and resource-efficient economies.

- Measures for increasing resource efficiency are equally important in projects concerned with economic development and private business promotion. In this context, partner countries for instance are supported in the introduction of an ecological fiscal reform or in the application of environmental and resource management instruments on the enterprise level. The new sector strategy for *Private Sector Development* will place high priority on *green technologies* and *green jobs*.

- In addition, BMZ is promoting the setting up of sustainable waste management systems in a number of developing and emerging countries. All these measures are in line with the concept of *circular economy* and contribute to the conservation of resources. The basis for this is a new BMZ guideline on waste and resource management.

- On behalf of BMZ, the Gesellschaft für Internationale Zusammenarbeit (GIZ) is currently carrying out a pilot project on the subject of *resource efficiency*. The project aims to integrate existing approaches and instruments for promoting resource efficiency in the manufacturing sector into a coherent implementation concept for development cooperation.

- The BMZ supports the transfer of environmentally-friendly and resource-efficient technologies, firstly, through the instrument of development partnerships with German and European companies, and secondly, through the promotion of an innovation-friendly environment in the partner countries and the provision of low-interest loans for environmental protection investments in small and mid-sized companies.

- Besides that, the BMZ is active in the area of product certification and the introduction of ecological and social standards. In this regard, it is also taking part in CSR initiatives of German and European retailers aiming to make the value chain of products manufactured in developing countries more ecologically and socially sound."

For further information see BMU ProgRess ‣

2 Approaches for Promoting Resource Efficiency in the Manufacturing Sector

Introductory Remarks

This publication focuses on the production sector and here mainly on the manufactur-ing industry. Even so, we are aware that *resource efficiency* is a concept that can basically be applied to all economic activities – to the extraction of mineral raw materials and the farming of biotic resources as well as to the consumption and infrastructure sector. However, if we had chosen such a widespread approach, we would have had to cover almost all sectors of development cooperation, ranging from agriculture, forestry, livestock farming, mining and energy supply on up to water management, transport and urban development. Furthermore, we would also have come into conflict with the concept of *sustainable resource management*.

When talking about *sustainable resource management* people from the 'development cooperation community' usually refer to those economic activities that occur at the first stage of the value chain of products and services; in other words, those activities that are directly linked to resource extraction and harvesting. For the following stages of the product lifecycle, especially for the manufacturing sector, preference is given to the concept of *resource efficiency*. People from the 'resource community', in contrast, are inclined to use both concepts synonymously.

From our point of view, there are two main reasons for making the distinction. First of all, *natural resources* as referred to in the concept of sustainable resource management *are not* identical to those resources one has in mind when it comes to *resource efficiency*. In the first case, the focus is on *natural assets* such as forests, fish, soil, water, minerals, etc., whereas in the second case reference is made to the goods and services produced from natural resources and used as input resources (material, water, and energy) at further stages of the production and consumption process. Secondly, *sustainability* is a much broader concept than *efficiency*; this is because in contrast to efficiency, it also addresses the issue of social justice and equity.

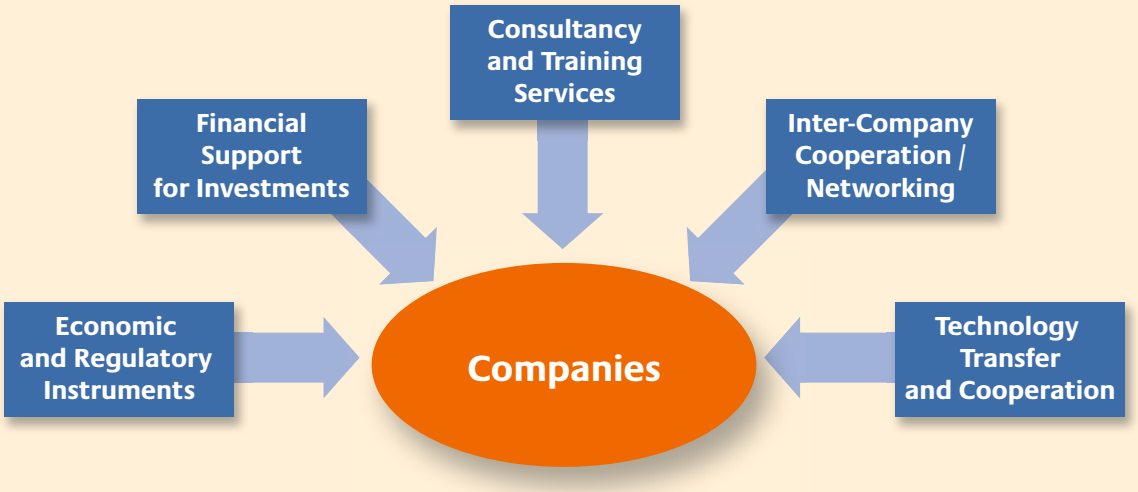
Differentiation is also recommended when using terms such as 'resource-rich' or 'resource-exporting' developing countries. Once again it should be made clear what kinds of resources are being considered: only abiotic raw materials, i.e. metallic ores, fossil fuels, and other minerals, or also biotic raw materials such as wood, fish, meat, coffee, cotton, etc.? In the framework of the global resource debate, resources are predominantly considered as a synonym for abiotic raw materials. From the perspective of the older and newly industrialized countries this might be justified, since their economies are highly reliant on these inputs. However, it should not be omitted that the revenues obtained from exporting renewable raw materials (crops) often represent an equally relevant or even more important source of income for developing countries than the revenues from mineral exports do, not to

mention the importance of these goods within their national and local economies.

Besides terminological considerations, there are two other reasons for concentrating on the manufacturing sector in this publication. To begin with, further economic progress in developing countries will only be successful if their domestic industries become more competitive. And one of the keys for increased competitiveness is resource efficiency. German development cooperation has gained quite a lot of experience in recent years with the implementation of different approaches and instruments that are commonly used for promoting resource efficiency in the business sector. However, a conceptual framework that enables decision makers and practitioners on both sides to identify potentials for creating strategic links and synergies is missing. We would like to provide such a framework in the following chapters.

The structure of the chapter is shown in the chart below. Four of the approaches displayed here (policy instruments, consultancy and training, inter-company cooperation, technology transfer) will be treated from the perspective of technical cooperation, notwithstanding the fact that technical and financial cooperation often overlap and complement each other in practice, particularly in the case of technology transfer and the use of consultancy services. A fifth section written from the perspective of the German development bank KfW is dedicated to the topic of financing. This part as well as the section on policy instruments is characterized by a broader focus than the other three. Whereas KfW sets its activities concerning resource efficiency in the context of financial cooperation in the areas of energy, environment and climate protection, the 'policy' section also refers to instruments that are not specifically aimed at the manufacturing sector.

Figure: Approaches for promoting resource efficiency in the manufacturing sector



All of the sections are set up in the same pattern:

Relevance of the approach
Where does the significance of the approach lie in regard to the promotion of resource efficiency and what can it contribute? Which experiences outside development cooperation can be drawn on? What relevance does the approach have in the portfolio of bi- and multilateral development cooperation?

Concepts and instruments
In which types of projects is the approach used or can be used? What is the underlying conceptual framework and which methods and instruments are applied? Are the specific conditions of developing countries and the requirements from development policy sufficiently considered in the design of the promotion measures?

Project Experience
What experience has been gained with the approach? Which effects were achieved by applying it in development cooperation practice (project examples) and what were the main factors of success? Which difficulties arose and what were the reasons for these difficulties?

Conclusions
Are there any aspects that need to be heeded when implementing the approach? How can problems be avoided or at least reduced to a minimum? Is there a need for improvement or further development?

The chapter will be closed with suggestions as to how more importance can be placed on the promotion of resource efficiency within the framework of development cooperation. Special attention will be given to the perspective of integrating various action approaches into a program approach that in turn can serve as a contribution towards the development and implementation of national resource policies in partner countries.

2.1 Policy Instruments for Improving the General Framework Conditions for Resource Efficiency

Relevance of the Approach

On a macro-level, environmental and economic policies determine the framework conditions for the economic activity of companies and the use of resources in an economy. Through political consulting in the areas of economic reform and environmental policy, German development cooperation supports governments in partner countries in actively creating and changing these framework conditions. To this end GIZ on behalf of BMZ offers advice and support both for general strategic reform planning and for tackling concrete policy challenges in specific policy areas. Services offered include advice and support in defining adequate policy goals, developing strategies, building efficient institutional structures, implementing reform concepts and developing regulatory frameworks. The objective of cooperation is always twofold: to increase the capacity of partners and to contribute to the tackling of specific environmental and economic policy challenges.

Development cooperation in the area of economic and ecological policy is guided by the specific German model of *social and ecological market economy*. It is based on the conviction that there is no mechanism more efficient for the allocation of goods than the price determined on the basis of supply and demand. At the same time, the social and ecological market economy is founded on the experience that, if unchecked, the free functioning of markets usually creates social and ecological externalities which are borne by the general public or particularly vulnerable groups. Therefore the social and ecological market economy is an economy which guarantees the free functioning of markets, but where the state creates and actively influences the framework conditions for economic activities so that social and ecological concerns are adequately respected.

As was pointed out in the introduction of this volume, the issue of resource efficiency is very relevant both from an economic and ecological point of view. Economically, the efficient use of resources allows companies to reduce production costs and improve their individual competitiveness. On a macroeconomic level, those national economies which are most resource-efficient will maintain or enhance their international competitiveness and be attractive for investment. Ecologically, the issue of resource efficiency is becoming of paramount importance in the light of increasing extraction of non-renewable resources from the earth, causing stress on local ecosystems and biodiversity through water and air pollution, soil erosion and the large-scale altering of landscapes.

In theory, the potential for resource efficiency should be tapped by companies spontaneously and without government intervention, driven by the motivation to lower production costs and increase competitiveness. However, looking at the record of resource efficiency, this is not

the case to the extent technologically possible, neither in industrialized nor in developing and emerging economies. Instead, sustainable use of resources is hindered by a number of critical factors:

- **External Effects:** Environmental damage from resource extraction and resource use are often externalized. These costs are borne by the general public instead of the beneficiaries of resource consumption. As a consequence, resource prices are below the macroeconomic optimum. The possibilities to externalize the negative environmental impact of resource use, together with improvements in extraction and transport technology as well as the overall increase in volume of extracted resources has allowed aggregated resource prices to drop over the last decades, rather than increase. The perception of skyrocketing raw material prices is the result of a short-term perspective. If looking at the aggregated price developments over the past century, resource prices have declined by about 30% (UNEP 2011a ▸) .

- **Fluctuating raw material prices:** At the same time, raw material prices are subject to strong fluctuations. Among other factors, these are primarily a result of strong rigidities both on the side of supply and demand. Supply is strongly determined by the capital- and time-intensive processes of exploration and development of new extraction sites. Demand on the other hand is strongly determined by the current state of technological and product development, as companies cannot easily adapt their material input according to current raw material prices. As a consequence, incentives to invest in more efficient production technologies or in recycling have been inconsistent and not effective over time.[2]

- **Lack of information:** Lack of information is a source of market failure at various stages of the value chain. Beyond uncertainties about the future development of resource prices, increasingly complex production chains and shorter product life cycles lead to information deficits on the composition of pre-products, the source of materials, conditions of resource extraction and the whereabouts of end-of-life products.

As a result, market-economy left to itself produces insufficient gains in resource efficiency, both from an ecological and a long-term economic perspective. Economic and ecological policy interventions must improve these framework conditions, create stronger incentives for companies to increase resource efficiency and compensate for information deficits. Development cooperation can develop capacities and offer concrete support and advice to governments in partner countries on how to carry out these reforms.

Concepts and Instruments

As global resource conservation is still a comparatively new issue on the international political agenda, so is the debate on instruments addressing it. Most experience so far has been acquired through approaches on the

2 The effectiveness of consistent incentives is illustrated by the contrasting example of labour productivity. Different from resources, the cost of labour at an aggregate level has persistently and predictably increased over the past decades as a result of wage agreements and the expansion of social security contributions. Due to this different incentive structure, labour productivity has increased much faster than resource productivity worldwide.

micro-level; increasing the capacity within individual companies to raise the efficiency of their production processes. Experience with macro-level instruments directly addressing resource efficiency is still very limited, even in industrialized countries.

Policy instruments creating the framework conditions of a market economy are generally **regulative instruments** (bans, requirements and standards), **economic instruments** (taxes and levies, subsidies, tradable permits or deposit-refund systems) or **informational instruments** (publicly provided statistical services, certification systems, product labels or awareness campaigns). Regulatory instruments influence individual behavior through the logic of legality (making certain behavior legal or illegal), economic instruments through the price mechanism (making certain behavior more or less expensive), and informational instruments through information (allowing market-actors to make better-informed choices). A brief overview of different instruments and their relevance for emerging and developing economies is given in form of a table at the end of this chapter.

Environmental regulation can be applied at all stages along the value chain, from resource extraction through production and consumption to the treatment of end-of-life products. For example, environmental (and social) standards at the stage of **resource extraction** (along with renaturalization requirements) are very important instruments in reducing the environmental externalities of resource use. Environmental regulation often leads to higher resource prices, thus creating significant upstream incentives for resource efficiency in production and consumption. Environmental regulation of resource extraction tends to be much tighter in wealthy countries than in less developed ones, where nowadays significant shares of resources are extracted. Supporting partner countries in establishing effective frameworks for sustainable mining can therefore be an important contribution to improving resource efficiency.

At the stage of **production and consumption**, environmental regulation can improve the framework conditions for resource efficiency through performance or input-oriented **process or product standards**. Examples for **process standards** are requirements for the efficient use of energy in industrial processes. In the EU, for example, the *Industrial Emissions Directive* (2010/75/EU) obligates operators of industrial facilities to make use of **best available technologies** concerning emission standards and additionally the efficient use of energy and raw materials. Similarly in China, the *Energy Conservation Law* which came into force in 2008 establishes mandatory energy conservation standards and design norms for energy efficiency for industrial facilities.

On a **product level**, regulators can establish minimal standards for specific product groups, which producers must meet to gain market access. The restriction of access to (important) markets creates incentives to meet minimal efficiency standards not only in those economies where the standard is implemented, but also for companies in other countries who want to sell their products in markets where product standards are effective. To create stronger incentives for innovation, these standards can be dynamic and periodically raised. A particularly promising mechanism for dynamic standard setting is the **top-runner model** where standards are determined by the

Box 1: Top Runner program for energy-efficient products

In the EU, the Framework Directive on Ecodesign Requirements for Energy-Related Products (Directive 2009/125/EC) establishes a framework to set mandatory ecological requirements for energy-using and energy-related products sold in all 27 member states. The directive currently covers energy-using products (consumer electronics, lighting, washing machines, etc.) and energy-related products (windows, insulation materials, water-using products, etc.). Altogether, 40 product groups are currently covered. For individual product groups, minimum ecological requirements are developed on the basis of preparatory studies in regulatory committees with participation of selected stakeholder groups and member states' experts. Currently, specific regulations have been adopted for 13 product groups. For these products, manufacturers and importers have to prove conformity of their products using assessment procedures identified by the Directive before placing them on the market. In practice, the introduction of (new) minimum requirements has resulted in effectively banning non-compliant products from the EU market. The most prominent case has been that of the incandescent light bulb, which is gradually being phased-out after adoption of minimum standards for the efficiency of domestic lighting in 2009.

Currently, discussions in the European Commission and among member states are ongoing on how to make standard setting under the Ecodesign Directive more dynamic during a future revision. Currently, product-specific regulations typically have a revision cycle of three to six years. One option under discussion is to make the point of revision more dependent on actual market development. The option of a top-runner model where requirements are determined by the performance of the best product on the market is also being considered.

The Japanese Top Runner Program is usually cited as the most successful example of product standardization. Most of its 21 regulated products have reached the top standard ahead of schedule or exceeded it, leading to the definition of a new top runner standard each time. For example, computers were meant to be consuming 83% less electricity on average by 2005. This target was reached in 2001. A second standard was set for 2007. Again, the expected reduction of 69% had been surpassed (minus 81%). Now, a third standard for 2011 has been set with an expected reduction of 78% (METI 2010 ▸). The more modest target for cars in 2010 (minus 23%) had already been reached five years earlier. Furthermore, a new standard was defined with the aim of further savings of 29% (ECCJ 2008). The Top Runner Program in Japan is generally considered as highly successful. It has promoted competitiveness for the products concerned. Despite fears, it has not resulted in higher production costs.

performance of the best product on the market. The benefits of this model are that it bypasses information deficit problems on the side of the regulator increasing the legitimacy of the regulation. Additionally, it has the merit that the technological feasibility of the standard is already proven. Energy efficiency standards for products are implemented in most indus-

trialized countries today. The EU has created a comprehensive framework for regulation in the form of the Framework Directive on *Ecodesign Requirements for Energy-Related Products* (Directive 2009/125/EC). A dynamic top-runner model is currently applied in Japan and South Korea, also for energy efficiency standards (see box 1). As product standards are effective through the restriction of market access they are most efficient in economies where a significant domestic market for the respective products exists. Beyond industrialized countries, product standards could therefore become an increasingly relevant instrument for emerging economies with rapidly expanding markets for consumer goods.

Both the EU and Japanese top runner programs do not currently include material efficiency standards. However, expanding the model to incorporate material efficiency is potentially feasible. A possible approach would be to establish mandatory **quotas for the use of secondary (recycled) materials** in products. These quotas could then be raised following a top runner model (Werland 2010 ▸) . Such a model of input-regulation would create significant incentives to increase the amount of recycled materials in products and would have significant downstream effects on the recycling industry. Another benefit of such an input-regulation solution is that it can pointedly address the efficient use of particularly critical materials, even though they are used only in small quantities.

A second group of policy instruments to improve the framework conditions for resource efficiency are **economic instruments**. If applied in the context of environmental policy, economic instruments form part of **Environmental Fiscal Reform** (EFR), aiming at creating environmental effects through a government's fiscal policy. The underlying rationale of EFR is the correction of price signals within the economy through the taxation of environmentally harmful products, emissions, or resource extraction, user fees and charges for disposal, as well as the removal of environmentally harmful subsidies. The use of economic instruments has increased significantly in recent years. In most OECD countries, the implementation of instruments in the context of EFR has been largely driven by the combined need to address mounting environmental problems and to relieve pressure from labor costs resulting from increasing income taxes and social security contributions. Recently, EFR instruments have also been used to generate revenue for austerity measures in the wake of the financial and economic crisis.

Most of the EFR instruments currently implemented are oriented towards energy efficiency. The most common EFR instruments are **energy or CO_2 taxes**, levied either on the input of fossil fuels, the consumption of electricity or emissions from fuel combustion. (A prominent example is the German *Ecological Tax Reform* described in Box 2). Another prominent economic instrument creating incentives to reduce emissions is an emission permit trading scheme such as the one currently being implemented within the European Union. Beyond the direct effects on energy efficiency, these instruments also have an indirect effect on material efficiency: As energy is widely produced from the combustion of fossil fuels, which make up for a large proportion of global resource extraction, the incentives for energy efficiency created by these instruments strongly correlate with overall resource efficiency.

Box 2: The Ecological Tax Reform in Germany 1999 – 2003

In 1999, Germany introduced an Ecological Tax Reform (ETR). The most important objectives of the ETR were to improve incentives for increasing energy efficiency and reducing emissions as well as creating positive effects on the labor market through reduced labor costs. From 1999-2003, rates for excise taxes on transport and heating fuels as well as on natural gas were gradually increased and a new tax on electricity was introduced. By 2003, tax rates had increased by approximately 30% for petrol, 28% for diesel, 25% for heating fuels and 10% for natural gas. Additional revenue from the ETR was EUR 17 billion in 2003, increasing the share of environmental taxes in overall state revenue by 20% from 8.0% in 1998 to 9.7% in 2003. The revenue was largely used to reduce social security contributions or offset increases in contributions that would have otherwise become necessary. It is estimated, that social security contributions in 2003 were 1.7% lower than they would have been without ETR. In order to limit the burden on companies created by higher energy prices and to protect their international competitiveness, reduced tax rates and exemptions were created for companies in the industrial sector, especially those relying on energy-intensive production processes. Impact assessments have estimated that ETR in Germany has led to a reduction of CO_2 emissions by about 2-3% and to an increase in employment by about 250.000 jobs (Kohlhaas 2005 ▸).

Other examples for economic instruments creating incentives for resource efficiency are **user-charges** for public services such as water usage, and waste management. Water abstraction charges, for example, have been collected by most of the German federal states since the late 1980s on the abstraction of water from ground or surface reservoirs by water suppliers or industrial companies. Justifications for water abstraction charges vary slightly between individual states, but objectives of the charge are generally to create incentives for an efficient use of fresh water and to raise revenue for water conservation. The most ambitious rates are applied in the state of Northrhine-Westfalia (NRW), which charges 5 ct/m^3. Revenue from the charge in NRW is earmarked for the financing of the water conservation obligations of the state resulting from the EU Framework Directive for *Community Action in the Field of Water Policy*. Similarly, at the other end of the resource stream, user charges for disposal services and environmental levies for sink functions can also create incentives for the efficient use of resources. For example, charges for waste collection and treatment services help to realize the "polluter-pays" principle and finance these public services. In some OECD countries, landfill taxes partly internalize the external costs of the disposal of residual waste. If these charges and levies are not designed as flat rates but have flexible rates depending on the volume of waste, they can create significant financial incentives to improve internal resource management of companies and increase recycling. In many municipalities in Europe, part of the revenue from waste charges is additionally used to promote recycling and sustainable waste management technologies (Schlegelmilch/Meyer/Ludewig 2010 ▸). Correspondingly, waste water disposal charges are collected in many OECD countries. In Germany, most fed-

eral states raise waste water disposal charges on the disposal of used water into natural water reservoirs. Charges are collected not only on the basis of volume but also according to a "toxicity unit" of the disposed water. This way, water disposal charges are designed as an environmental levy reflecting the usage of the sink functions of ecosystems. This way they create incentives to minimize water disposal and to improve the environmental quality of the disposed water. Like water abstraction charges and waste charges, the revenue of water disposal charges is often used to finance measures to improve water quality but also to promote the efficient use of water and other resources.

An EFR instrument more directly oriented towards resource efficiency is **resource taxation**. Resource taxes can be introduced as input taxes on the use of resources in production. They are collected from the mining companies first bringing the resources to the market but are passed on up the value chain within the price of resources. Their environmental objective is to internalize the external costs of resource exploitation, this way correcting market failures and improving incentives for resource efficiency. Resource taxes are not the same as mining royalties, whose objective is to "skim" the resource rents, which mining companies are earning from the exploitation of a public good like mineral resources. Consequently, royalties are usually profit- or ad valorem-taxes. Resource taxes on the other hand should be unit based, as the external effects of extraction correlate with the volume extracted.

While royalties are a long-standing source of government revenue in most countries, the implementation of resource taxes is not yet very common. The first example of resource taxes with the stated objective to reduce resource use were **taxes on primary construction materials** (sand, gravel, and rock) levied in several European countries. The most ambitious of these taxes was introduced in the UK and has produced rather promising results (see box 3). The rationale behind taxing primary construction materials is twofold: (1) The construction sector makes up for a very relevant share of overall resource consumption and (2) construction materials are traded within limited geographical areas due to their extremely high weight. A tax on primary construction materials therefore affects a very relevant part of overall resource streams while having negligible distorting effects on competition.

Another approach to create incentives for resource efficiency through taxes is through a **differentiated rate of the Value-Added-Tax (VAT) according to the resource efficiency of products**. VAT-systems in most EU countries implement reduced tax rates, usually to increase availability of specific products to poorer households (e.g. food, books, etc.). An extension of reduced VAT-rates to energy or material efficient products would be effective on the consumption level and would create downstream incentives for resource efficiency. A first step could also be scrapping those currently reduced rates for especially resource intensive products and services such as meat and dairy products or airfare.

Finally, a very important approach of EFR is the **reduction of environmentally harmful subsidies** (EHS). The OECD had identified the importance of reducing perverse incentives by abolishing subsidies which favor pollution and resource consumption already in the late

Box 3: Experiences with the Aggregates Tax in the UK

A tax on primary construction materials (rock, gravel, and sand) was introduced in the UK in 2002 and justified by the presence of external costs of aggregates extraction. The tax is charged on quarry operators and other organizations that commercially exploit aggregates. It was introduced at EUR 2.35 per tonne (approximately 20% of the average price per tonne of material). In 2008, the tax rate was increased to EUR 2.87 to take inflation into account.

The objective of the UK aggregate tax has been principally twofold: The primary aim has been to reduce the environmental costs associated with quarrying operations, e.g. noise, dust, visual intrusions, loss of amenity and damage to biodiversity. Secondly, the tax aims to reduce the demand for aggregates and encourage the use of alternative materials.

Revenues from the aggregates tax are recycled to businesses through a 0.1% cut in employer social insurance contributions. A small proportion of the revenue is also earmarked for an *Aggregates Levy Sustainability Fund* aimed at delivering local environmental benefits to areas subject to environmental costs.

The production of primary aggregates had already been falling in the UK since 1990. A number of factors, preceding the introduction of the aggregates tax have contributed to this decline: The introduction of a landfill tax in 1996, a general decline in road construction, lower intensity and improved use of aggregates in construction due to technical improvements. The tax created additional incentives for the recycling of construction waste. Demand for recycled aggregates and the recycling rate of aggregates in the UK rose to 25%.

1990s. In Germany the Federal Environmental Agency has identified EHS of EUR 48 billion per year through state aid and tax reductions for fossil fuels, air transportation, the construction sector, and the like. Recently the G20 has also raised the issue on its agenda, mainly focusing on fossil fuel subsidies. While the focus of these initiatives has primarily been on climate protection, the correlations between energy and overall resource efficiency are significant and the potential to examine government subsidies supporting particularly resource intensive economic activities is a promising strategy.

EFR instruments, especially environmental taxes, are a very promising instrument for developing and emerging countries. They are relatively easy to implement at low administrative costs and generate urgently needed additional revenues for the provision of social and healthcare services as well as other pro-poor policies. With an eye on resource conservation, taxes on the extraction of raw materials have the potential to correct market failures and create significant upstream incentives for efficiency. As a large part of the world's raw materials are extracted in poorer developing countries and consumed in wealthier industrialized ones, resource taxes are a promising option to create incentives at the beginning of the value chain and for resource rich developing countries to transform their natural capital into positive development opportunities, without causing trade distortions. However, a prerequisite to

implementation is the existence of a sound institutional framework for revenue collection and fiscal governance. Also, the effect of excise taxes on individual social groups and sectors of the economy must be carefully assessed to ensure that they do not excessively harm vulnerable groups.

Finally, framework conditions for resource efficiency can also be improved through **informational instruments**. Information deficit about increasingly globalized resource streams and product life cycles is one of the most significant barriers for an effective resource policy. This applies to the supply side, where resources are used in industrial processes far away from their origin and without reliable information on the environmental (and social) impacts of their extraction and processing, as well as to the disposal side, where information about the whereabouts of end-of-life products is sparse. Also, the environmental effects of resource consumption are complex and generally underexposed.

One set of options to improve information on the environmental (and social) impacts of resource extraction are **certification systems**. For some resources like wood (Forest Stewardship Council), fisheries (Marine Stewardship Council) or diamonds (Kimberley Process) certification systems are already in place. The establishment of similar systems for metals and other minerals might arguably be confronted with higher obstacles due to more complex global value chains and the "pooling" of raw materials from different origins during processing. The German Geological Agency is running a pilot project for the certification of coltan, cassiterite and gold in the DR Congo based on the "mineralogical fingerprint" to overcome this obstacle. One of the objectives of these certification schemes is to exert downstream pressure on resource extraction activities by informing buyers on the environmental and social standards at the source of the resource. The other way around, if this pressure indeed results in the actual reduction of the externalities of resource extraction, resource prices will ultimately be adjusted upwards, thus creating incentives to increase resource efficiency.

A different approach for improving information on the environmental impact of resource use is to complement official economic statistics with environmental statistics, or **green accounting**. Economic accounting by national statistical offices is traditionally focused on recording national income by factoring labor and produced capital. The point of departure for green accounting is the recognition that not only produced capital but also natural resources are relevant economic input factors and form part of a nation's wealth. In classical economic accounting, depletion of natural resources, contamination of the environment as well as efforts to mitigate these impacts all appear as positive values as long as they generate income. Green accounting aims to correct this one-sided perspective on income by also recording material flows, the condition of the environment and measures aimed at its protection. This way, the value of natural resources and environmental sustainability for the economy as a whole becomes statistically visible. In the long-term, the impact of green accounting is a contribution to improving the framework conditions for environmental protection and resource efficiency by informing political decision-makers about the effects of their policies on natural resources.

Experiences from Development Cooperation

Generally, programs of international development cooperation can facilitate the introduction of EFR instruments as well as regulatory standards and informational instruments in partner countries through capacity development. As shown earlier, EFR policies can have a very positive effect on general framework conditions for a more efficient use of resources in developing countries through improving economic incentives. However, EFR policies are usually politically controversial, as they produce winners and losers (usually traditional energy and material intensive industries and/or consumers). Correspondingly, the implementation of EFR instruments is often hindered by diverging perspectives and motivations of different government agencies (mostly Ministries of Finance, Economy and Industry). Capacity development can help partners in developing and emerging countries by increasing their capacity to design strategic approaches to EFR in consideration of its specific political economy.

Good experiences for example have been made with a capacity-building training for the implementation of EFR instruments. The **training seminar** *Capacity Development for Environmental Fiscal Reform* was developed by Green Budget Germany on behalf of GIZ/BMZ and has so far been successfully implemented by GIZ in Thailand, Morocco, and by UNDP and UNEP with participants from Burkina Faso, Mauretania, Mali and Ghana. Partners of German Development Cooperation in Tunisia, India, and Peru have also requested the training. The overall objective of the interactive training seminar is to familiarize participants with the basic concepts of EFR, to increase awareness of its political economy and to build the capacity to design appropriate strategies for implementation of EFR instruments. Target groups are mainly policy makers (mostly representatives from relevant ministries, i.e. environment, finance, industry), NGO representatives and other stakeholders from developing and emerging economies. The training currently offers sector specific modules for industrial pollution, transport and waste management. However, it can be amended with additional modules focusing more specifically on EFR instruments improving incentives for resource efficiency in the industrial sector. These modules could include topics such as resource taxes or water charges.

Another way to assist partner governments in the process of introducing EFR instruments is supporting them in conducting an **ex-ante impact assessment** of the instrument. This has proven to be very helpful in the case of an environmental tax reform introduction in Vietnam. On behalf of BMZ, GIZ has supported the Vietnamese Ministry of Finance in the elaboration of an environmental tax law through the bilateral *Macroeconomic Reform Program* (see box 4). The program's support started in 2008 and ended in 2010, when the law was passed. Vietnam was pleased to see that the entire legislation process went much faster than other tax laws. A key feature in the design of the environmental tax law was the successful transfer of international know-how by an experienced expert on environmental taxation. Additionally, the program facilitated two study tours to selected European countries experienced in environmental fiscal reform in addition to organizing multi-stakeholder workshops and trainings for Vietnamese tax policy officials. Most helpful, however, proved to be

an ex-ante impact assessment that analyzed the socio-economic and environmental effects of the taxation. The results of this assessment helped in identifying winners and losers of the reform, design appropriate compensatory measures and generally helped in making the debate objective.

Yet another example for a capacity development measure with regard to the improvement of general framework conditions for resource efficiency is the support of partner governments in developing a Green Accounting System. As already pointed out above, these systems help to overcome information deficits

Box 4: Environmental Tax Reform in Vietnam

Vietnam is one of the fastest growing economies in Southeast Asia with an average growth rate of 7.3% since 2000. However, this rapid development comes with an important drawback as it is currently coupled with increasing environmental pollution. GIZ supported the Vietnamese partners in implementing an environmental tax law according to international standards. In 2010, the Vietnamese parliament passed the bill with a large majority. As the law will come into force in 2012, Vietnam has succeeded in becoming a frontrunner in Southeast Asia on environmental taxation. The Vietnamese government will levy taxes not only on energy in terms of refined fuels and coal but also on environmental harmful substances such as Hydrochloro-fluorocarbons (HCFC) substances, selected pesticides and soft plastic bags. According to the ex-ante impact assessment, the environmental taxes will contribute to the weak state budget with up to EUR 1.5 billion in additional tax revenues expected for 2012.

The environmental taxation is also expected to contribute largely to reduce Vietnam's greenhouse gas emissions. Here, the ex-ante impact assessment analyzed quantitative changes in the domestic use of fossil fuels and translated it into changes in carbon emissions: For the year 2012, the results suggest a reduction between 2.3% and 7.5% of greenhouse gases.

With regard to the socio-economic impacts, simulation results show a significant shift in purchasing power from the household sector to the government sector. That is, households will bear the main burden of the energy taxation. Analyzing the effects on different income groups however revealed that the tax burden will be carried by enterprises and private households equally and that poorer households will not be adversely affected by the environmental taxes.

The impact assessment further indicates that fuel intensive sectors like road and air transportation will shrink significantly, while sectors with low fuel intensity like the clothing and textile sectors will expand output and employment considerably. Thus, notable shifts in production and consumption patterns are expected and desired. Adverse effects are expected for the fishery sector, which from a purely environmental perspective might be considered as beneficial as it reduces the pressure on fragile ecosystems. However, fish-related sectors employ a considerable fraction of Vietnam's labor force. Model results suggest that these unintended side effects can be largely eliminated through an output subsidy for the fishery sector.

concerning resource use, by including the use of natural resources, the condition of the environment and measures aimed at protecting the environment in the statistics. Good experiences with capacity building in this regard have been made in India, where GIZ, under the bilateral Indo-German Environment Program, embarked on developing a Green Accounting System for the State of Andhra Pradesh (see box 5). The development of environmental statistics must be seen as an intervention in the first step of a policy cycle. The impact of instituting a green accounting system is that it helps to mainstream environmental concerns into policy making and the statistics are used to make policy making more objective and oriented towards the conservation of resources. In India, the implementation in Andhra Pradesh can be considered a pilot for the rest of the country.

Finally, a complementary approach for promoting the introduction of EFR instruments in partner countries is through supporting **good governance in the tax administration**. Even though environmental taxes have the merit of being comparably easy to administer, one prerequisite for their effective implementation is an effective and transparent tax administration. Especially if environmental taxes are to be levied on resource extraction, the threat of corruption is a serious obstacle. In light of this, Germany is currently supporting the Extractive Industry Transparency Initiative (EITI) as an internationally accepted transparency standard. Beyond that, GIZ is currently running programs to increase transparency in the mining sector and build capacity for good financial governance in the DR Congo, Ghana and in the Central African Economic and Monetary Community (CEMAC). With an eye on the need to further increase framework conditions for resource conservation, these programs should be further expanded and complemented with a more direct focus on EFR instruments in the natural resources sector.

Box 5:
Green Accounting in Andhra Pradesh

Andhra Pradesh is one of the fastest growing regions in India and one of the most progressive states in the country implementing a number of large infrastructure projects with a progressive GDP growth rate of 10.37%. Given its rapid growth and the associated concerns for the environment, the state of Andhra Pradesh is one of the first states in India to demand the development of green accounts and estimate the environmental cost adjusted Gross State Domestic Product.

Responding to this demand, GIZ set out to support the installation of a *Green Accounting System*. The first step in implementation was the creation of a multi-stakeholder group consisting of government representatives, research institutions, NGOs and donor agencies to serve as an advisory group for the process. To develop, adapt and modify the methodology appropriate to the local context, workshops and roundtables were organized. Furthermore, links were established between the Environmental Statistics Division of the German Federal Statistics Office to facilitate the exchange of best practices.

Conclusions

Development cooperation can support governments in developing and emerging countries to actively improve the macro-level framework conditions for the use of resources. Current market conditions do not lead to sufficient levels of resource efficiency. This is the result not only of market failures like external effects and strong rigidities on raw materials markets, but also of information deficits and political mismanagement.

At the same time, the level of the international division of labor and the complexity of international value chains lead to a situation where large quantities of natural resources are extracted in developing and emerging countries, while a disproportionate amount of these resources are processed and consumed in industrialized countries. Significant improvements of the framework conditions for resource efficiency can therefore only be realized on a global level, specifically including resource rich developing and emerging countries.

Policy interventions should start at the very beginning of the value chain by addressing market failures and information deficits at the stage of resource extraction. A framework of sound environmental and social standards can minimize the opportunity for mining companies to externalize the costs of resource exploitation. Certification and tracing systems that begin with the extraction of the resource and continue along the value chain can contribute to improved information on the source and whereabouts of resources throughout international value chains. Resource taxes should increasingly be applied to internalize the environmental effects of mining and to create significant upstream incentives for resource efficiency at the stages of production, consumption, and recycling. Input regulation can help to create markets for resource-efficient products and can be fine-tuned to address the efficient use of particularly critical resources, even though they may only be in circulation in small quantities.

Throughout all stages of the value chain, state subsidies must be reviewed in a context as to whether or not they eventually support specifically resource intensive economic activities. Policy interventions to improve framework conditions for the use of resources must always consist of a mix of measures adjusted individually to predefined objectives and to the circumstances of a respective country. The improvement of environmental regulation of mining activities and the development of resource taxation schemes may be especially important and effective in resource-rich developing countries, whereas for emerging and newly industrialized countries the development of refined input-standard regulations and the advancement of energy and emission taxes will be much more relevant.

Development cooperation can fruitfully support governments in partner countries in designing and implementing these policy mixes. Depending again on the situation in the individual country, bilateral programs can support partner governments in identifying goals and objectives as well as appropriate instruments to reach them. For the implementation of EFR instruments, training activities for improving the capacity of relevant actors to design strategic implementation plans have proven successful as has the support in carrying out ex-ante assessment studies. Where governance

structures are weaker, a necessary first step may have to be capacity building and the strengthening of good governance especially in the tax administration. As a large part of the resources are extracted in poorer developing countries, efforts in this direction should be stepped up as much as possible. If significant gains in resource efficiency are to be realized it is imperative that the signals given by the development of prices are pointing in the right direction. To this end, resource taxes in resource rich developing countries are a promising opportunity to create significant incentives and allow the populations of these countries to profit from the natural wealth of their countries.

Table: Overview of Policy Instruments and their relevance for developing countries

Instrument type	Examples in industrial and emerging economies	Relevance for developing and emerging economies
Environmental standards for resource extraction	Germany: **Federal Nature Conservation Act** or **Federal Mining Act**, depending on type of resource	High. Mining is usually not strictly regulated in developing and emerging countries.
Energy/resource efficiency standards for industrial processes	EU: **Industrial Emissions Directive** China: **Energy Conservation Law**	Medium. Interesting for rapidly industrializing emerging economies, where administrative capacity is in place for monitoring.
Product standards	EU: **Ecodesign Directive** Japan: **Top runner Program for Energy Efficiency**	Low. Potentially interesting only for those emerging countries with rapidly expanding markets for consumer goods.
Energy taxes	Germany: **Ecological Tax Reform**	High. Relevant especially for rapidly industrializing countries.
Resource taxes	UK: **Aggregates Tax**	High. Interesting for resource-rich countries, but effective and transparent tax administration is an important prerequisite.
User charges for water supply	Germany: **Water Abstraction Charges**	High. Especially for countries or regions with scarce water resources or rapidly decreasing groundwater tables.
Certification Systems	Global: **Forest Stewardship Council** (Wood) Global: **Marine Stewardship Council** (Fisheries) Global: **Kimberley Process** (Diamonds)	High. Transparency of supply chains and conditions of resource extraction are important contribution to improving environmental and social conditions of extraction.
National Accounting	Germany: **Green Accounting System**	Medium. Good resource for policy planning and evaluation, especially in emerging economies.

2.2 Financial Support for SME from the Perspective of a Development Bank

Relevance of Financing

As the promotional bank for the German federal government and states, KfW is tasked inter alia with promoting small and medium-sized enterprises (SME) and investment in environmental and climate protection as part of its financial cooperation with developing and transition countries. SME play a key role – alongside private households and municipalities – in achieving sustainable and wide-ranging environmental and climate protection goals.

Economic growth in developing and industrializing countries is critical to the fight against poverty. The challenge of delivering development and economic growth in partner countries in a sustainable and hence ecologically compatible manner is a key factor in the selection, financing, structuring and monitoring of projects. In terms of sustainability as well as cost and competition aspects, the protection of natural resources and the improvement of resource efficiency is a task of supreme importance for industrialized nations as well as developing and transition countries. Using resources carefully helps to bring about a lasting reduction in dependence on raw materials imports, improve international competitiveness by cutting the cost of energy and materials and relieve strains on the environment and climate. As for producers, resources can be spared through process optimization and better product design. The financing of suitable investments plays an important part in exploiting this potential and promotes innovation that offers significant economic opportunity for the partner countries.

A Holistic Approach

KfW Entwicklungsbank takes an essentially holistic view on the broad issue of environment, natural resources and climate change. Projects aimed at conserving natural resources (biodiversity) and specifically tropical forests have been supported for the purposes of climate protection and biodiversity conservation for many years, but so too has, for instance, the use of recycling in order to save raw materials and energy. This approach is applied across many countries and sectors and reaches public institutions, municipalities, private households as well as SME. Furthermore, all projects seek to comply with environmental and social standards.

Studies have shown that a sustainable economy – whatever the degree of industrialization – must be resource-efficient. This applies not only for energy, but also for metals and many other industrial minerals. These studies have also revealed that there is considerable potential in efficiency gains that can be delivered relatively easily. In Germany, for instance, this is true in sectors such as the manufacturing of metal products, plastic goods, and equipment for electricity generation and distribution, the chemical industry and the construction sector (KfW 2009 ▸). Options include resource-efficient product design, the substitution of scarce resources, the optimization of existing production processes, the reduction of waste and recycling of materials if waste reduction is not (or no longer) possible.

Energy – A Key Factor in Resource Efficiency
This article is directed at resource efficiency in SME and is focused particularly on energy efficiency (EE). Special emphasis is given to individual projects and programs that have been run by KfW on behalf of the German government for the purpose of financing environmental protection and in particular energy efficiency in the partner countries. The core aim of these approaches is to contribute to development and to the reduction of poverty by ensuring access to energy and by improving the security of energy supplies. Developing and industrializing countries are expected to see a sharp rise in energy consumption due to anticipated economic growth – but with negative consequences for the environment and climate. The energy sector accounts for a critical share of harmful greenhouse gas emissions and thus is a substantive contributor to global climate change. That is why KfW Entwicklungsbank, working on behalf of the German government, also helps partner countries establish and modify their energy systems. It is precisely SME that play a key role – alongside private households and municipalities – in achieving sustainable and wide-ranging environmental and climate protection goals. In principle, all activities of KfW Entwicklungsbank in the energy sector aim, in dialogue with partner countries and other donors, to make a contribution towards the creation of a suitable economic and legal framework and to promote the acceptance and dissemination of new and efficient technologies and processes by promoting best-practice projects.

Importance of Promoting Energy Efficiency
One of the key factors in environmental and climate protection is dispensing with fossil fuels and avoiding additional energy consumption. Many approaches therefore aim to boost efficiency not only in the generation, transfer and distribution of energy, but also on the demand side, such as in industrial facilities and buildings, striving at the same time for a greater use of renewable energies. Experience has shown that the trade and industry, commercial and services sectors account for a high proportion of total national energy consumption. To give a comparison, in Germany they account for 44%, with energy costs of companies making up some 5% of total costs, although this figure is often much higher in industry. The potential savings are estimated at between 5 and 20%. There is still, though, a gap in implementation among SME at home and abroad (KfW 2010a ▸). Potential energy savings often fail to be exploited because of a lack of qualified personnel and capital. Given such structural obstacles, it is all the more important that promotional and financial instruments continue to be developed and tailored to the needs of partner countries, the particular task in hand and the situation of companies.

Concepts and Instruments

The Spectrum of Energy Efficiency Projects
The projects supported cover the entire range of generation, transmission, distribution and use of heat and power. In electricity generation, financing has been concentrated in particular on projects aimed at improving the efficiency of power stations – examples include the rehabilitation of thermal power stations in China, Egypt and Kosovo – or the cogeneration of electrical power and heat combined with district and local heating networks, but has also been provided for measures to promote fuel substitution, such as diesel and coal with

gas.[1] To reduce losses in power transmission and distribution, grids are strengthened and substations optimized. In addition, systems for consumption-dependent accounting (meter installation and rehabilitation) can create incentives for efficient distribution and usage – with positive effects on consumption on the demand side. With heat transmission and distribution, too, the aim is both to improve storage and to reduce losses by eliminating leakage. Again, incentive systems aimed at reducing consumption and based on consumption-dependent accounting are created.

Large Individual Projects – Programs for a Large Number of Smaller Investments

The financing concepts must be versatile enough to fulfill the requirements of major individual projects as well as those for a large number of smaller investments. An example of a large individual project is the financing for the restoration of the district heating networks in Serbia since 2001: in total, the restored networks reach some 345,000 households, public institutions such as schools and kindergartens as well as 21,000 customers from trade and industry (over 80% of all district heating customers). Another major individual project is the financing of the construction of a modern CHP plant in China and, with it, the installation of a district heating system and other environmental measures such as flue gas cleaning and waste water treatment with the aim of boosting the production of electricity, improving the supply of heat and reducing the emission of pollutants.

Just as important are broad-based packages of measures aimed at increasing the energy efficiency of end users, not only in industrial production, in the service industry and in buildings, but also in private households. It goes without saying that such projects consist of a large number of individual measures: KfW finances projects to promote the efficient use of energy by end consumers primarily through the provision of lines of credit to local banks. This instrument has already proved its worth in domestic support projects and has now become firmly established in many partner countries.

Promotional and Financing Instruments

Environmentally and climate-relevant investment in developing and industrializing countries on behalf of the German government is supported using the instruments of financing and consulting products of Financial Cooperation (FC). This allows projects aimed at boosting energy efficiency, reducing emissions and assisting technology transfer to be financed through a differentiated mix of grants, low-interest loans with long terms (e.g. as development loans, promotional loans, lines of credit) or even equity participations. This spectrum is supplemented by innovative approaches such as fund solutions that also attract investment from the private sector – some constellations (particularly in the area of renewable energies) even allow purely private-sector project financing. There are also a number of special facilities and packages for projects and programs in environmental and climate protection.

The financing terms of FC are always more favorable than those available on the market and depend particularly on the sector or the nature of the project, the performance capabilities of the partners and promotion areas, the economic situation of the given partner country, its state of development, the strength of its

1 For further information about the energy sector see KfW website ▸

foreign trade and the extent of its indebtedness. For its financing KfW Entwicklungsbank uses funding from the federal budget and supplements this with its own funds, which it raises on the capital markets and increasingly allocates at its own risk. This expands the volume of financing and hence broadens the effect of the measures.

Transparency and Effectiveness

To ensure the greatest possible effectiveness, the available funds and instruments are employed in consultation with the partner countries in accordance with principles of transparency and efficiency. The effects of exacerbating local factors (natural events) or international conditions and events (e.g. financial and economic crises) must also be considered. A sustainable support package that is tailored to national and sector needs and capabilities will utilize and strengthen local know-how, indigenous initiative and responsibility and existing development structures and institutions in the partner countries. Many different combinations with varying degrees of concessionality are feasible in principle. For the poorest and most highly indebted countries, grants are the suitable instrument, which is also the case for projects in the field of capacity building. Graduated loan financing takes into account the fact that industrializing countries with high economic growth can obtain credit at near-market terms, while for other countries and sectors the grant element must be greater (KfW 2010b ▸).

It is also important to consider the particular circumstances of the sector and the economic viability of the project. For projects that do not generate any income at all, and the accompanying consultancy programs (studies, development of know-how, technical consultancy, pilot projects), grants are usually required. Where projects generate cash flows, however, or even raise investment themselves in individual sectors, such as through cost savings – a frequent side-effect in the case of increasing energy efficiency – loan financing with a broad spectrum of possible instruments is a possibility.

Because of their relatively shorter terms, subsidized loans are the preferred option in the financial sector. Typical approaches for subsidized loans are credit lines by which loan programs are established for energy efficiency measures in the industrial sector (or also for the promotion of renewable energies), while longterm development loans may, for instance, finance the construction of an efficient waste water network. Differentiating the employment of grants and (concessionary) loans according to these aspects is also intended to mobilize private commitments and capital and prevent private capital being crowded out through excessively high level of subsidization that distorts the market.

Approaches through the Financial Sector of Partner Countries

KfW develops instruments for financing energy efficiency and renewable energies in developing and industrializing countries based on the know-how gained over many years of collaboration with key stakeholders in the financial and energy sectors. It thereby enables partner countries to adapt knowledge and experience garnered from the model of environmental and SME support given by the local banks that has been proven in Germany for decades to their specific situation. It has also introduced the corresponding financial products in credit institutions of the partner countries under its *Banking Facility for Sustainable Energy Finance* approach.

Special Facilities and Initiatives

The special facility set up jointly by BMZ and KfW as the *Initiative for Climate and Environmental Protection* (IKLU) and the *International Climate Protection Initiative* (IKI) of the Federal Ministry of the Environment provide for the promotion of renewable energies and energy efficiency with the aim of ensuring that economic growth is both environmentally and climate-friendly and hence conserves natural resources.

The **IKLU** focuses particularly on climate and environmental investment in developing and industrializing countries, including projects in the fields of energy efficiency, renewable energy sources, environmentally friendly urban development, industrial pollution control, energy-saving mobility and adaption to climate change. EUR 382 million was committed in 2010. The funds are provided in the form of low-interest loans (budget for interest subsidies). One of the particular windows under IKLU is the *Special Facility for Renewable Energies and Energy Efficiency* (known as the 4E facility). This was set up as long ago as 2005 on the basis of the German government's commitment at the 2004 International Conference for Renewable Energies in Bonn. It provides low-interest loans for projects that help to reduce carbon dioxide emissions. The response to the 4E facility, launched in 2005, was so great that the target of EUR 500 million, which had originally been planned for 5 years, was reached after just three years.

Under the **IKI**, revenue from the trade in CO_2 emission certificates that was introduced in the EU in 2008 is deployed on behalf of the Federal Ministry of the Environment in part for international climate cooperation (EUR 120 million in total in 2008). In support of climate-related investment in developing and industrializing countries, funds are provided through KfW Entwick-lungsbank both as low-interest loans (2010: EUR 55 million) and directly in the form of grants for projects (some EUR 14 million in 2010).

For financing investments in energy efficiency, it makes long-term low-interest refinancing and consultancy services for program design and realization available to the partner institutions on behalf of the German government or the European Commission. This allows the partner institutions to introduce a new and innovative credit supply and hence tap into a new client base in the growing market for environmental investment.

The partners for the support programs are local financial institutions, including leasing companies in the partner countries. The partner institutions can thus allocate funding for investment in micro, small and medium-sized enterprises and in housing. This is accompanied by grants for consultancy services to support the introduction of the corresponding lending products and the embedding of these programs within the partner financial institutions. Potential customers apply for funding to the partner financial institutions, which examine the proposed investment projects and carry full liability for the credit risk. Consultants help the partner financial institutions identify potential projects and assess their technical and financial feasibility.

Among the prerequisites for supporting an investment are the credit standing of the funding recipient and the microeconomic viability of the particular investment as well as an energy saving and/or reduction in CO_2, normally of at least 20 percent, as a result of the investment. The effects of these programs are that the end borrowers obtain improved access to finance for their investments. The outcome is the more efficient use of energy, a relative reduction in energy costs, enhanced competitiveness of businesses as well as greater market penetration of innovative technologies. Ultimately, the wide-ranging introduction of such loan products in the banking sector contributes to climate protection by reducing CO_2 emissions.

In collaboration with partner banks in places such as Eastern Europe, Brazil and Chile, such lending schemes have provided low-interest loans for businesses and public-sector applicants seeking finance for investment in energy efficiency and renewable energies and have also helped to establish banking systems.

Fund Solutions for Climate Financing – An Innovative Approach

KfW has already collaborated several times with partners from the political and financial sphere to launch fund solutions for developing the financial sector in partner countries, drawing on the positive experience gained from them to develop new approaches to finance climate, environmental and natural resources conservation. Current examples include the *Green for Growth Fund* (GGF) Southeast Europe and the *Global Climate Partnership Fund* (GCPF). KfW holds EUR 33 million in equity in the Green for Growth Fund on behalf of the German government and has undertaken to invest EUR 78 million of its own and public monies in the *Global Climate Partnership Fund*.

These funds have similar structures to the multi-award-winning *European Fund for Southeast Europe* (EFSE) that was launched so successfully 5 years ago. They are structured funds drawn from funding provided by multilateral and bilateral donors – participating states, international financial institutions – as well as private investors. This also serves to strengthen the coherence of donor activities in the financial sector. The principle is that the funds provide medium and long-term loans to qualifying private and public-sector financial institutions in the target countries – developing and industrializing countries. Partner institutions include local commercial banks, microfinance banks and other microfinance institutions.

These institutions in turn use the resources to finance innovative and wide-ranging – in the relevant country context – environmental and climate protection programs for SME as well as private households and municipalities in the fields of energy efficiency (EE), renewable energies (RE) and greenhouse gas reduction. In individual cases the funds may also finance direct investment for demonstration or pilot projects in the above areas.

Here too, the provision of funding for lending programs is complemented by the financing of consultancy measures for the financial institutions lending the money. Unlike credit lines and other funding approaches, with this innovative financing instrument for international climate protection the fund does not deplete public funds; instead, the funds are used on a revolving basis, allowing the money which is paid back to flow into the fund assets.

This allows the funds to make a contribution towards the comprehensive development and expansion of the market for energy financing in the partner countries. Such funds make it possible to ensure the sustainable, efficient and wide-ranging use of funding for climate protection and energy security. In addition, a 3-tranche model means that public funds can be leveraged to a significant extent by funding from international financial institutions (IFI) and private investors through a PPP structure.

Experience and Examples

Experience with Programs for Financing Energy Efficiency

Acting on behalf of the German government, KfW has run a number of programs in many regions and countries for financing EE in SME. The joint development of the programs with financial institutions in the partner countries, e.g. with local development banks or even newly established banking partners such as ProCredit Bank in Ukraine, allows the desired broad-based effectiveness of the programs to be achieved. The first projects to be financed were in Southeast Europe, but since then there have been similar measures in Asia, Latin America and Africa as well. In some cases the programs are co-financed. This was the case for a USD 20 million lending program in Ukraine, which is being financed through ProCredit Bank energy saving investments and is offered in co-financing with the International Finance Corporation (IFC), a subsidiary of the World Bank.

Banking Facility for Sustainable Energy Finance

In Southeast Europe, for instance, where energy intensity and greenhouse gas emissions are still well above the level of Western European countries, there is still considerable potential for improving energy efficiency and exploiting renewable energy sources. Under the *Banking Facility for Sustainable Energy Finance* approach, suitable financial products are introduced in the credit institutions of the region and financing is provided for investment in energy efficiency and renewable energy of micro, small and medium enterprises and in housing. This ultimately contributes to strengthening the financial sector and, through the wide-ranging introduction of the lending programs, leads to a greater awareness of environmental and climate protection, the more efficient use of energy and a reduction in CO_2 emissions. Typical EE investments by businesses in Southeast Europe include investment in fuel switching, variable-speed drives and lighting (such as lamps and illuminants), the replacement of motors and drives, the modernization of heating boilers and investment in heat recovery and combined heat and power generation. Among typical EE investment in the building sector are the insulation of windows, walls, roofs and pipes, the modernization of heating systems and hot-water boilers and the installation of thermostatic valves and meters (for gas and electricity).

Extending Environmental Protection to SME

The rapid and largely unregulated economic growth in some countries has resulted in a number of environmental problems, e.g. in Latin America and Africa. Companies often lack clean production methods, sewage treatment plants and filters. In many cases, hazardous wastes are not even recognized as such – and if they are, there are not enough landfills for proper disposal. The associated problems are exacerbated if companies operate in residen-

tial areas, where they pose a direct health hazard for the local population. In addition, energy bottlenecks alongside greater energy intensity are an obstacle to economic development. German Development Cooperation has thus long prioritized urban and industrial environmental management and supported the necessary measures through advice, training and technology transfer. If they are to be able to finance essential investment, businesses need financial backing. KfW Entwicklungsbank participates in programs which grant appropriate loans to small and medium-sized enterprises. The aim is to reduce the pollution burden on the environment and the population and to contribute to the conservation of natural resources. In the long term, financing mechanisms are also to be established in order to fund company investments in environmental protection. Such programs are being launched in Mexico and South Africa, for instance. The partner of KfW Entwicklungsbank in Mexico is the state-owned development bank Nacional Financiera S.N.C. (NAFIN), which provides a refinancing line for loans to Mexican commercial banks. This enables the banks in turn to offer low-interest loans to SME for environmental investment projects. Additional consultancy services are also financed. Local consultants both support NAFIN in marketing and training for the Mexican banks and help the companies themselves to identify the necessary investment measures and complete the loan applications. Similarly, in South Africa long-term credit lines have been provided for partner institutions in order to facilitate the promotion of EE and RE investment in SME, public institutions and private households and thereby make a contribution to cutting energy demand and reducing carbon dioxide emissions.

Promotion of Green Technologies within IKLU

Under the BMZ global *Initiative for Climate and Environmental Protection* (IKLU), KfW supports environmental investment, particularly by SME, through long-term low-interest loans. SME make up 95 per cent of private businesses in Central America and are therefore a key factor in the creation of jobs. At the same time, however, free trade agreements and the economic crisis have put them under increasing competitive pressure, but they have only limited access to credit for essential investment, such as in environmental and climate protection. Industrial plants, the transport sector and energy production pollute the air, water and soil with their often inadequate technologies. The need to finance green technologies – whether on site in the factories or nationwide to meet the constant rise in energy demand – is great. In El Salvador, for instance, the national development bank is now providing support to SME for financing urgently required investments in industrial pollution control, the use of renewable energy sources and energy-saving measures. The average size of the individual loans is USD 1 million. The supported companies also obtain essential technical and business management advice.

Cross-Border Support

Germany is also concentrating its support on cross-border projects. On behalf of BMZ, KfW is supporting the Central American Bank for Economic Integration (BCIE). Through national financial institutions, BCIE finances investment by local businesses in El Salvador, Guatemala, Honduras, Costa Rica and Nicaragua (Panama is also planned) in environmental protection and improving energy efficiency. In December 2010, KfW was the first European financial institution to sign a mandate agreement with the

EU as part of its new *Latin American Investment Facility* (LAIF) initiative. This provides for a grant of EUR 3 million to promote renewable energies and energy efficiency in SME in Central America.

Experience and Success Factors

There is enormous potential for investment in energy and resource efficiency in the partner countries. Climate and environmental damage, dependence on expensive resources and rising energy prices alongside high energy intensity are a drag on development and require considerable additional investment, particularly in production technology and energy efficiency in the private and commercial sectors. It is crucial to design programs that have a broad effect if energy and resource efficiency and environmental protection are to pay off for the majority of small and medium-sized enterprises. In addition to major individual projects, support programs such as those involving the financial sector capitalize on the many years of experience gained by KfW in collaboration with key stakeholders in the financial and energy sectors of the partner countries and its knowledge and experience in domestic promotion. This is clear from the results in Southeast Europe, the "pioneer region" of KfW for this approach. One of the central questions is how these emerging environmental financial markets can be established permanently as a business model for the institutions in the partner countries. The typical products – credit lines and fund solutions for refinancing the partner banks as they develop programs to promote EE investment in SME (and also for private house-holds and municipalities) – have proved to be very suitable for general promotion because they offer the possibility of standardization and hence a broad impact. The individual loans to end customers are characterized by low volumes. Although these may not be attractive to major financial institutions, a large number of smaller investments can have a very positive impact.

It is also clear that the provision of advice both to partner banks in marketing the programs and training bank staff and to companies in identifying investment measures and preparing the loan application is vital. This applies in partner countries as well as domestically as described above. A key element is that the local institutions must have the means of raising customer awareness of the issue and an infrastructure that allows small-scale measures. The requirements for lending have been set out already – energy savings of at least 20% are normally expected. In return, the partner institutions report back on the information received about the actual energy and CO_2 savings. The underlying models must be simple if prohibitive costs are to be avoided and the products designed in such a way that they also function for small-scale measures. The availability of such loans is an incentive for SME and private individuals to invest in modern, environmentally friendly and energy-efficient equipment. This will enable economic development and an expansion of production capacities while at the same time preserving scarce resources, which will in turn create markets for green technology and promote low-carbon development. Both funds and credit lines intend reporting and monitoring of the investments.

Conclusions

The financing approaches set out above have long proven their worth not only for the promotion of energy efficiency in particular, but

also for the objective of supporting SME and environmental protection in economic development in partner countries. They should also have a positive impact on resource efficiency in the broader sense (not just considering energy efficiency, but also materials efficiency), although they have not so far been specifically designed with this in mind. In the experience of KfW Entwicklungsbank, the key is to adapt the financing instruments for environmental, natural resources and climate protection to the vastly differing needs and demands of countries and sectors. A mix of grants and (publically granted) loans allows the limited public funds to be employed efficiently and effectively and can – particularly if combined with innovative approaches such as the fund solutions outlined – also lead to an increase in funding by attract-

Experience from domestic promotion is transferable

The special facility set up jointly by BMZ and KfW Experience from the promotion of energy efficiency in Germany demonstrates that it is important to assist SME at an early stage in identifying possible savings potential in terms of energy and resources, and in calculating the potential for cost savings. This is indicated by the *Special Fund for Energy Efficiency in SME* program that KfW set up in 2008 on behalf of the German government. The fund comprises energy efficiency advice and provides focused support for SME in Germany to help them increase their energy productivity. Many investments relate to buildings (shells, heat supply, lighting), but they also concern process and production-related measures such as heat recovery and the use of compressed air, always preserving the primacy of the functional capability of the production processes and the quality assurance of the products (KfW 2010a ▸).

Evaluation of the program shows that participating companies save costs and improve their competitiveness – the energy and cost-saving potential is normally between eight and twenty percent – and thereby make an important contribution to efficient climate protection.

The energy efficiency advice provided in the period from the start of 2008 to mid-2010 has yielded EUR 666 million in energy saving investments. This compares with an annual energy cost saving of EUR 122 million (IREES/Fraunhofer ISI 2010 ▸). The great majority of the supported companies recommend the program. Just how important the incentive is that the support program offers is indicated by the fact that, in the absence of a grant, only nine percent of the companies questioned would have sought energy efficiency advice. The survey also reveals that the integration of multipliers (in Germany these are chambers of industry and commerce, energy agencies and other institutions) has proven its worth.

DEG, the German Investment and Development Company, a member of KfW Bankengruppe, offers its clients from the manufacturing industry a similar approach: experienced energy specialists go on site to analyze production systems and processes and highlight any opportunities for waste heat utilization and the use of new technologies. If the companies decide to invest in improved energy use, DEG can step in directly as financier.

ing private capital. Given the background of limited public resources and the enormous challenges, attention in the future will focus even more on the efficient use of funds provided in loans, the scalability of the instruments, evidence of the effectiveness of the support instruments, greater speed of implementation and the international coordination of different promotional initiatives.

It is important both for major individual projects and for the intended broad impact of support programs that the relevant political and economic conditions, particularly in the financial sector, create the right incentives to ensure the greatest possible effectiveness and the efficient use of financial resources. Local banks in particular can strengthen demand for investment in environmental protection and resource efficiency. In addition to favorable refinancing terms – through credit lines or funds – there needs to be accompanying advice so that they can establish themselves as green, environmentally friendly institutions. Staff training helps to identify the potential of such investments and to calculate the impacts on climate and environment.

Only if the local institutions are convinced of the investment program benefits it will be possible to convince customers that investment in environmental protection and energy efficiency is worth it since they can save money by cutting their use of energy and resources and obtain economic opportunities in addition to the environmental effects. That requires not only that borrowers are given advice and support up front, but also that the investment is sufficiently firm. Monitoring and reporting are also important if the programs of the banks are to be optimized on an ongoing basis.

With a view to sustainability, the aspects of environment, climate and resource efficiency should be considered in the context of development. What is needed are framework conditions that set the right incentives in order to generate stimulus for environmentally and climate-friendly growth. They must also help to ensure on the one hand that the efficiency gains and associated cost savings are not negated by at least as large increases in resource consumption resulting higher CO_2 emissions and, on the other, that renewable energies and green and environmentally friendly technologies are used to a greater extent.

2.3 Tapping Resource Efficiency Potentials in SME through Training and Consultancy Services

Relevance of the Approach

Small and medium-sized enterprises (SME)[1], particularly in developing countries, are considered **limited in their capacity** to quickly adapt to new challenges such as those stemming from:

- Tightening of legal requirements towards the environmental impact of production processes and products,
- Increasing consumer demand for products and services which are demonstrably environmentally and socially sound,
- Demands of international customers for adoption of certifiable management systems,
- Competitive pressure resulting from technical progress, increasing production efficiency and intensified international integration of production,
- Requirements from international (environmental) agreements, and
- Rising costs of inputs (raw materials, energy).

The limited response capacity of SME, especially with regard to resource use and environmental performance can be attributed to weak management, lack of qualified (technical) personnel, outdated technical equipment, inefficient processes, weak capitalization, and limited access to loans as well as innovative know-how and technologies.

There is a general consensus among private and public sector stakeholders that attenuation of the problems that SME face is reliant on **external support**, for instance:

- Informational (incl. methodological know-how) – consultancy and training programs which aim at strengthening personal and organizational capacities in a broad range of technical and management issues,
- Technological – facilitation of technology transfer and related services,
- Financial – preferential loan conditions and venture capital (equity participations).

In the past, all respective national and international promotion programs started from the implicit assumption that the decisive bottleneck for SME's economic, environmental and social performance was **insufficient information**. Hence, most of the consultancy and training programs on Quality and Environmental Management, Business Development Services, Innovation Management, etc. concentrated on 'what to do'. This led to familiarizing SME in developing countries with **international best practice**.

Over the years, the content of programs in development cooperation have reflected the most up-to-date environmental policy and management practices in industrialized countries:

1 The term SME usually refers to companies which count 10 - 50 (or up to 100) employees (small) or between 50 (100) and 250 (or 500 employees) (medium). The definition also depends on the sector and the specific characteristics of local markets as in countries like China a company with less than 1000 employees might still have to be considered as small. As an additional criteria turnover is looked at where according to the EU definition small companies would have a turnover of less than EUR 10 million and medium sized less than EUR 50 million.

- In the 1980s and 1990s **technical consultancy on end-of-pipe solutions** for companies towards meeting the legal requirements and standards of **environmental command and control** prevailed. Progress was often measured by environmental investment.
- In the mid 1990s, following the perceived limitations of command-and-control approaches, subsidized consultancy for the implementation of **voluntary management systems** according to ISO or EMAS (European Management and Auditing Scheme) were being offered. A self-dependant, significant and continuous improvement of the company's environmental performance was expected from embedding **systematic observation of environmental protection** into the company's management system.
- SME in developing countries have since become a target for **material and cost saving efforts**. Process-integrated approaches such as Pollution Prevention, Waste Minimisation, and Cleaner Production have tried to optimize material and energy flows and have started to discuss 'how to achieve' environmentally sound and cost-efficient production.

In 1996, as response to the decisions of the UNCED conference and discussions about the adequacy of prevailing programs on environmental management to SME needs,[2] the German Ministry for Economic Cooperation and Development (BMZ) commissioned a pilot project which assessed and further developed market-oriented concepts tailored to the specific conditions of SME (Kürzinger 2004a). The resulting PREMA® method (Profitable Environmental Management) combined the prevailing economic-environmental win-win approach with a management approach that helps companies to find answers on 'how to implement' cost effective and sustainable changes, addressing, simultaneously, safety and risk issues.

Concepts, Instruments and Experiences

Cleaner Production – Implementing Process-Integrated Pollution Prevention

The term *Cleaner Production* (CP) had been defined by UNEP in the 1990s as "the continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment" (see UNEP website ▸). This definition has been used since in all programs related to the promotion of cleaner production.

CP has been systematically promoted and subsidized by UNEP/UNIDO as well as some bilateral donors (Scandinavian countries, the Netherlands, Austria, Switzerland), particularly through the creation of *National Cleaner Production Centres*[3] in an increasing number of developing countries. These centers provide technical advice and other services to companies in their respective geographical areas. As a consequence, the concept has become predominant in the development cooperation community and serves as a generic term for varying technical and methodological content of process-

2 For example in the Journal of Cleaner Production: Applications of Industrial Ecology. Vol. 12 (2004), Issues 8-10.
3 For an evaluation of the performance of the NCPC see Grütter/Egler 2004 or UNEP/UNIDO/SECO 2010 ▸ .

integrated pollution prevention measures. In recent years CP has been rebranded as *resource-efficient and cleaner production* (RECP).

CP aims to minimize waste and emissions of production processes as well as promote organizational and technological improvements. This is achieved through various options (Yacoub/Fresner 2006):

- Analysis of material and energy flows,
- Use of indicators and monitoring instruments,
- Substitution of raw materials and auxiliary inputs,
- Increase of useful life of auxiliary materials and process liquids,
- Reuse of waste (internal or external), and
- Introduction of new, low-waste processes and technologies.

According to a UNEP publication from 2004, CP can also mean the application of any known method or instrument provided that it follows a 'produce more with less' approach (UNEP 2004 ▸): from mass balance analysis, risk analysis, engineering design, life cycle assessment, and full cost accounting to environmental management systems or even ISO 14001 (Redda 2009 ▸).

The classic CP audit approach consists of seven steps (planning and organization, pre-evaluation, evaluation, develop and screen measures, feasibility analysis, implementation of measures, sustaining CP), usually executed by an external consultant (Dietmar/Hicks 2007). It is supported by a CP team from inside the company and has a duration of 8 to 12 months. To a large extent, this approach tends to result in company compliance with environmental legislation.

This is also true for another, slightly different approach called *Ecoprofit*. It was developed as *Ökoprofit*® in Austria and has been widely disseminated throughout German-speaking countries. In spite of a number of similarities, it has modified the classic CP application in various ways:

- Stressing the economic impacts through documentation and marketing of convincing case studies,
- Addressing sustainability after the end of the program, through partnership with a regional 'host', e.g. municipalities and local institutions who pay license fees, trigger subsidies for the program, and will promote replication,
- Choosing a group approach which combines several one-day workshops with short on-site consultancy,
- Controlling quality of consultants and partners by a certification scheme.

German development cooperation has supported the dissemination of CP in several Asian countries and has cooperated on specific issues with some Cleaner Production Centres in countries such as Indonesia, Egypt and China.
CP has been very helpful in putting resource efficiency on the agenda of major stakeholders. However its impact probably would have been even greater if the thousands of case studies and pilot projects from the 15 years of donor sponsored CP programs had been documented and disseminated in a systematic manner thus enabling the NCPCs and their clients and partners from the business sector to scale-up application of CP in SME.

Ecoprofit in India ASEM program

Ecoprofit was integrated as a service into the GIZ-ASEM Program ▸ for companies in the National Capital Region of India. It had the objective of setting up a model that would strengthen industries economically while simultaneously improving the ecological situation of the region through the use of environmentally friendly technologies.
It was implemented in 2005-2006 in 9 manufacturing industries including the automotive, confectionary, electrical appliances, and electroplating through the following steps; these industries paid two thirds of the training costs (one third was subsidized by GIZ-ASEM):

- Technical presentations on different topics of CP in 8-10 modular workshops for company teams,
- On-site consultation and follow-up visits by international and national experts on specific topics to identify, assess and implement the technical options, and ultimately evaluate results,
- Award of the ECOPROFIT certificate to company teams after verification of satisfactory economic and environmental benefits:
  - Creation of 236 options for improved resource management: energy (36 %), auxiliary (21 %) and raw materials (4 %) , water (21 %), waste (5 %), waste water (8 %) and hazardous waste management,
  - 16 % energy savings only by substituting air compressors with more efficient ones,
  - 21.5 % less ground water consumption,
  - 450 t less CO_2 emissions.

ISO 14001 – Continuous Improvement through an Environmental Management System

The International Standard Organization (ISO) defines the elements of an effective voluntary environmental management system (EMS) as one which aims at continuous improvement of a company's environmental performance in all types and sizes of business and under diverse geographical, cultural and social conditions. It can be self-declared or certified by accredited third parties.

ISO 14001[4] is typically implemented over the period of a year (ranging from 8 to 18 months), and consists of 5 core components:

1. Adoption and publication of an environmental policy which is binding for management (plan);
2. Establishment of a planning process, which analyzes all relevant environmental aspects of production, relevant legal requirements, and defines clear objectives for environmental improvements, as well as the necessary environmental program (plan);
3. Creation of an implementation system which defines responsibilities, training for staff, internal and external communication of the EMS, a system for documentation and control, the processes for operational control of environmental impact as well as the preparedness for prevention and management of contingencies (do);
4. Establishment of a monitoring system which registers progress as well as the documentation of the EMS and audits (check), notifies of non-compliance, and envisages corrective and preventive measures;

4 For further information see ISO website ▸

5. Review of the EMS in proper intervals, in order to assure its continuous improvement (act) by correcting and improving plans as well as learning from mistakes.

Nearly 75 % of ISO certified companies are located in industrialized countries (the bulk in Japan, USA and Europe). Their interest is influenced either by the attractiveness of international certification, the eventual rewards of environmental policy or requirements by clients. The number of ISO certifications in developing countries has increased rapidly primarily due to Chinese companies and their international clients who consider certification as part of the overall quality and environmental management along the supply chain. Around 20 % of certified companies lie in Asian developing countries; China accounts for 3/4 (15 %) of these. Latin America counts for 3.4 % of total ISO certifications, with Brazil contributing to more than half (2 %). African and Arab countries account for only 1 %, with South Africa holding nearly 1/3 of these certifications.

ISO certification brings benefits to companies, such as improving their corporate image, increasing their competitiveness, and fostering compliance with legal and market requirements. However, it is hard to find comprehensive and quantitative assessments of its actual impacts on resource efficiency and economic performance, due to the following reasons:

- Lack of a specific mechanism within ISO to evaluate effectiveness; there is no obligation of companies to publish results in a generic format which includes cost effectiveness;
- ISO certification only attests the conformity of EMS with the ISO standard, not good environmental performance or resource-efficient production; no minimum performance is required for certification;
- ISO will not show whether the company is fully compliant with environmental legislation, as the standard only requires proof that the company knows all relevant legal obligations, keeps itself informed, and monitors and documents (non)compliance while implementing the EMS.

German bilateral cooperation has joined the efforts of the international donor community, and offered ISO 14001 training to SME by integrating ISO as a Business Development Service into private sector promotion projects, e.g. SME program in Vietnam, environmental programs in Algeria and Tunisia, integrated environmental and quality management in Central America, and the classical consultant training of auditors in Asia.

ISO certification is an interesting instrument for SME in developing countries, when it is done bottom-up, striving for quick increases in resource efficiency by applying Good Housekeeping, systematically quantifying and documenting the economic and environmental results, and mobilizing the implementation capacity of the company system. A method to turn the certification process in a more user-friendly one is the *ISO/EMAS easy group consultancy method*, which reduces documentation requirements and the costly external consultancy to a minimum.[5]

5 EMAS easy is designed with small and micro businesses in mind with the maxim '10 people, 10 pages, 10 days'. It is based on the Eco-mapping© concept, where the business is mapped – in terms of both location and internal processes – to identify its environmental aspects. Using simple and sequential tables and prompts, smaller businesses can develop an Environmental Management System (EMS) and either register for EMAS or achieve certification to ISO 14001. For further information see EMASeasy website ▸

Results from ISO 14001 application in Nouvelle Conserverie d'Algérie Rouiba

1 of 7 SME in a GIZ sponsored program, 2006-07

Results (Rahmani 2010):
- Better management of environmental impact of the company
- Introduction of clean technologies
- Cost savings through
  - 16% less water consumption (equal to consumption of 6 months of production)
  - 19% less gas consumption (equal to consumption of 5 months of production)
  - 17% less electricity consumption (equal to consumption of 2 months of production)

Results from ISO 14001 application in Tunisie Lait S.A.

1 of 10 companies in a GIZ sponsored training and coaching program

Results [6]:
- Introduction of an environmental 'culture'
- Improved brand image
- Savings on energy consumption: electricity and fuel costs reduced by EUR 30,000/year
- Savings on water consumption: reuse of 1000 m^3 – saving 18.000 EUR/year; water cost/kg of product reduced by 34 % (year 1), 7 % (year 2) and 8 % (year 3)
- Zero environmental fines in 2003 due to a EUR 800.000 wastewater treatment plant
- Savings on packaging material
- Certification was achieved after 18 months

PREMA® - Incentivizing Change Management

PREMA, which stands for *Profitable Environmental Management*, was developed in cooperation with local partners in over 30 countries as a training approach to increase resource efficiency in SME. PREMA has been applied in different contexts and development cooperation programs and is disseminated as a market-oriented service through the international trainer and consultant network PREMAnet ▸ which is a non-profit organization under German law. Similar to other approaches PREMA allows SME to reduce environmental impacts and increase resource efficiency while substantially cutting production costs and enhancing economic competitiveness. Moreover, it helps them to:

- Implement measurable sustainable change, and increase problem-solving capacities by involving employees from different departments and hierarchies,
- Acquire a new holistic view on the company system by applying modern management methods and integrate new tools into everyday practice,
- Continue learning in the context of the PREMA company network after the training,
- Take advantage of group-oriented coaching for realization of resource efficiency measures.

6 For further informationsee CITET website ▸ . Unfortunately the documentation in German cooperation projects reflects the habit of ISO consultants to mostly document compliance with procedures and not also systematically quantify impact on resource efficiency and production costs and savings, so there are no similar results available from other companies.

All PREMA applications share the same **four basic conceptual elements** and can be combined depending on the needs of different target groups or the institutional partners' context (see Fig. 1–3):

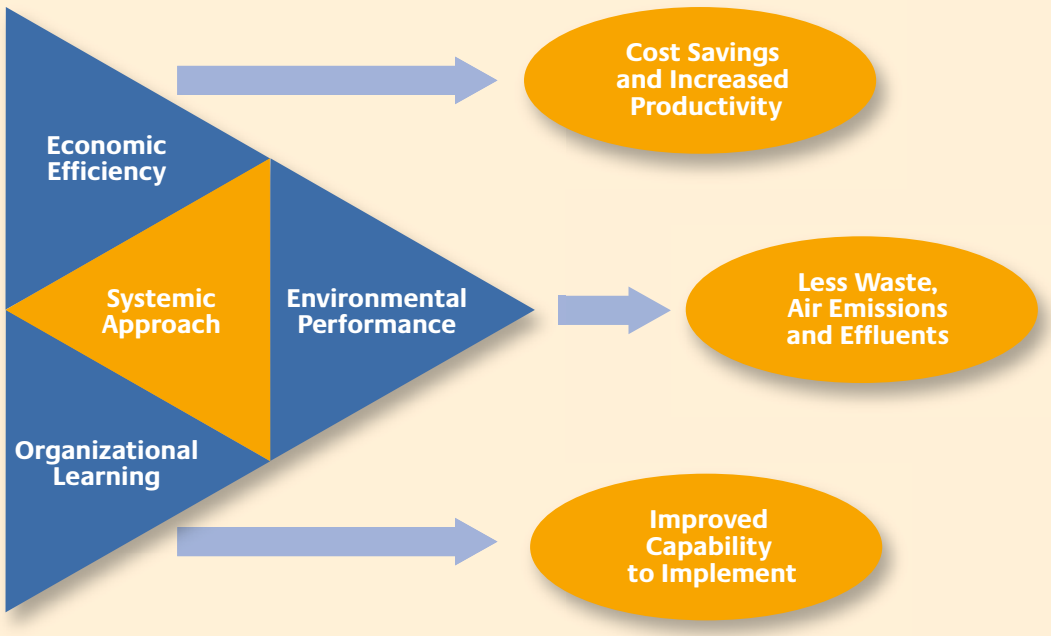
1. The **systemic approach** to realize a triple win+. It gives the motivation for change to the company (the + means adding risk/safety issues and/or social aspects).

2. The **Non-Product Output (NPO)** concept. It helps to identify the blind spots in resource efficiency.
The concept combines elements from quality, environmental and change management. NPO encompasses all material, water and energy resources which are used in the production process, but do not end up in the final product desired by the client. These 'blind spots' are normally overlooked or not quantified, but often represent between 10 and 30 % of total production costs. Based on experience with SME, reducing NPO throughout the production process typically raises profit by 1 to 3 %.

3. The **Cycle of Change**. It is a 'road map' to mobilize energy in the SME system for effective implementation of measures and continuous improvement.

4. **Interactive training methods** provided by highly qualified facilitators and based on proven concepts of andragogy, group dynamics, and tapping of tacit or implicit knowledge of company staff to assure effective learning.[7]

Figure 1: The systemic approach



7 The triple win approach reduces costs and environmental impacts while building capacities to implement change (Kürzinger/Miller 2009).

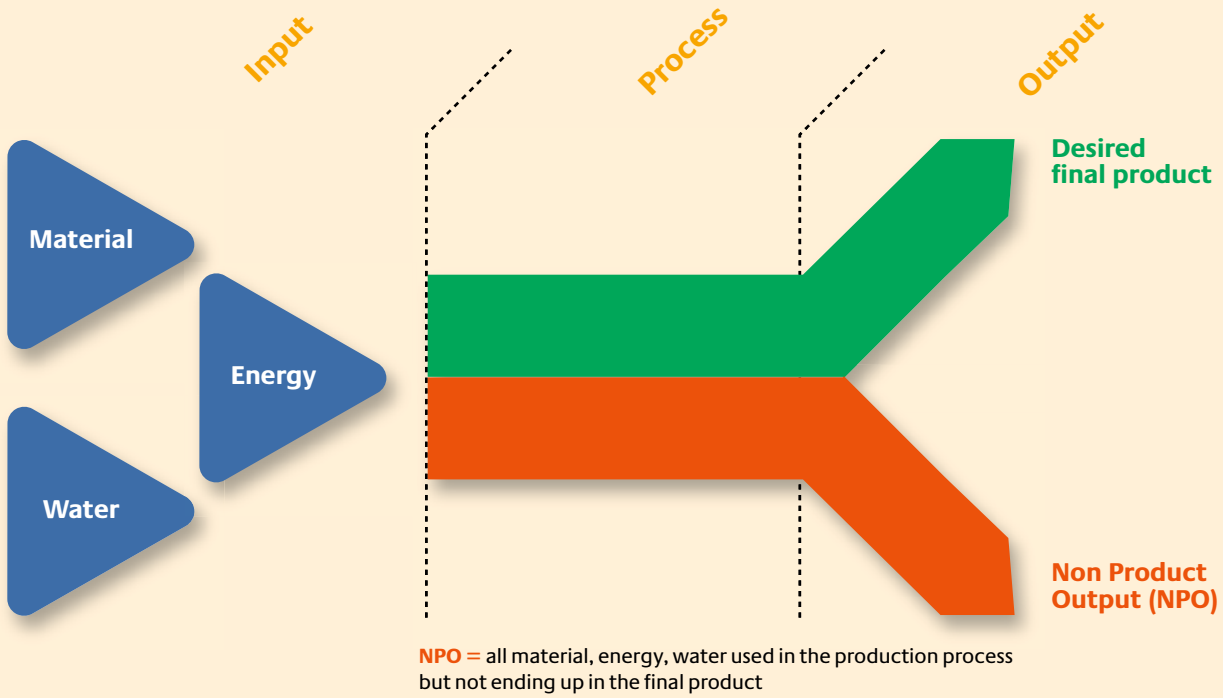


Figure 2: The Non-Product Output (NPO) concept

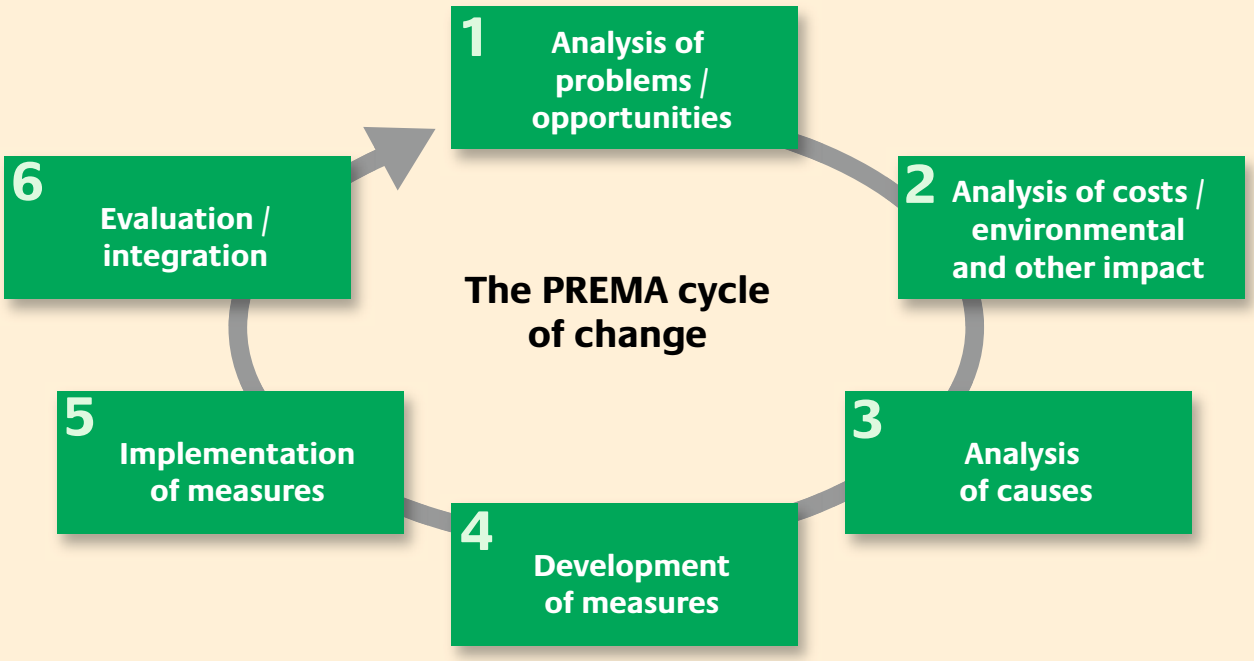


Figure 3: The Cycle of Change.

Training Module	Target Group	Partner Countries
Resource Management RMM® (3-4 days)	micro, small, medium enterprises	based on CEFE method[10] applied in Latin America, Sri Lanka
Good Housekeeping GHK® (4-5 days including company application)	for all (including certified) companies with improve-ment potentials	in 40 countries on all continents (except Oceania) for groups of up to 10 companies
Environment-oriented Cost Management[9]; EoCM® (depending on size 4 days or up to 5 sub-modules of 3 days each, supplemented by up to 4 on-site application events)	medium to large companies who are open for change management; small companies when combined as PREMA with GHK and/or RMM	Zimbabwe, Nigeria, China In combined projects also in China, Indonesia, Maghreb, Latin America, Europe
PREMA plus gap analysis (4-5 days plus on-site consultancy depending on gap)	companies who have applied at least 1 module and seek certification	Vietnam (in combination with GHK), Morocco, Algeria

Together with coaching, on-site consultancy and the PREMA company network, these methods are immediately transferred into everyday practice by increasing problem solving capacities of involved staff and stimulating positive attitudes towards learning and change. The **four basic training modules**[8] of the PREMA product family can be adapted by experienced trainers to different target groups and specific needs, applied as stand-alone training, or combined to a maximum of 4 modules. The *Good Housekeeping* and *Environment-oriented Cost Management Modules* are those most broadly applied. All modules include company application elements, at least two moderated network meetings and follow-up consultancy on site.

Impacts and Benefits of PREMA

Some 600 case studies from more than 30 countries in which PREMA applications have been facilitated show that:

- Companies typically implement 1 to 3 measures per training event;
- Average net **cost savings** per year through reduction of NPO is USD 20,000 per implemented measure;

8 Additional modules have been developed with partners: Chemical Management (GIZ Chemical management Guide for SME ▸), Profitable Social Management (GIZ PSM Module ▸), Profitable and Climate-friendly Management (GIZ ProfitCliMa, see CSCP website ▸).

9 EoCM is based on a method called Environmental Cost Management (Fischer et al 1997), but was substantially adapted to developing countries conditions, needs of replicability and cost-effectiveness, e.g. by group approach and an organizational development component (Kürzinger 2004b).

10 CEFE (Competency based Economies through Formation of Enterprises) is a set of training instruments using action-oriented and experiential learning methods to enhance business management and personal competencies of future or existing entrepreneurs supported in many countries by GIZ. For further information, see cefe website ▸

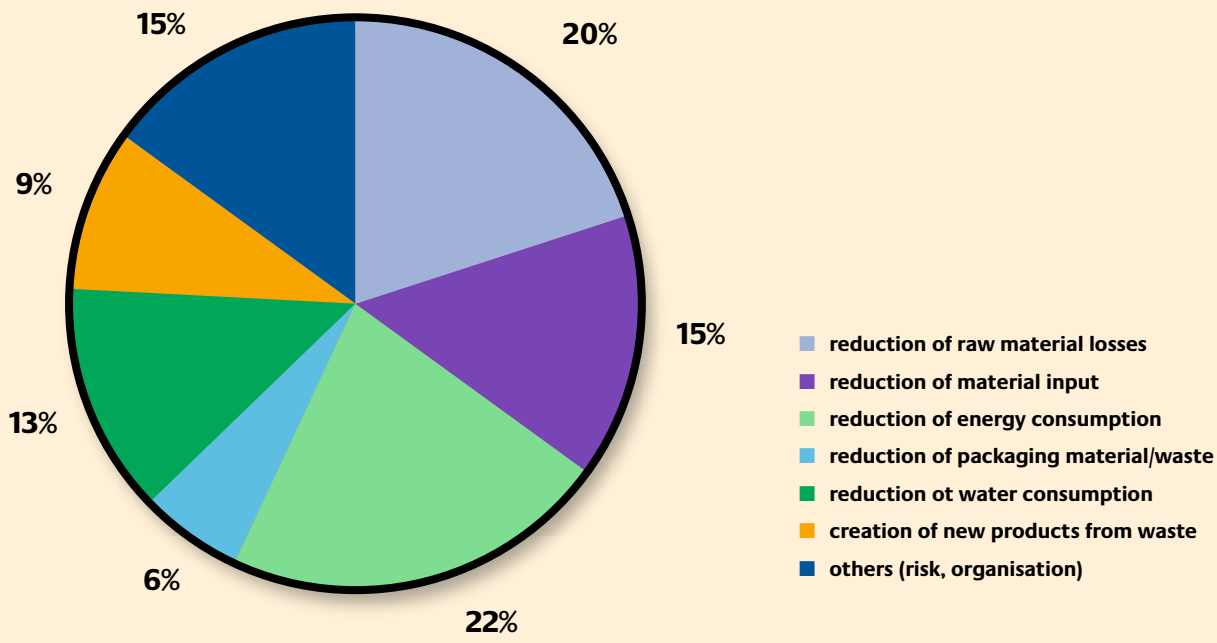


Figure 4: Type of PREMA measures yielding Triple Win+ benefits for resource efficiency (Basis: 296 case studies)

- **Payback period** is usually short enough to be attractive for implementation: for 25 % of the measures, the payback was immediate; for 30 % of the measures between 1 and 6 months were needed; only 13 % of the measures implemented had payback periods over 12 months (usually larger companies or 1 year EoCM programs);
- **Investment** required is moderate: 25 % of the measures required no investment, 35% less than USD 1,000, 12 % between USD 1,000 and 5,000, 4 % between USD 5,000 and 10,000, and 16% more than USD 10,000 (usually EoCM measures);
- Increased **resource efficiency** is considerable due to the application of the NPO concept [11] supported by the systemic approach and coaching of the change process: 85 % of all measures undertaken by nearly 300 companies in 22 countries have improved resource efficiency either by more effective use of raw materials and packaging, reduction of unqualified products, or by turning former non-product output into new products.

Regardless of many success stories an overall self-evaluation of PREMA has shown some short-comings in the application of the method:

- The challenge to qualify PREMA trainers in the required management, facilitation and coaching skills, in addition to the new methodological elements, as this means to qualify them in a short time, at least selectively, in new 'professions';

11 In Germany, the NPO concept has been further developed methodologically and technically to a complex Zero Loss concept (Fischer et al. 2004 ▸)

- Problems in convincing local partner institutions of the economic and organizational benefits that can be achieved by investing in coaching of application processes;
- The limited structural impact as long as PREMA is only added to projects and programs with other major objectives and not mainstreamed as an integrated resource efficiency approach;
- Inability to sell PREMA services on a cost recovering basis by PREMAnet members as long as competing programs are fully subsidized (SME will always take the free of charge product, even if it is less cost effective);
- Difficulty in receiving recognition within markets where other tools are well established and wholeheartedly supported by important international institutions.

Conclusions

In addition to specific lessons learned by German development cooperation from the application of different concepts, some general conclusions can be drawn:

- None of the training and consultancy concepts has so far reached **massive dissemination** in spite of many successful pilots and convincing cases studies. Only a dissemination strategy which is applied in the context of a minimum of legal requirements on environmental performance and takes into consideration economic incentives for increased resource efficiency as well as due certification of training and consultancy services can provide sufficient stimulus for SME to become interested and queue up for capacity building measures on resource-efficient production.
- No mechanism so far exists, which can critically review and compare results of the main approaches in terms of respective **cost effectiveness**. As SME are interested in quick economic results, all concepts have to take this into ac-count. In light of the limited funds of development cooperation and the lack of preparedness by SME to pay for such services, this question becomes ever more important if the impact of all these approaches should advance beyond pilots.
- As long as programs which create considerable economic benefit are heavily subsidized, no sufficient **market demand** for the provision of these services by trained local consultants can be created. The reflection on alternatives to motivate companies (e.g. resource efficiency labels, certificates for improvements and other non-economic incentives) to apply cost-effective measures should be intensified by concerned stakeholders in all countries. At the same time a discussion about the basic shared principles of delivery mechanisms of different approaches would be helpful.

The fact that all approaches are aiming at similar objectives, but using different ways and means could provide a chance to learn from each other and eventually complement each other, thus creating **synergies**. PREMA could lay a base for increased resource efficiency in the bulk of SME through triple-win measures. CP could then help to fully exploit company-specific technical improvement potentials. Finally, ISO or EMASeasy could provide certification of an effective environmental (and resource) management system at a modest cost.

EoCM® implementation in China

The starting point was that only 2 % of the companies required by the National Cleaner Production Law to apply a CP audit had done so by 2004. Hence, the GIZ project supporting the Zhejiang CP Centre proposed EoCM as a cost-effective method for groups of companies to achieve a triple-win, especially cost savings through reduction of Non-Product Output (NPO), and at the same time to comply with CP legal requirements.

Teams from 7 pilot enterprises went successfully through 4 training sessions, 4 on-site visits and 3 network meetings within 7 months. The teams combined personnel from accounting and production to enhance the mutual understanding of cost and production issues while identifying NPO flows, assessing their impact and causes, and developing measures for integration into an Action Plan, the basis for implementation.

The measures implemented at the end of the program resulted in savings of USD 1.1 million, i.e. 5% of total production costs. Additional measures for implementation after the program finished were to save another USD 2.1 million. More than 50 % of the measures saw a full return on investment in less than a year. Resource consumption was considerably reduced, e.g. up to 45 % of water, and up to 22 % of electricity, thus reducing coal combustion-related sulfur oxide, nitrous oxide and dust emissions. Waste water was also reduced by an average of 15 %. Among the *organizational benefits* were the acquired problem-solving methods. The assessment of consumption also served for defining baselines and improvement scenarios, award systems assured continuous improvement and motivation of staff to participate in further actions. The companies passed the CP audit. In comparing EoCM and CP the advantages of EoCM lie in the use of economic drivers to motivate companies to increase resource efficiency and comply with regulation. Since the pilot program, PREMA-EoCM has been marketed through the local PREMAnet trying to charge cost recovering fees.

2.4 Capitalizing on Synergies: Linking Companies towards Resource Efficiency

Paving the Ground for inter-company Cooperation

Industries play a central role when addressing resource efficiency. One reason for this is the enormous amount of material and energy used within their production processes. What is more, considerable portions of these inputs are either not incorporated into the final product or simply wasted. The frugal use of resources is one of the potentials inter-company cooperation intends to tap by creating synergies between companies (Cohen-Rosenthal 2003 ▸).

Ideally, cooperation in different areas of production will lead to a collective benefit which is greater than the sum of individual benefits each company would have realized while only optimizing their own individual performance. Various options of company cooperation are subsumed under the concept of *localized industrial symbiosis* [1], one element of eco-industrial development (EID)[2].

To foster resource-efficient production processes, companies may cooperate in three types of activities (Chertow 2007):

- **Reuse of by-products**, e.g. by exchanging firm-specific materials which substitute purchased commercial products or raw materials;
- **Sharing of utilities** such as the pooled use of resources, e.g. energy, water and wastewater or joint use of a boiler house;
- **Joint provision of services**, such as fire service infrastructure, means of transportation, training and staff canteens.

Cooperation can have different forms and intensity. The following list (Cohen-Rosenthal 1999) gives more detailed examples of cooperation options, in line with Chertow's threefold range of activities for companies oriented towards EID (see Figure).

Scientific literature stresses one or more of the following benefits over traditional, unlinked industrial operations:

- Reduced use of raw materials as resource inputs;
- Reduced pollution;
- Increased energy efficiency;
- Reduced volume of waste materials for disposal (with the added benefit of preventing disposal-related pollution);
- Increase in the amount and types of process outputs that have market value.

1 Chertow defines *industrial symbiosis* as the engaging of „traditionally separate entities in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and by-products. The keys to industrial symbiosis are collaboration and the synergistic possibilities offered by geographic proximity" (Chertow 2000: 314). New definitions like the one from Lombardi and Laybourn try to redefine industrial symbiosis by widening the scope and not limiting industrial symbiosis to physical exchanges. They place more emphasis on industrial symbiosis as a positive source of innovation and knowledge transfer and see the aspect of geographic proximity as less relevant (Lombardi/Laybourn 2011).

2 EID is a strategy that has been endorsed in the USA by the President's Council on Sustainable Development, the Department of Energy's Center for Excellence for Sustainable Development, and the Environmental Protection Agency.

The anticipation of these benefits can serve as an incentive for companies to improve their environmental and economic performance through more efficient management of raw materials, energy and waste. However, this requires a lot of foregoing activities such as consciousness building, facilitation of stakeholder dialogues, management support and others; all of which are important elements of a strategy to foster resource efficiency.

There are various interlinking options for putting 'Capitalizing on Synergies' strategies into practice including: industrial clusters, value

Figure: Potential areas of eco-industrial networking

Materials

- common buying
- customer/supplier relations
- by-product connections
- creating new material markets

Transportation

- shared commuting
- shared shipping
- common vehicle maintenance
- alternative packing
- intra-park transportation
- integrated logistic

Human Resources

- human resource recruiting
- joint benefit packages
- wellness programs
- common needs (payroll maintenance, security)
- training
- flexible employee assignment

Information / Communication Systems

- internal communication systems
- external information exchange
- monitoring systems
- computer compatibility
- Joint MIS system for Park Managements

Quality of Life / CommunityConnections

- integrating work and recreation
- cooperative education opportunities
- volunteer and community programs
- involvement in regional planning

Energy

- green buildings
- energy auditing
- cogeneration
- spin-off energy firms
- alternative fuels

Marketing

- green labelling
- accessing green markets
- joint promotion
- joint ventures
- recruiting new value-added companies

Environment / Health / Safety

- common buying
- accident prevention
- emergency response
- waste minimization
- multimedia planning
- design for environment
- shared environmental information systems

Production Processes

- pollution prevention
- scrap reduction and reuse
- production design
- common subcontractors
- common equipment
- technology sharing and integration

chain approaches and eco industrial parks (EIP). Whereas industrial clusters and value chains are formed by companies linked through vertical (buyer/supplier) or horizontal (similar products and technologies) relationships, industrial parks are characterized by the fact that several companies share the same location as well as common facilities.

Experiences of GIZ have shown that there is a high potential for cooperation in well-defined industrial areas, or even industrial parks with operational management. The main reasons are:

- Industrial park managers can facilitate stakeholder meetings, collect and analyze information as well as facilitate cooperation;
- The management of an industrial park may offer or trigger the provision of new or innovative services such as joint infrastructure (e.g. water supply and waste water disposal, shared energy systems, etc.);
- Information platforms or training facilities may already be available.

Eco-Industrial Parks: Concept and Instruments

The EIP concept had first been described in 1992 at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. It was Ernest Lowe who together with the Asian Development Bank coined the commonly accepted international definition of EIPs: "An eco-industrial park or estate is a community of manufacturing and service businesses located together on a common property. Member businesses seek enhanced environmental, economic, and social performance through collaboration in managing environmental and resource issues." (Lowe 2001: 1 ▸)

In order to facilitate cooperation among companies, specific instruments are needed. For this purpose, GIZ developed a variety of tools and integrated them in a so-called *Eco-Industrial Development Toolbox*. The EID-Toolbox is structured alongside five major themes: (i) new industrial parks, (ii) industrial area transformation, (iii) company improvement, (iv) management structure and (v) climate change. It comprises seventeen experience-based and inter-disciplinary tools which are independently combinable. [3]

GIZ is especially experienced in **technical advice** towards the development of Eco-Industrial Parks (EIP), both on the decision making and operational level. The establishment of EIP can be supported by numerous measures. Three examples are given below:

- For new industrial parks, location plays an important role. During this stage GIZ supports a process called *Site Suitability Assessment*. It concentrates on related environmental and economic factors, such as availability of raw materials, market for finished products, transportation networks, water supply, electricity, labor availability, etc. Consideration of economic factors may maximize profits over a short period, whereas consideration of environmental factors can help minimize liabilities over a longer period.

3 The EID-Toolbox can be accessed via the following link: http://www2.gtz.de/network/eid-toolbox/info/abfrage.asp

- Another process is the structural integration of *Site Master Planning*. This concept refers to wisely planned areas which bear the potential to efficiently use space, improve traffic infrastructure and locate companies which have the potential to share resources in proximity to each other.
- To certify EIPs, the development of criteria on national level is crucial. GIZ supports political decision makers in formulating and promoting standards as well as in the training of auditors. Considering land as an important resource, GIZ supports the reactivation of derelict industrial sites. As a result, greenfields have been saved, jobs created and the quality of life for surrounding neighborhoods improved.

In the case of already existing parks, GIZ helps to tap inter-company synergies by building up or strengthening **network structures**. Measures include:

– Information exchange, helping to identify new potentials of cooperation (e.g. to establish an inter-connected or integrated waste management system);
– The moderation of meetings between companies, helping to identify promising common goals;
– Aiding in the discussion of conflicts with neighboring communities or joint positions via governmental representatives.

Another important role of GIZ as an external actor is to **disseminate information, motivate discussion and open new perspectives.** This is especially relevant because for decision-makers in companies, breaking with daily routines is not an easy endeavor. Most managers and company employees have an inward-looking focus. In most of the cases, they do not know their neighbors do not meet and talk to other entrepreneurs, nor do they initiate an information exchange on possible synergies with other companies. In such circumstances, the first challenge consists in stimulating behavior change.

An integrated and more ambitious approach to **increase capacities** of industrial area managers and foster **organizational development** has been applied by GIZ through the training tool *Sustainable Management of Industrial Areas* (SMIA). It is based on experiential learning in a wide variety of management situations. Skill improvements comprise of effective communication, cooperation, negotiation, marketing of services as well as risk management. Participants discuss existing problems as a starting point, followed by a peer-to-peer coaching process which helps address specific and complex problems through moderated group consultancy and networking. The experience shows that organizational development can make industrial areas more functional, but is only possible if supported by external and local facilitators over a longer period of time, as many problems are complex and relate to management of relationships and institutional power.

Project Examples and Lessons Learned

Within GIZ, EID issues are addressed in programs tackling economic development and employment, energy efficiency, environment and climate change. Some project examples are given alongside this chapter.

Eco-Industrial Parks in India: The case of Andhra Pradesh

India's economic development is advancing rapidly. Simultaneously, this BRIC country is among the world's fastest growing emitters of greenhouse gases. In an effort to decouple the link between economic growth and environmental degradation, GIZ supports the Andhra Pradesh Industrial Infrastructure Corporation Ltd. to foster the eco-industrial park approach.

The implemented project (2008-2010), funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), intended to improve energy and resource efficiency in four existing and two newly created industrial estates in Andhra Pradesh by facilitating technology transfer as well as carrying out trainings and related capacity development measures for the management of industrial zones and local administrations. Clean technologies, waste minimization and pollution control measures were demonstrated and strategies to monitor the progress and impact of the implementation were established. A supporting partner from the German industry was Bayer Technology Services.

One result of this project comprised of the establishment of the Multi-Product Andhra Pradesh Special Economic Zone in Visakhapatnam. The Environmental Impact Assessment (EIA) that was conducted led to a comprehensive land consolidation plan including the establishment of renewed transport networks, a joint wastewater plant as well as joint waste management structures and the establishment of a mutual emergency system. Scaling-up of the results was ensured through workshops, discussions and exhibits.

Sustainable Industrial Zones in Tunisia: ReCapZI

Currently, Tunisia holds 121 industrial zones. These are the drivers for economic growth fostering regional and local development in the country. However, more than 2/3 of Tunisian industrial zones lack adequate maintenance systems and infrastructure. In this context, GIZ aims at assisting the stakeholders of industrial zones to improve the park's management.

The project Capacity Building for Sustainable Management in Industrial Areas "Renforcement des Capacités de la gestion durable des Zones Industrielles – ReCapZI" (2008-2014), funded by the German Federal Ministry of Economic Cooperation and Development (BMZ) in collaboration with the Tunisian Ministry of Industry, Energy and Small and Medium sized Enterprises (MIEPME), intends to increase the number of companies involved in the activities of functional industrial zone management (Groupement de maintenance et de gestion - GMG), to foster documented strategies for GMGs and to launch roundtable processes in industrial zones for problem-solving. Furthermore, it aims to promote energy efficiency.

The training of GMG managers is conducted in different regions in Tunisia and helps to make management more effective and as a result, the industrial area more attractive. Furthermore, it ensures a regular sharing of experiences among GMG managers as well as the discussion of structural problems and the implementation of management standards for industrial areas.

From literature as well as from project experiences there are lessons learned which need to be kept in mind:

- The higher the level of cooperation, the higher the interdependence and the risks for the collaborating companies. This means that companies which use each other's residual products as inputs may face the risk of losing critical supply or market if a plant closes down. To some extent, this can be managed in the same way as with any supplier or customer relationship (i. e., keep alternatives in mind and write contracts assuring reliability of supply). However, the risk to companies increases if they must invest in process changes or transport infrastructure to accommodate exchanges. Companies need to understand in which way they are affected by inter-firm dependencies and how they can keep the negative impacts as low as possible (Lowe 1997).

- Another challenge for strong interlinkage lies in its potential for becoming an obstacle to further technological innovation (Bringezu 2000) through the continued reliance on availability of (sometimes toxic) residual materials (Lowe 1997) within the cooperating companies. In an ever changing environment, continuous innovation is a must to stay competitive or conquer new markets, which also affects inter-linked partner companies.

- Crucial to the success and sustainability of inter-company linkages is ownership on the company side. Whenever models and best practices are created, they need somebody to take up the idea and make further use of it. The scaling up of results is especially difficult when money for infrastructure development is involved, which often cannot be maintained over long periods. To avoid unsustainable supporting practices, a clear time frame and exit strategy must be communicated to ensure the timely and complete takeover by the participants, hence beneficiaries, of the network. Additionally, the planning and maintenance of network structures comprises the risk of high costs which can only be justified if the economic benefits of cooperation between the participating companies are even higher and periods of amortization on the investments are not too long.

- Without conducive framework conditions and stimulating policies EIP approaches are difficult to realize. In such a situation it might be the role of the park management to demonstrate the benefits of an *Eco-Industrial Park* via policy and the general public. Development cooperation might support such dialogue structures.

- When analyzing the cooperation potential in a certain area, it should not be neglected that companies outside of the defined space of an industrial area might be interested and suitable to be integrated in networking activities, etc. As the concentration of inter-company linkages in industrial areas is only one of the many opportunities for taking advantages of efficiency gains, no project should be restricted to working only within these boundaries.

- Another aspect to be taken into consideration is the time frame of development cooperation activities in the field of EIP. Experiences from German development cooperation show that a time frame of less than two years is largely insufficient to over-

come resistance to change and to trigger complex processes of organizational development.

Conclusions

Development cooperation can play an important role in the promotion of enabling conditions for resource efficiency in industrial areas. Based on many years of experience, one can conclude that through facilitating cooperation between companies located on the same grounds, new opportunities for taking advantage of efficiency gains usually arise. In the broader context of eco-industrial development (EID) inter-company cooperation may even catalyze the three Es of sustainability: *Economy, Environment and Equity*.

The experiences gained with the EIP approach have been assessed and best practices are being disseminated within GIZ and the donor community so that they can be continuously applied and replicated. The main potentials of facilitating inter-company linkages to foster resource efficiency consist of the following:

- By addressing a group of companies, economies of scale can be incorporated.
- Reuse of by-products, sharing of utilities and the joint provision of services are promising options to achieve economic and environmental benefits for every single company as well as for industrial areas as a whole.
- Technical advice, facilitation of stakeholder dialogues, dissemination of information, trainings as well as organizational development are relevant methods in how development cooperation can support inter-company cooperation.
- As practiced in India and China, working in industrial areas bears the potential to cooperate with German companies. In doing so, German development cooperation capitalizes on the vast variety of know-how from private sector firms while providing room for them to present their strengths abroad.

The successful implementation of the EIP approach depends on a set of critical factors which need to be taken into consideration before entering into any form of development cooperation:

- Is the right **political institution** involved? Does it have the power and will to initiate change of policies and governance structures?
- How is the industrial area or the industrial park managed? Is there an official management structure in place? Is the **administrational setup** promising to play a viable role in approaching tenant companies and facilitate activities towards more resource-efficient production?
- Is the **size of the area** sufficient to set up sustainable networking structures? Is the number of companies and the production capacity high enough to identify and implement a variety of possible cooperation?
- Is the **mix of companies** promising for inter-company linkages? Can a potential for material exchanges or shared infrastructure and services be foreseen?
- Is there an intrinsic **motivation** of relevant actors to foster cooperation between companies, to initiate measures and take up responsibilities?
- Can **up-scaling** options of pilot activities be identified?

Eco-Industrial Development in Ghana

Smallest, small and medium-sized enterprises (SSME) in African countries oftentimes employ outdated technologies with severely negative environmental impacts. However, they are an important contributor to employment and economic growth and their numbers are vastly increasing. In this context, GIZ aims at consulting governments in fostering SSME clustering and related resource efficiency measures.

In Ghana, GIZ advised four regional districts in the establishment of sustainable industrial zones. Eight industrial zones, mostly populated by SSME, were offered trainings in *Profitable Environmental Management* (PRUMA) and *Sustainable Management of Industrial Areas* (SMIA). The participants in the trainings were primarily managers of industrial zones.

One output of this project comprised the relocalization of automotive companies to areas more distant from the local communities. In addition, the involved companies commenced to collect their waste oil for reuse and resale. Furthermore, they harmonized their provided services and started a joint advertisement campaign. In this way, they increased their profit while reducing their environmental and negative social impacts.

Efficient utilization of energy resources and their by-products in China

In China, where the fastest growing industrial development takes place, BMZ finances a project with the title "Energy Policy and Energy Efficiency". As one of the components, GIZ, in the Province of Shanxi, works in the coal industry by supporting the framework conditions for more sustainable and environmentally friendly production of coke. A concept was developed to promote the efficient production of coke as well as utilize the by-products of its production.

Furthermore, a concept was developed to promote the efficient utilization of by-products through the establishment of coking plant parks. For these parks, expert studies have been conducted and communication structures facilitated. One supporting partner from the German industry is Uhde, a company of ThyssenKrupp Technologies.

To find the right administrational model for the parks, GIZ supported the Provincial Development and Reform Commission of the Province of Shanxi in organizing an international conference where a discussion on the opportunities and challenges of locating coking plants in industrial parks took place.

To answer all of the above mentioned questions, there is a need for feasibility and baseline studies in advance of any project. However, such pre-appraisals are not sufficient for estimating the full potential of inter-company linkages in a given situation. This potential can only be found and ultimately realized through the continuous exchange of ideas between private and public stakeholders.

2.5 Technology Transfer and Cooperation – Making Resource Efficiency Happen

The use of outdated, inefficient technologies has detrimental impacts on the environment and the climate, while also adversely affecting the competitiveness of individual companies and entire industrial sectors and economies. This applies to all countries, whether industrialized or developing. "Technology is at the core of competition and at the core of development. Where implemented correctly through technology cooperation it is proving to be an engine for improved environmental performance and poverty alleviation." (UNIDO/WBCSD 2002: 7 ▸) As a country's technological and economic development are closely interlinked, technology transfer and cooperation have traditionally had a key role to play in development cooperation.

Basic Concepts

First of all, it should be underlined that the term **technology** does not relate solely to machinery and equipment but to the totality of processes and techniques for producing goods and services, and the incorporated knowledge. The IPCC defines technology as "practical application of knowledge to achieve particular tasks that employs both technical artefacts (hardware, equipment) and (social) information ('software', know-how for production and use of artefacts)" (IPCC 2007: 56 ▸). In this context, literature also makes reference to the so-called four dimensions or components of technology, consisting of *technical hardware, know-how, organization and products* (Meyer-Stamer et al. 1994).

Based on this concept, **technology transfer** can be described "as a broad set of processes covering the flow of know-how, experience and equipment [...] amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental Organizations (NGOs) and research/education institutions" (IPCC 2000: 3 ▸). This also comprises processes of learning aimed at enhancing the ability of the 'receiving side' to understand, utilize and replicate technologies, including the capacity to make the right choices and adapt a given technology to local conditions. The term *transfer* encompasses the diffusion of technologies both across and within countries.

Particularly in the context of development cooperation, the conceptual differentiation between **vertical** and **horizontal technology transfer** as proposed by UNIDO proves to be useful: "Vertical transfer refers to technology being transferred from research to development to production. Thus it follows the progressive stages of invention, innovation and development, with the technology becoming more commercialised as it proceeds through each stage. (...) Horizontal transfer refers to an established technology being transferred from one operational environment to another. The technology is already commercialised and the purpose is to disseminate the technology and extend its application into other contexts. Horizontal transfer is more common when technology is being transferred from industrialised to developing countries. There is usually no further improvement or change to

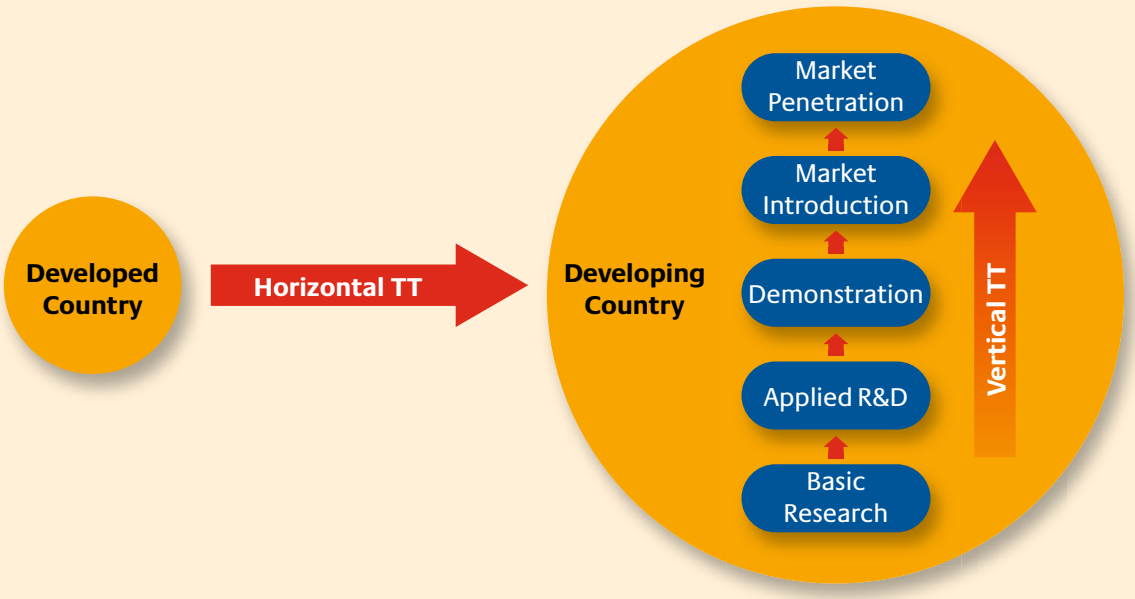
the technology unless it needs to be modified to suit local circumstances or environmental regulation, in which case when it is adapted and/or refined there will need to be a linkage between vertical and horizontal technology transfer." (UNIDO 2002: 6 ▸). The distinction is illustrated in the figure below.

It is common for development cooperation to promote both types of technology transfer, although its sphere of action rarely extends beyond the stages of *demonstration, market introduction* and *market penetration*. The emphasis may differ from case to case, but as a general rule complementary supportive measures in the partner country are essential even when it comes to the (horizontal) transfer of mature technologies or those that have already achieved a high level of market penetration.

The reason for this is that the framework conditions in developing countries often constitute an obstacle to technology transfer that is difficult to overcome.

Apart from legal, economic and fiscal obstacles, there are usually also difficulties caused by a lack of technical and organizational capacities on the partner side. Thus a main condition leading to innovation and transfer is **technological competence**, which encompasses the capacity of producing firms and knowledge providers to adopt, adapt and ultimately create their own technological solutions (Janischewski 2005). In the development cooperation context, approaches intended to contribute to strengthening technological competence in the receiving countries are commonly subsumed under the concept of **technology cooperation**.

Figure: Horizontal and vertical technology transfer (TT)



Environmental and Efficiency Technologies

Technologies designed to increase resource efficiency are generally known as **efficiency technologies**. They are characterized by a reduction of materials and energy input per product unit, the optimization of manufacturing processes, and the implementation of recycling principles in goods production (Forschungszentrum Karlsruhe 2010 ▸). They are also used in the extraction and processing of raw materials, in waste management, in product design, in the substitution of primary raw materials, and in the introduction of new production processes.

Efficiency technologies are a subset of environmental technologies which cover not only the broad area of conventional pollution and emission control, but also the rapidly growing area of renewable energies. Environmental technologies are sometimes described as the *flagship industry of the 21st century*. A study published by the German Federal Ministry for the Environment (BMU) forecasts an annual increase of five percent in global demand for such technologies. Accordingly, the market volume of EUR 1,400 billion in 2007 will more than double by 2020 to reach EUR 3,100 billion, roughly half of which is set to be made up by efficiency technologies. While future sales in the energy efficiency sector are due to rise to EUR 1,030 billion, in the field of material efficiency the market volume is expected to triple, from EUR 95 billion to EUR 335 billion (BMU 2009 ▸).

Most of the demand for environmental technologies will continue to come from industrialized countries. However, the market share in developing countries and especially in emerging economies will grow rapidly in the coming years. Not the least of the reasons for this will be the increasing importance of new technologies required for the intended global transformation towards a low-carbon and resource-efficient green economy. The *Green Climate Fund* agreed upon in Copenhagen, for example, will soon make a multilateral financing instrument available that will give additional impetus to technology transfer to developing countries (UNFCCC 2009 ▸).

A bilateral equivalent to this was created in 2011, in the form of the *German Climate Technology Initiative*. The Initiative focuses on two priority action areas. Firstly, it plans to implement demonstration projects in selected technology fields to serve as models and to promote their market introduction and penetration. Secondly, the aim is to improve the general political, legal and economic framework by strengthening the relevant institutions and capacities so as to press ahead with the widespread dissemination of proven mitigation and adaptation technologies.

One crucial aspect of this concerns the issue of patent legislation, because patent protection has been proven to encourage innovation and can significantly boost business interest in technology transfer (BMWi 2007 ▸). It is also essential to pave the way for upscaling of environmental and efficiency technologies by removing obstacles to investment. Inadequate environmental legislation and poor enforcement of such legislation, for example, or subsidies for fossil fuels can seriously impede the spread of technologies that protect the environment and conserve natural resources (UNCTAD 2009 ▸).[1] To lead

technology cooperation arrangements towards a successful outcome, it may therefore be necessary to back them up and complement them with corresponding advisory measures at an economic and/or environmental policy level.

Experiences with Technology Cooperation Approaches

The main reason why it is necessary to promote resource efficiency in emerging and developing countries is because many of these countries are currently experiencing an industrial growth phase. The accompanying expansion of energy and material consumption in such countries can only be restrained by replacing obsolete technologies with new, more resource-efficient ones as quickly as possible. In this connection the need to engage in *leapfrogging* has repeatedly been pointed out. Skipping certain technology stages could bring about a rapid improvement in resource productivity and decouple economic growth from resource consumption (WBGU 2011 ▸). To help achieve a breakthrough in sustainable development towards a green economy however, it is necessary for there to be market penetration of efficiency technologies across a broad front. Technological leaps in just a few segments of the economy or in niche markets are not sufficient (Jänicke 2008).

Against this background, technology cooperation approaches are highly significant. The objective of these approaches must be to establish and expand developing countries' capacities to develop, adapt, use and disseminate resource-efficient technologies. Within German development cooperation, these forms of cooperation primarily take place in the context of economic promotion programs or environment-, and energy-related activities. Three **cooperation approaches** that are most commonly used in practice in technical cooperation are described in the following pages. They are differentiated according to whether they predominantly serve the purpose of horizontal or vertical technology transfer.

Horizontal Technology Transfer

One way in which technical cooperation can promote horizontal technology transfer is to establish direct **cooperation ties between technology providers from industrialized countries and technology users in developing countries,** and to provide support in overcoming any obstacles in the way of possible transfers. This approach presupposes the existence of a mature technology that is suitable for use and dissemination in a partner country, and that is also capable of triggering positive developmental effects. In order to estimate the appropriateness, replicability and potential co-benefits of a technology it is essential to perform sector analyzes and impact assessments in advance of such cooperation projects.

BMU's *Recycling and Efficiency Technologies Initiative* (RETech) promotes the transfer of recycling and disposal technologies made in Germany with the aid of development partnerships with the private sector. RETech is designed

1 The positive impact of environmental regulations can be demonstrated by the example of the prohibition of chlorofluorocarbons (CFCs) that were damaging the ozone layer. The Montreal Protocol resulted in a series of product innovations and was the trigger that made the global distribution of CFC-free technologies possible.

to support the export of waste management concepts, services and products to emerging and developing countries. The aim of the initiative is to raise waste management standards in partner countries and optimize the support for and networking of German stakeholders in technology export and know-how transfer .

Box 1: Proklima – Protection of the ozone layer

Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) which are used as refrigerants and foam blowing agents are controlled under the Montreal Protocol due to their ozone depletion potential. These substances do not only deplete the ozone layer but are also potent greenhouse gases. They are mainly replaced by hydrofluorocarbons (HFCs) which are not controlled under the Montreal Protocol but also contribute to global warming (some of the HFCs have even higher global warming potential than the HCFCs replaced). On behalf of BMZ (since 1995) and BMU's *International Climate Initiative* (since 2008), the Proklima program is working towards phasing out the production and consumption of ozone-depleting substances and promotes the introduction of ozone- and climate-friendly natural gases like hydrocarbons, CO2 and ammonia as alternatives. Phasing out the production and consumption of ozone-depleting substances not only benefits the ozone layer but also promotes the introduction of more resource-efficient appliances in partner countries. Proklima's activities comprise technology transfer in the foam, refrigeration and air-conditioning sectors. Natural gases like propane and isobutane are particularly viable alternative refrigerants, for example, and in most cases they are also more energy-efficient.

Proklima's services include government advisory services (e.g. on national guidelines and standards), cooperation with industry associations to implement sector phase-out plans, and advice to individual enterprises on the selection of appropriate technologies. This also includes qualification and training measures in the safe use of ozone- and climate-friendly technologies. Comprehensive capacity development support for the use of innovative technologies is provided through a broad-based approach. The program has implemented almost 200 projects in about 40 countries, cooperating with governments, UN agencies, NGOs, private companies and vocational training institutions. The most important impacts include reducing greenhouse gas emissions (CO_2 equivalent) by 46 million tonnes, increasing energy efficiency and influencing market reaction and legislation in partner countries in favor of natural gases. Good examples are the introduction of air-conditioner manufacturing with propane refrigerant in China and India and the establishment of a comprehensive exchange program and recycling system for old household refrigerators and freezers in Brazil.

Proklima supports partner countries in overcoming barriers to technology transfer and facilitates access to growing markets for technology suppliers. This is only possible through close technology cooperation with the private sector, which relates to almost all steps of the technology cycle, from technology adaptation to market penetration.

To speed up market introduction, however, there is also a need for promotion that is quite specifically targeted at mainstreaming a particular technology within a certain country. This is where there is useful scope for pilot projects that are implemented in cooperation with technology providers on the one hand and potential technology users on the other. GIZ has gained valuable experience with this approach in the context of the **Proklima International** program, for example, which contributes towards ozone layer and climate protection (see Box 1).

In the above case the technology providers and technology users are different actors, whose relationship is solely determined by their mutual interest in selling or acquiring a certain technology, respectively. The situation is different when companies from industrialized countries own or set up production facilities in developing countries (as subsidiaries or as joint ventures with local partners) and want to equip these facilities with technologies that correspond to the state of the art in their countries of origin but whose transfer is hampered by a range of obstacles (whether legal, economic or institutional). This is a case of horizontal technology transfer **within a company or between companies in the same industrial sector.**

One way in which this type of transfer can be promoted is through demonstration projects, which are set up to show how a technology can be adapted to suit the circumstances in the partner country. Another is through advisory and training measures that help to improve the operating conditions and the level of acceptance of the technology. GIZ supports the transfer of best practices in the technology sphere, above all in the form of development partnerships with the private sector. A particularly successful example of this form of technology cooperation was the **strategic alliance** with the cement manufacturer **Holcim**, which ran for a period of six years, from 2003 to 2009 (see Box 2).

Vertical Technology Transfer

According to a survey of companies, technical feasibility and profitability prospects are necessary but not sufficient conditions for technology transfer. Many companies, especially SME, are faced with a shortage of research and development capacity, insufficient numbers of trained personnel and a lack of acceptance of innovative technologies (Forschungszentrum Karlsruhe 2010 ▸). Experience with horizontal technology transfer approaches shows that vocational qualifications and technological knowledge constitute crucial weak points in developing countries when it comes to advancing the diffusion of resource-efficient technologies.

One means of improving these underlying conditions is through strengthening of the technological competence and cooperation capability of the various actors throughout the *technology cycle* (from technology development through to market penetration), in particular in those institutions that act as intermediaries between applied research and the private sector. In addition to this it can be useful to create links to international innovation networks, support the establishment of information platforms and promote bilateral or also triangular exchange between knowledge brokers in the field of technology transfer. A prominent role can be

Box 2: Holcim – Co-processing waste material in cement production

Inadequate solid waste management in developing countries and a shortage of fossil fuels mean that innovative technical solutions and forms of cooperation are called for. Cement manufacture, which is an energy intensive industry, offers an alternative form of waste treatment, known as co-processing, where alternative fuels and raw materials generated from waste enter the production process. The strategic alliance between GIZ and Holcim, a world leading producer of cement and aggregates, explored options to increase resource efficiency through the responsible use of waste as fuel and raw materials. The project, funded with resources from BMZ and Holcim, developed guidelines for this approach and a model application in four pilot countries (Chile, Mexico, Morocco and the Philippines). Based on this, the partnership continued to promote, disseminate and anchor this technology in several other developing countries.

A critical success factor was the integration of the stakeholders involved, including national authorities, UN Organizations, NGOs and the cement industry itself. Furthermore a modular training scheme was designed, based on the requirements for capacity development as stipulated in the guidelines. GIZ's global networks, work experience in developing countries and advisory services enabled the creation of an enabling environment for the use of new technology.

Technology cooperation was only able to succeed because clear legal provisions were in place; laws had to be amended, and approving authorities given the power to review compliance with regulations. The alliance paved the way for the transfer of technological expertise and provides an example of how to disseminate innovation. The guidelines were adopted as standard within the Holcim Group as well as by other cement companies. As an additional outcome the Basel Convention is preparing 'Technical Guidelines for Co-processing of Hazardous Wastes in Cement Kilns' based on the experience gained within this technology cooperation.

played here by the technology competence centers that already exist in many countries, and normally act as service providers for the private sector. An example of this approach is the **TecnoTrans** project, which was implemented by GIZ in the state of Bahia in Brazil in the period from 2001 to 2006 (see Box 3).

Conclusions

It is not possible to achieve a significant improvement in resource efficiency without technological innovation. Such innovations mostly originate from industrialized countries. If they are also to be put to use in developing countries, these countries require at least a

Box 3: TecnoTrans – Regional technology centers

The TecnoTrans project was part of the local and regional economic development and employment promotion program funded from BMZ resources in northeastern Brazil. Its objective was to improve the productivity and competitiveness of SME in the Brazilian state of Bahia. In order to boost the innovation potential of these companies, a method of systematic technology transfer management was introduced via the vocational training organization for industry, SENAI (*Servico Nacional de Aprendizagem Industrial*), which has a countrywide network of technical schools and technology centers. The focus was directed at introducing and disseminating resource-efficient production technologies in the region's industrial enterprises, making use of the expertise available from renowned institutes and companies in Germany.

To meet the needs of industry for technology-related training and advisory services, the existing advisers and trainers were given training to enable them to fulfill their role as knowledge providers and multipliers more effectively. Ultimately a total of over 100 SME from various sectors, many of them from the metalworking industry, benefited from the improved advisory and training services offered by the regional technology centers. The fact that the support they received from the SENAI centers was now more closely matched to their needs enabled them to at least in part make up for their technology lag with respect to companies situated in Brazil's industrial south.

The TecnoTrans project thus illustrated that technology transfer to companies can be substantially improved if the institutions that are intended to serve as conduits and driving forces can be dovetailed more closely with industry and establishments engaged in applied research and professional training.

minimum level of technological infrastructure and competence and must provide a sufficiently innovation-friendly framework. Technology cooperation between industrialized and developing countries can contribute to the creation of such conditions.

This involves strengthening the various actors to the extent that they are in a position to shape horizontal and vertical technology transfer themselves. A variety of cooperation approaches can be used to bring this about. These include individual demonstration projects, dissemination programs in certain fields of technology, and the establishment or expansion of support structures required for the transfer of efficiency technologies.

The forms of technology cooperation that have proved particularly successful are those in which private-sector companies play a substantial part in driving and shaping outcomes. Increasing use has been made of this possibility in German development cooperation since the introduction of development partnerships with the private sector in the 1990s. Such partnerships appear to be a particularly good choice when it comes to promoting resource efficiency in the manufacturing industry. As of yet however, their potential is far from being fully exploited.

According to UNEP, a combination of rigorous environmental policy and technological innovations is necessary to make full use of the economic and ecological advantages of efficiency technologies (UNEP 2011b ▸). In other words, the success of technology cooperation depends on whether the companies receive sufficiently powerful incentives to innovate either from the market or from the state. If these incentives are lacking, it is advisable to supplement technology cooperation by measures that can help partner countries to improve their economic and environmental policy framework.

2.6 Moving forward towards a Program Approach

The following statement is taken out of the German Resource Efficiency Program entitled ProgRess: "The Federal Government **will strengthen its efforts to promote resource efficiency in developing and emerging countries** using as framework the bilateral development cooperation of the BMZ (Federal Ministry for Economic Cooperation and Development), the International Climate Initiative of the BMU (Federal Ministry for the Environment) and the German Climate Technology Initiative to be implemented by GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) and KfW (Kreditanstalt für Wiederaufbau)." But what could these types of projects look like? Is it enough to simply carry out more projects than in the past, or does the "strengthened effort" call for other project concepts to go a step (or steps) further than they do now?

Each of the five approaches for promoting resource efficiency in industry presented in the previous sections, i.e. *policy instruments, financial support, consultancy and training, inter-company cooperation, technology transfer*, can be implemented either separately or in conjunction with others. However, in general they are not suited to be executed as stand-alone projects. Even financing relies on complementary support measures such as consultancy services in order to bridge the gap between loan creditors at the national level and loan recipients at the local (enterprise) level.

In German development cooperation, the different approaches for promoting resource efficiency in industry usually are integrated into broader programs, mainly in the areas of economic development, private business/SME promotion, environmental management or energy. In many cases this might be a good or even the best solution. However, if we start thinking about how to raise the current standing of resource efficiency on the development cooperation agenda, we should consider other options, too.

The alternative that will be proposed and discussed hereinafter consists in integrating various individual action approaches into a program approach of interrelated promotion measures, thus creating synergies between them and increasing their effectiveness. This can be achieved through horizontal and vertical integration.

Horizontal Integration

Horizontal integration is defined here as the **combination of several action approaches** by taking advantage of existing complementarities between them. Figure 1 is designed to help explain this concept.

The diagram portrays the relation between resource efficiency gains on the one side and investment costs or pay-back period on the other. The leap that companies can make concerning an increase in resource efficiency naturally depends on which technological level they start at. The lower it is the greater the potentials that can be tapped by using Good Housekeeping Measures (GHK) or through relatively simple and cost-efficient upgrading measures (e.g. by replacing outdated 'cross-sectoral technologies'

such as pumps, motor drives, compressors, etc.). But at the same time it becomes increasingly more difficult for companies to achieve the next, considerably higher level of advanced or best available process technologies – not to mention the research-intensive cutting-edge technologies.

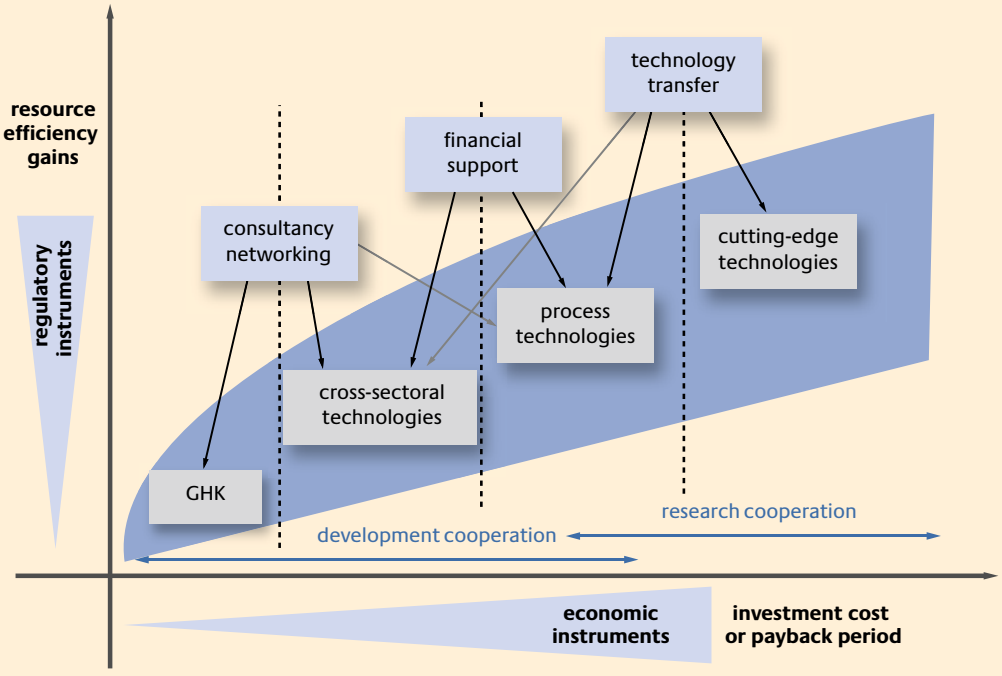
The action approaches can be roughly assigned to the different technology levels according to their relevance for realizing resource efficiency gains in the manufacturing sector. Doing this, it becomes clear that they overlap and complement each other mainly in the two middle ranges. And it is in these areas, where policy instruments (regulations and economic incentives) can most effectively comply with their function as catalysts for investments in resource efficiency.

Vertical Integration

Under *vertical integration* we understand the **conjunction of different action levels** of an approach by taking advantage of existing impact linkages between them. The meaning of this definition is illustrated in Figure 2.

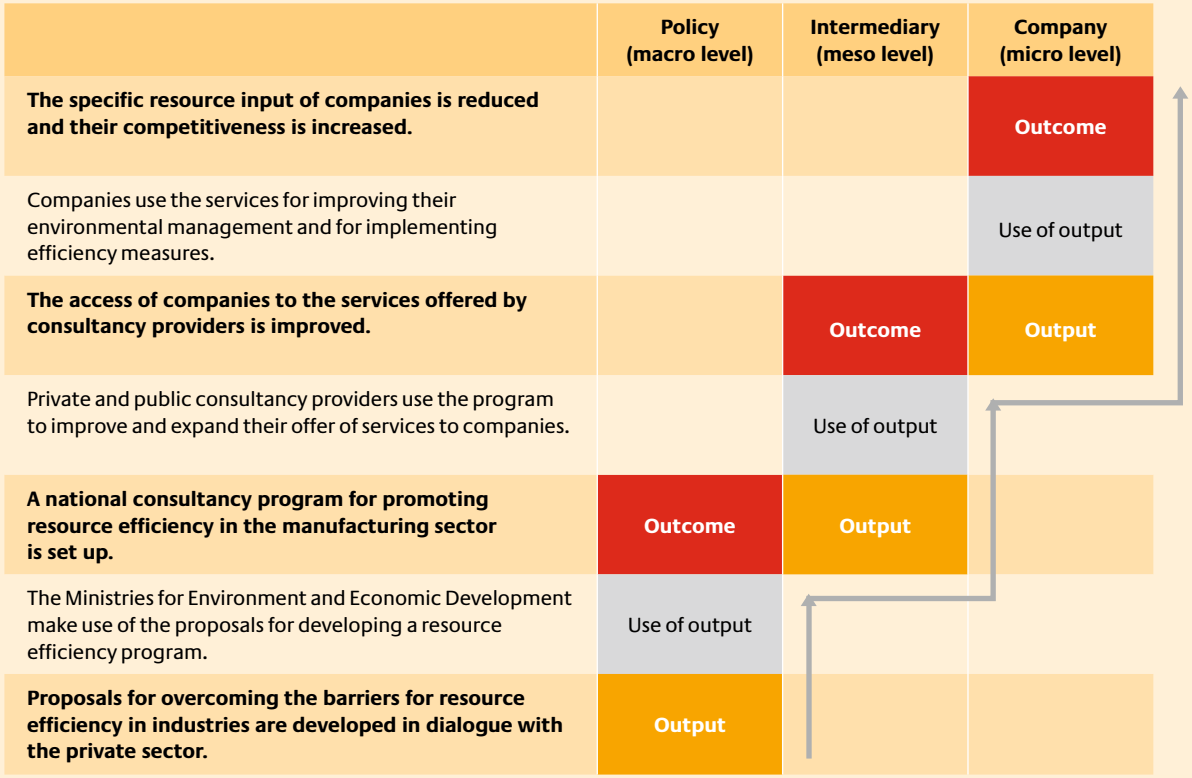
The chart presents for a specific approach (consultancy services) several examples of outputs and outcomes that can be achieved at different levels of action (macro – policy, meso – intermediary, micro – company).[1] Furthermore, it is shown how these outputs and outcomes

Figure 1: Example for horizontal integration: The technology link



1 The term *intermediary* encompasses all private and public stakeholders that provide services for companies or act toward them as executing or law enforcement authorities.

Figure 2: Example for vertical integration – The consultancy approach



can be linked together through *impact chains* that stretch across the three action levels. Similar impact chains can be designed for other approaches, too.

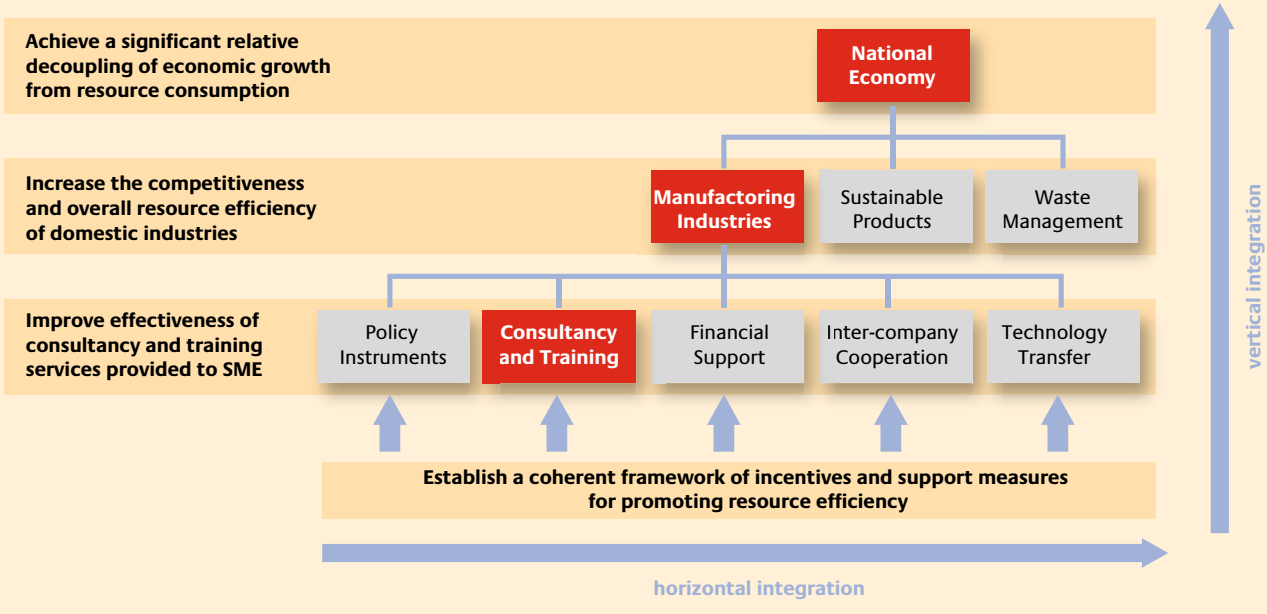
By combining the logic of horizontal integration with that of vertical integration, a pattern for structuring programs can be created. Figure 3 shows a very simplified form of what such a program structure could look like. In this chart, the goal hierarchy has been extended to the top by the national economy level. The decoupling goal stated at this level normally functions as the strategic compass for programs designed to promote resource efficiency. Depending on the conditions and necessities of a country, these programs can naturally be supplemented by additional approaches and components. For example, it could make sense to include specific measures in the field of chemicals management. Under certain circumstances it might be advantageous or even imperative to extend the scope of the program to other sectors or stages of the value chain (such as consumption and waste management) instead of only focusing on the manufacturing sector. At least this is the way European countries currently handle things when designing and implementing programs for promoting resource efficiency.

Barriers to a Program Approach

However, developing and implementing a program approach is not as easy as it might seem at first glance. Some of the constraints are enumerated below:

- Resource efficiency policies are rather new, even in the most developed countries. As long as policymakers in developing countries do not recognize the importance of resource efficiency for the country's economic development and competitiveness, it will be difficult to obtain a positive response from government officials towards proposals to set up a national promotion program supported by development cooperation.
- When implemented, resource efficiency policies tend to incur additional public expenses (e.g. through subsidies for the early adopters) or additional fiscal revenues (e.g. through levies for the latecomers). Such consequences can provoke upfront resistance within the government (e.g. Treasury) and from business sectors who fear suffering disadvantages.
- Resource efficiency policies are implicitly multi-sector policies. Depending on the scope, they may involve up to six ministries (e.g. economy/industry, environment, energy, science/technology, public works, and finance). Besides this they have to deal with many stakeholders (supporters or beneficiaries) primarily from the private sector but also from the academic community and civil society. Such a governance and management challenge will be accepted by governments only if there is a real need and pressure for a programmatic political response.

Figure 3: Structuring a resource efficiency program



- Although development cooperation may be able to foster joint initiatives shared by different public and private stakeholders, at the same time it strongly relies on already existing structures and processes where it can link in with a (multi-sector and multi-stakeholder) program approach. If the political willingness, the cooperation culture and the institutional framework in a given partner country are too weak for sustaining a resource efficiency program, development cooperation should continue to pursue less ambitious goals and impacts.
- Multi-sector approaches, however, can also be hampered by homemade problems within development cooperation agencies. One of these problems is the traditional competition for the lead function between people belonging to different sector divisions. In the case of resource efficiency, this refers especially to those divisions that are in charge of private sector development and environmental management.

What can be done to overcome these barriers, thus paving the way towards the introduction of resource efficiency policies in emerging and developing countries? Instead of a set of definitive answers, we will only provide some ideas here before closing up the chapter.

1. Regardless of the importance of resource efficiency for greening the economy and turning companies more competitive, it should not be ignored that there are other issues which are just as important for industrial enterprises as well as the general public. Therefore, embedding resource efficiency in a broader policy approach might be helpful or even necessary.

2. It is not advisable to treat resource efficiency as a new or even separate area of public policies, particularly at an early stage of industrialization or at a low level of industrial pollution control. Instead it should be closely linked to environmental policy and management on the one hand and economic and business development on the other. UNIDO and UNEP did this several years ago when they integrated resource efficiency into the portfolio of services provided by the National Cleaner Production Centers.[2]

3. If representatives from the public and private sector are to be sensitized and won over by the idea of setting up a resource efficiency program, they first have to be convinced of the benefits that such an initiative can have for individual companies as well as for the national economy as a whole. There are various measures that are suitable for awareness building, for instance: offering an award and designating a national efficiency prize; carrying out comparative country or sector studies with estimates of the actual resource efficiency potentials; organizing multi-stakeholder dialogues, fair exhibitions or other net-working events; and finally implementing a training program addressing above all high ranking government officials from different ministries.[3]

4. At the same time, it should be avoided that the issue of resource efficiency gets overloaded by political expectations and purpos-

2 UNIDO's new strategy has recently been published under the title "A greener footprint for industry - Opportunities and challenges of sustainable industrial development". (UNIDO 2010 ▸)
3 The concept of such a training program is outlined in Chapter 4.

es. It is better to start with a set of concrete actions that are able to produce tangible and scalable outcomes than to create a big bubble of political rhetoric and lip services. To do so, it is important to achieve active involvement of the business sector from the very beginning of any process aimed at resulting in a publicly supported but privately driven action plan.

5. Development cooperation has its own role to play in this process. It can serve as facilitator bringing together relevant public and private stakeholders, showcasing good practices, incentivizing international networking and knowledge transfer and – last, but not least – providing appropriate management and training tools. However, the most important thing is that the people working for or on behalf of implementing organizations strive towards exemplifying the capabilities needed for designing and introducing a (multi-sector and multi-stakeholder) program approach for promoting resource efficiency.

3 Resource Efficiency Indicators and their Relevance for Development Cooperation

Indicators serve different purposes. They are used for example to describe the state of environment, analyze problems, make comparisons and monitor changes. They are indispensable wherever the aim is, to specify policy or corporate goals by defining targets, and to examine whether and to what extent these targets have actually been achieved by the measures taken. Indicators are essential for planning and steering strategies at national and corporate levels. This also applies to the field of resource efficiency, and to development cooperation programs that are designed to support the development and implementation of efficiency strategies.

There are many proposals on how to measure resource efficiency. While standardised and widely accepted indicator systems already exist at the corporate level, these are still being developed and debated at the macroeconomic level. At this level the significance, measurability and suitability of some indicators remain a controversial issue. This is particularly true for those indicators designed to show a country's overall resource consumption. We shall look into this in the section on 'macro indicators'. To wind up, we will assess the relevance of both groups of indicators for development cooperation.

Micro Indicators – Determining Resource Efficiency on the Enterprise Scale

Resource efficiency at corporate level is usually seen as part of environmental management. This explains why the EMAS core indicators relate not just to the environmental impacts caused by a company, but also to resource inputs (see Table 1).

The ISO norm 14031, which introduced a model for evaluating the environmental performance of enterprises, also takes this approach, but differs from other systems in one respect. Apart from the physical indicators that are termed 'operating performance indicators' in this standard, it also contains so-called 'management performance indicators'. These are suitable for indicating the performance of the corporate environmental management system and serve to determine, for instance:

- the degree to which the company achieves its policy goals
- the degree to which it complies with legal regulations
- its economic performance (investments, savings, profitability, etc.).

Table 2 shows the example of a Chinese enterprise that took part several years ago in a consultancy and training program on Environment-oriented Cost Management (EoCM) supported by German development cooperation, and demonstrates how this affected its operational and management performance. The percentages stated here relate to absolute baseline values that provide information on resource consumption and emissions in the year of comparison, i.e. the year before measures were implemented. Although this gives some indication of the measures' effectiveness,

Table 1: EMAS Environmental core indicators[1] (without 'biodiversity'/'land use'):

Key environmental area	Input / impact
Energy efficiency	**Total annual energy consumption** expressed in MWh or GJ **Total renewable energy use:** Percentage of total annual consumption of energy (electricity and heat) produced by the Organization from renewable energy sources
Material efficiency	**Annual mass-flow of different materials used** (excluding energy carriers and water), expressed in tonnes
Water	**Total annual water consumption** in m^3
Waste	**Total annual generation of waste** broken down by type, expressed in tonnes **Total annual generation of hazardous waste** expressed in kilograms or tonnes
Emissions	**Total annual emission of greenhouse gases** including at least emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, expressed in tonnes of CO_2 equivalent **Total annual air emissions** including at least emissions of SO_2, NO_X and PM, expressed in kilograms or tonnes

Table 2: Environmental performance indicators (after having applied the EoCM-method)
Case: Leather and fur fabrication, Zhejiang, China

			absolute values	relative values
operational performance indicators	reduction of resource inputs	water	-1,125,00 t/a	-47 %
		electricity	-960,00 kWh/a	-4 %
		chemicals	-259 t/a	-26 %
	reduction of emissions	effluents	-859,000 t/a	-36 %
		emissions (SO_2)	-84 t/a	-22 %
		solid waste	-259 t/a	-42 %
economic indicators	anual cost savings		580,000 €	3,8 %
	investment		120,000 €	
	Ø pay-back period		3.5 months	

Source: GTZ, Environment-oriented Enterprise Consultancy Zhejiang (EECZ)

1 For further information see: European Commission, EMAS Factsheet 09/2010

it says nothing about their efficiency [2]. To judge this, the resource inputs and the emissions need to be related to an output. The usual method for determining resource efficiency indicators is to choose a physical reference value as output. In production companies, this is usually the production volume in tonnes. In this case, one also speaks of the specific resource input or of specific emissions. The following indicators are used in the cement industry, for instance: specific energy input measured in 'megajoule per t of clinker'; specific greenhouse gas emissions measured in 'kg CO_2 per t of cementitious material'.

By contrast, an economic reference value is usually chosen as output for the *resource productivity* indicator [3]. This reference value is given as the company's gross value added (GVA = turnover minus purchases of products and services). Thus, energy productivity is measured in 'GVA in EUR per kWh'; material productivity is measured in 'GVA in EUR per t of material', etc. Instead of this, the *resource intensity* indicator can also be used. This is nothing other than the inverse of resource productivity. Intensity values are recommended in particular to describe environmental impacts, because it makes little sense to speak of 'waste productivity' or 'CO_2 productivity'.[4] The *cost efficiency* indicator is additionally used to assess the economic efficiency of specific resource efficiency measures. In this case, two economic values – the cost of a measure and the obtained or obtainable benefit (savings) – are viewed in relation to each other.

However, when judging the resource efficiency of companies and of their products, the question of the system boundaries needs to be raised. Whereas in the past, it was common to look only at the production processes within the physical limits of a business, there is now an increasing tendency to consider the entire life cycle of a product or at least its upstream value-adding steps. In the latter case, one also speaks of the 'cumulative' energy, raw material or water requirement. The MIPS (Material Input per Service Unit) concept[5] developed in the 1990s at the Wuppertal Institute for Climate, Environment and Energy was one of the first attempts to establish a measure for the cradle-to-grave natural resource consumption of a product or service (raw material extraction, production, use phase, waste/recycling). This is related to the 'ecological backpack' model that reduces 'natural resource consumption' to a single factor, i.e. the quantity of material that is 'involved' in whatever way in producing, using and disposing of a product.[6] In this model, it is irrelevant whether a material is really used to manufacture a product or remains unused as waste (e.g. as overburden in mining). So the material volume is used as a proxy indicator to represent the ecological impact of the product throughout its life cycle. The ecological footprint model or its special form, the carbon footprint, work in a similar way, except that with these, the ecological impact of products and services is converted to a unit of square measure (hectare) or to tonnes of carbon dioxide, respectively.

2 *Effectiveness* is the degree to which a measure achieves objectives ('distance-to-target' in relative figures).
3 Detailied information can be found in: UNIDO, 2010 ▸.
4 The quotient of the economic value of a product and the environmental impact generated by its production is also called eco-efficiency. This may explain why the term 'carbon efficiency' is frequently used instead of 'carbon intensity'.
5 For further information see MIPS website ▸.
6 It would therefore be more correct in this context to speak of the 'material backpack' rather than the 'ecological backpack'.

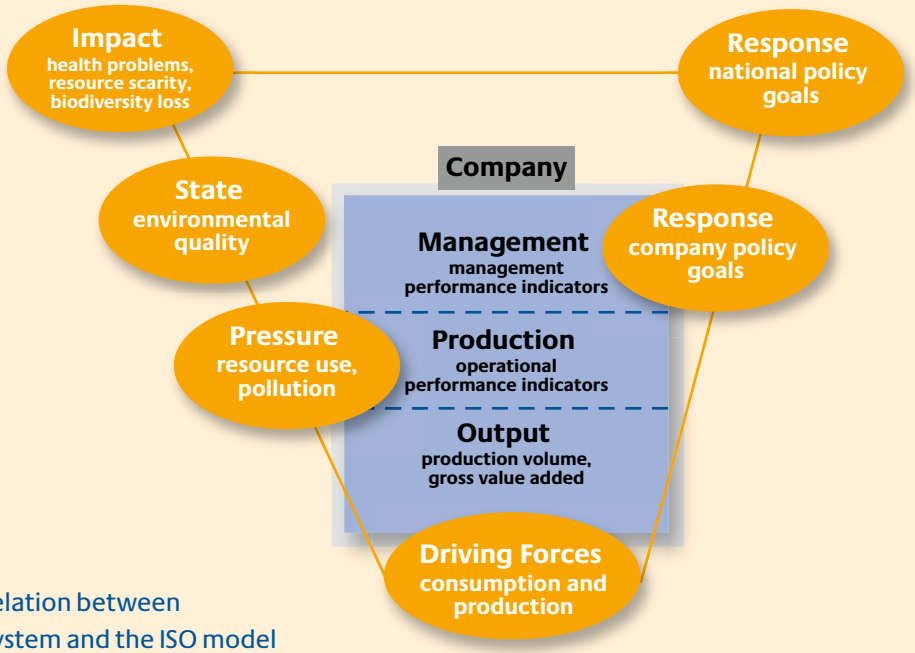


Figure 1: Relation between the DPSIR system and the ISO model

Aggregated indicators of this kind will become important if companies can be called to account for the downstream and upstream environmental impacts of their products, or if benchmarks based on life cycle assessments are established that are legally binding, entail the obligation to provide information or are linked to economic incentives. But, apart from a few exceptions, there is still a long way to go before such requirements will become obligatory.

Macro Indicators – Determining Resource Efficiency on the National Economy Scale

The EMAS and ISO indicators are not fundamentally different from the indicators used at meso level (industrial sectors) and macro level (national economies). Thus, also in a macroeconomic context, one speaks of material and energy productivity or of waste and emission intensity. In all these cases, the reference value is the corresponding 'gross value added' at national level, i.e. the gross domestic product (GDP). Nevertheless, the requirements to be met when collecting, controlling and processing data at national level are naturally much higher than at corporate level. Sound macro data can only be obtained if the micro data delivered by companies is relatively reliable and shows no systematic errors.

For some years, the DPSIR (Driver-Pressure-State-Impact-Response) model[7] proposed by the European Environment Agency has served as the methodological basis for creating environmental indicator systems at macro level. This is a further development of the OECD's PSR model dating from the 1980s. Figure 1 shows how this model correlates to the aforementioned indicator systems at micro level.

7 For further information see for instance: EEA, 1999 ▸ .

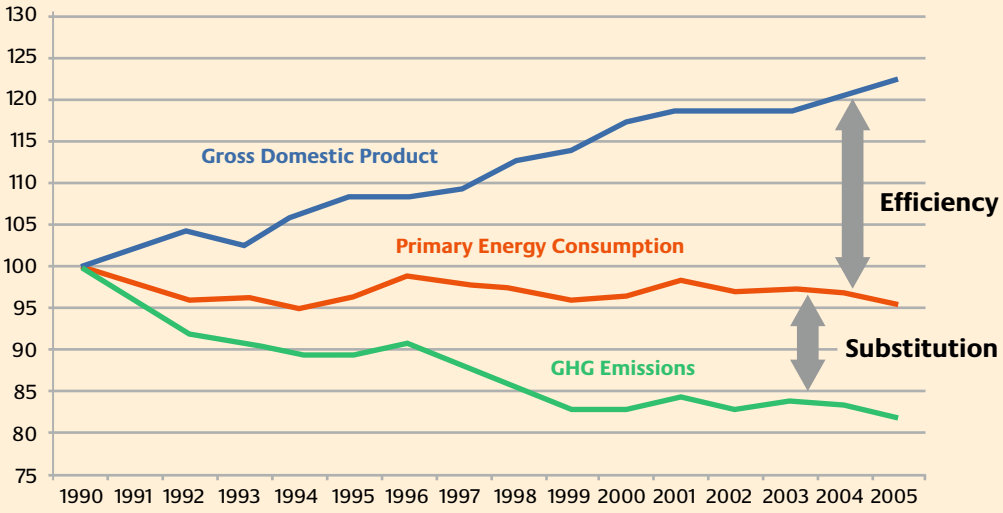


Figure 2: Decoupling of energy consumption and GHG emissions from economic growth (Germany)

Indicators can be formed both for each individual link in the DPSIR chain and for combinations of individual links. By relating the response to a pressure (environmental performance), for instance, one obtains an indicator that shows the effectiveness of the policy measure. Combined indicators of the type 'driver to pressure' or 'pressure to driver' are certainly most common. The first relates to 'productivity', the second to 'intensity'. Their importance is based on their suitability as indicators of decoupling. Figure 2 shows the extent to which decoupling has occurred in Germany between the 'pressures' of primary energy consumption and greenhouse gas emissions, and the 'driver' economic growth (GDP), since 1990 (Destatis 2000 ▸).

The degree of decoupling can be measured by relating the resource or emission intensities at the beginning and end of a given period to each other. Figure 3 explains the difference between no, relative and absolute decoupling for a random 'pressure value' (P) and rising gross domestic product (D).

As is known from countries with strong economic growth, the rise in absolute resource consumption or absolute emissions may be huge, even if decoupling is relatively pronounced. Thus, China's (absolute) energy consumption in the period from 2005 to 2010 rose by approximately 20 % although energy intensity was reduced by almost the same percentage during this period. China also set itself the objective of reducing greenhouse gas emissions intensity by around 40 % from 2005 to 2020. If GDP continues to grow by an average

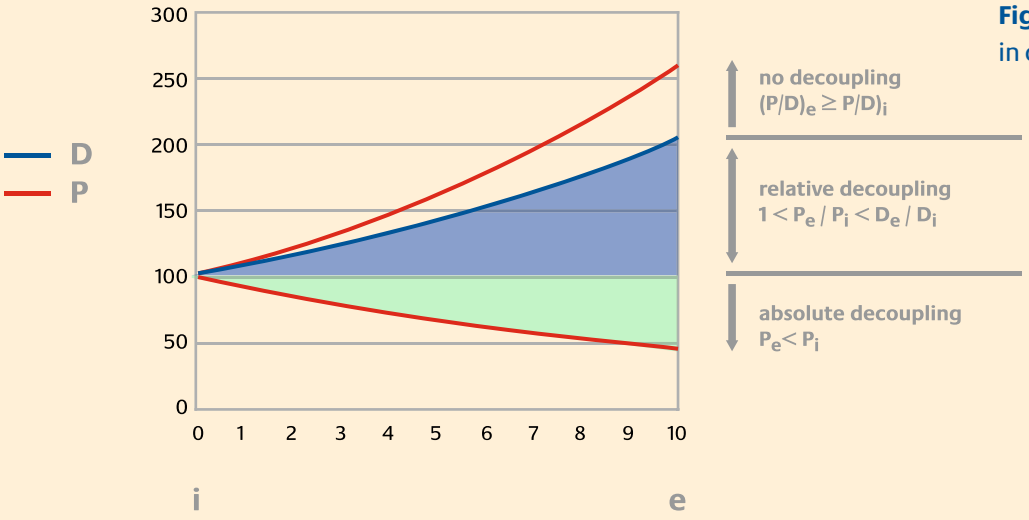


Figure 3: Decoupling in case of rising GDP

of 8 % per year, the (absolute) greenhouse gas emissions will almost double by 2020.

This example shows the dilemma the world is currently facing. Absolute resource consumption continues to grow in most countries (especially in the emerging economies), with commensurate greenhouse gas emissions, and the absolute decoupling in a few industrialised countries (including Germany) is far too low to compensate for this increase. To be fair, it should be added that countries with a high degree of material wealth and relatively modest economic growth naturally find it much easier than emerging and developing countries to reach the absolute decoupling stage.

Apart from that, the question that poses itself in this context is what exactly should we understand by a country's *resource consumption* and which indicator is most suitable for determining it. This question is controversial particularly with regard to *material consumption*. Extensive research has been done in this field in past years, especially under the auspices of the OECD. Consequently, there is now a wealth of experience in applying the material flow analysis (MFA) method developed in this context[8]. The strengths and weaknesses of the different ways of calculating material consumption are now also relatively well known.

It appears that the *Domestic Material Consumption* indicator (DMC) will assert itself as the international standard. Compared with the

8 For further information see for example: OECD, 2008

Direct Material Input indicator (DMI), it offers the crucial advantage of avoiding double counting by offsetting imports and exports (Physical Trade Balance). What it does not map are the *indirect material flows*. Thus, a country can apparently reduce its material consumption simply by transferring production sites abroad and importing capital goods and consumer goods instead. This produces so-called leakage effects in the relevant statistics, similarly to inventories of greenhouse gas emissions. So it is not enough to measure the imported products by their own weight; the raw material demand involved in their production (the raw material equivalent of the products) also has to be considered. In this case one also speaks of the *Raw Material Consumption* indicator (RMC).

Some go so far as to demand that *unused material* be included in the equation. This refers to the portion of indirect material flows that are produced as overburden in mining and as excavated material in construction. The corresponding indicators *Total Material Requirement* (TMR) and *Total Material Consumption* (TMC) are noteworthy in that they take into consideration the entire 'ecological' backpack of the imports, irrespective of whether these are raw materials, intermediate or end products. Since the efficiency of raw material extraction depends heavily on the geological conditions, however, it is questionable whether indicators that consider 'unused extraction' are really suitable for measuring a country's resource productivity. This is apart from the problem that the volume of overburden or excavated material can hardly be used as the sole assessment factor for the ecological impact of mining operations. It therefore makes more sense to speak of the 'total material backpack' of imports rather than of their 'ecological backpack'.

Target-based Resource Efficiency Policies: A Challenge for Development Cooperation

It is usually fruitless to proclaim policy goals that are not underpinned by indicators and targets. This is also true of the new policy field of resource efficiency. The following controversial statements about the EU's resource efficiency policy show that resource efficiency indicators have long ceased to be a theme that only interests a small group of specialists and statisticians:

"There is a saying that *what you don't measure you won't achieve*, and one of the most pressing objectives for me will be to *develop good indicators for resource efficiency*. Policy makers at all levels will need the right indicators and targets if we are to induce the right changes." (Janez Potočnik, European Commissioner for Environment, Resource Efficiency as a Driver for Growth and Jobs, March 2010)

"Target-based resources policies must be considered very cautiously. *The concept of resource efficiency can hardly be restricted to a simple numerical target* such as a universal resource productivity target, recycled content in materials or to a limitation in the use of specific resources for their criticality." (BusinessEurope, Contribution for EU Policy Assessment on the Sustainable Use of Natural Resources, including Resource Efficiency, April 2010)

The conflicts of interest revealed by such statements are also one reason why politicians find it so hard to establish binding indicators and targets. Thus, the EU Commission took about two years to add indicators and targets to the *Roadmap to a resource-efficient Europe* that

was adopted in September 2011. The German Resource Efficiency Program ProgRess has also postponed a decision on concrete targets for the time being. By contrast, establishing targets at corporate level has meanwhile become a widespread practice, mainly due to companies' interest in obtaining ISO or EMAS certification. But the fact that politicians are comparatively reluctant to follow suit is not due merely to the resistance of business associations to any attempts to prescribe targets. It is also due to the high methodological and technical requirements related to establishing reliable baselines and monitoring the achievement of objectives at macro level. As long as the significance (informative value) of an indicator is controversial and data collection remains an insoluble task for statistical offices, there would appear to be little sense in defining targets. This is precisely the situation found in most developing countries.

Development cooperation usually operates between two different levels: the corporate (micro) level and the policy (macro) level. This means most of its activities are carried out in the broad field of intermediaries. This is also reflected in the project outcomes and the corresponding target indicators, which mainly describe results that are to be generated at the meso level. Several examples taken from GIZ project descriptions are given in the box below. The same box also contains some indicators for outcomes at corporate and policy level. However, these types of indicators are found much less frequently in project descriptions than at the intermediary level. This is no coincidence: usually, observable changes at the micro or macro levels can only be indirectly or partially attributed to a project. This certainly applies to project approaches that are restricted to capacity building measures and are therefore generally unable to make a direct and measurable contribution towards implementing specific policies and measures.

Beyond that, there is also a major difference between the relevance of micro and macro indicators. Unlike the indicators at enterprise level, macro indicators derived from environmental accounting and used for sustainable development, green growth or decoupling strategies are usually well beyond the sphere of influence of development cooperation programs. It is for this reason that corresponding national policy goals, in case they actually exist in a partner country, are not directly reflected in the outcomes of a program but just serve as a rationale and strategic compass. Of course, this does not relieve development cooperation of the duty to think about how it can provide the most effective support for developing and implementing national resource efficiency strategies and thus contribute to achieving decoupling targets. One way to do so consists in advising partner governments on setting up a system of macro indicators which, in the future, will help them to establish nationally appropriate policy goals and targets.

Selected target indicators for resource efficiency – Examples from GIZ project descriptions

Intermediary level

- "Consultancy Organizations offer companies qualified services with regard to energy efficiency issues."
- "The partner Organization carries out at least 8 consultancy assignments each year for private sector companies and other Organizations on measures to increase energy efficiency."
- "A database on advisory services (...) has been set up and is maintained."
- "At least two new training courses are on offer in the field of energy efficiency."
- "At least two environmental management instruments (...) for integrating environmental issues (...) have been developed and tested and are being adopted by the partner organisations."

Corporate level

Operational performance:

- "The specific consumption of resources (energy, water, raw materials) goes down by at least 10 % at a minimum of 50 companies that have received support in introducing environmental management methods and optimising their production processes."
- "Specific electricity consumption has been reduced by an average of 5 % in 20 large electricity consumption units."

Management performance:

- "At least 50 % of industrial companies under the obligation to submit energy reports have achieved their targets to improve energy efficiency in line with the Energy Conservation Act."
- "x companies use the services offered by private sector companies, associations or governmental Organizations to improve energy efficiency, and take corresponding action."

Policy level

- "At least two changes in the legal frameworks (...) have improved the prerequisites for increasing energy efficiency (...)."
- "Based on macroeconomic models, two recommendations will be submitted to the government for designing an energy policy that is geared towards energy efficiency."

4 Training Course on Resource Efficiency

The different approaches for promoting resource efficiency (RE) in economic activities as described in previous chapters have to be incorporated into policies, plans and programs in partner countries to become relevant in practice. This challenge is far from being trivial. Even if concepts of integrating resource efficiency might be understood, they have to be made operational and 'translated' into concrete policies and actions within the frame of Economic Development Programs, SME support strategies, Fiscal and Sector Reforms, Environmental Action Plans, etc.

An adequate framework for policy development and implementation in this complex field can be provided by a National Resource Efficiency Action Plan or Program (REAP). The REAP should be understood as a process - rather than a mere planning document - which organizes the agreement on national goals for RE, on adequate measures to achieve these goals, on responsibilities, time frames and conditions of implementation, and finally on monitoring and evaluation mechanisms.

Several countries have started to develop REAPs, among them Austria, the UK, Japan with its so-called 3R-concept and Germany with its Resource Efficiency Program (ProgRess). An important point of departure for EU member countries was set 2005 by the Thematic Strategy on the Sustainable Use of Natural Resources and, recently (2011), by the Flagship Initiative *A resource-efficient Europe* and the *Roadmap to a resource-efficient Europe*.

Training Concept: Objectives, Target Group, Content

The challenges of a REAP process form an important reference point for the training. The interactive and integrative character of REAP development defines the course's objectives, content and methods.

With this background, the overall objectives of the training are:

- to familiarize senior officials, experts and decision makers of relevant sectors - such as economic development, SME promotion and environmental management - with the potentials and challenges of RE programs such as REAP;
- to provide them with orientation on concepts and concrete approaches for promoting RE; and
- to qualify them for incorporating appropriate RE approaches into their sector related strategies and activities.

A REAP cannot be drafted in an uniform, 'blue print' fashion. Rather it has to build on existing relevant policy approaches, integrate additional activities into sector programs using critical entry points, and should use incentives adjusted to the concrete situation as well as communication strategies. The training concept imitates this approach by focusing on a REAP development process from different angles rather than suggesting a REAP design 'straight out of the box'. Different modules will reflect these different challenges and entry-points into the subject.

As a further guiding principle, the training addresses RE related challenges of the mentioned target groups in their day-to-day work and focuses on practical solutions, rather than providing theoretical knowledge on RE. As an adequate way to pursue this approach the training reflects case situations, which could stem from the practical work of the participants. These are centered around a planning situation in a developing country, where existing plans and programs have to be screened regarding their relevance and potential for including resource efficiency measures. In a second step, the relevant planning elements have to be optimized and condensed into a REAP.

The different modules of the training include practical exercises as so called case work, some of which support a general orientation on entry-points, challenges and potentials of RE programming, and on tools available at the enterprise level such as Efficiency Checks.

In particular, the following content fields are subjects of the training:

1. Concepts for RE in policy and program formulation;
2. Approaches for including RE through concrete measures;
3. Instruments for promoting RE in SME sectors; and
4. Principles for monitoring and evaluation as well as definition and use of indicators.

The case situation mentioned above takes place in a fictitious developing country called Ganama. Details are shown in Box 1.

Training Method and Structure

The key teaching approach selected for pursuing the mentioned process and practice orientation is the Harvard Case Method. This well-proven approach for interactive adult learning achieves its practice-orientation through practical case related exercises. The process character of REAP development is mirrored by the case method through its module-like structure, which allows for exploration of different entry points and aspects of REAP development through subsequent modules. The case method stimulates active development of conclusions by the trainee through intensive discussion within a group format, rather than providing ready-made teaching messages.[1]

The case method requires intensive preparation. In particular, case/training materials have to be handed out to trainees and elaborated upon prior to the course. These materials exist in principle for the RE training course, but might be further adjusted to a concrete course application.

The materials usually consist of the following issues:

- Introduction to the case: baseline situation, problems faced, challenges arising,
- Working materials: data, specific information, work sheets, etc., facilitated through the use of lists, charts, maps, etc. which can be attached in exhibits,
- Possible information on institutional setups and other relevant background information,
- Clear instructions on the main tasks for the trainees during group work.

1 For in-depth background reading on the Method it is recommended to visit the HARVARD website: ▸

Box 1: Case construction for the RE Training

Ganama is a development country with 22 million inhabitants and a territory of 240,000 km², located in the tropics. It shows a medium level of development with an HDI of 0.72 (in comparison: Egypt 0.703, Indonesia 0.734). The GDP growth is considerable and ranges between 5.3 % (2009) and 8.2 % (2007).

The Government of Ganama makes significant efforts to maintain and further stimulate economic growth. Policy approaches include loan support programs to keep the interest rates at low level, as well as support schemes to artificially keep energy prices down. The subsidy policy leads to considerable national debt and increases inflationary pressure.
The Government of Ganama pursues an ambitious policy to transfer its economy from old patterns of heavy and dirty industries towards modern, export oriented economic sectors. Relevant sectors of these innovative paths of economy comprise the textile, metal, food, and electronic industry.

The country has large quantities of coal in the northern 'coal belt', which is currently observing a decline in output. All other sources of energy have to be imported. The country has significant potentials for renewable energies (especially biomass, solar and wind), which have not yet been exploited.

As part of its strategy for economic modernization, but also as a means to keep resource import expenditures low and to combat projected supply bottlenecks for some key resources, the country increasingly engages itself in strategies for resource efficiency. Recently, the Government of Ganama decided to establish a **Resource Efficiency Action Plan (REAP)**

The REAP should make as much use as possible of adequate approaches for RE, which might be already reflected in existing plans and programs. In this respect, the following plans and programs are of particular interest and are being evaluated during case work:

- the **National Environmental Action Plan (NEAP)** of Ganama of 2002, which stipulates a number of 'conventional' environmental policy measures such as pollution abatement, but also offers elements of relevance to RE such as environmental management in industrial parks;
- the **SME Promotion Program** of Ganama of 2005, which aims at higher performance quality and better market access for different SME sectors, while also offering entry points for RE such as advisory services for SME;
- the existing **Credit Line for promoting environmental protection in SME** provides credit access to the business sector for environmental investments in general but could also be used for RE improvements in particular;
- the new **Energy Strategy** for Ganama of 2008, which aims at securing energy supply for Ganama but also includes approaches on energy efficiency.

The REAP should devise additional and appropriate measures for promoting RE where existing approaches in the programs and plans mentioned above seem to be insufficient. Further, the REAP should ensure a stringent implementation mechanism, supported by a monitoring & evaluation scheme, to ensure efficient accomplishment of its goals.

The trainees play the role of members of a national committee for developing the REAP and are as such exposed to different challenges in the elaboration of an Action Plan.

Box 2: The five 'golden rules' for a Harvard Case teacher

Rule 1: Don't spell out the messages of the case directly. Let the trainees find the conclusions out by themselves. Guide them through questions.

Rule 2: Provide enough time for the wrap-up phase where the messages and conclusions from the exercises are intensively discussed by the participants.

Rule 3: Be very precise with your instructions for the case work/exercises. The trainees should start into the case work with a clear vision on what they have to do.

Rule 4: Limit presentations. Don't talk longer than 15 minutes (except the introductory lectures). If necessary, split lectures into several shorter inputs.

Rule 5: Always invite the trainees to reflect on how the lessons learnt relate to their day-to-day work or how trained approaches should be adjusted to fit it.

This method requires trainers, which are trained on the specific approaches and techniques. Some essential rules for a trainer conducting Harvard Case training are condensed in Box 2.

The following types of elements are used to compose the course:

- **Lectures:** Mainly at the beginning of the course and as short introductions to each case work. Duration of the main lecture at the beginning of the course: 45 minutes, introductory lectures for each case work: approx. 10 - 15 minutes.
- **Case work:** The central exercises, which allow interactive elaboration of the main teaching points in small working groups and, later, through joint exploration with the trainer. Duration of each case work (group work and joint wrap-up) approx. 90 minutes.
- **Action Learning exercises:** For additional insight as well as 'energizers' for improving group dynamics. Duration of each action learning approx. 15 – 30 minutes.
- **Peer-to-peer advice:** Towards the end of the training, a volunteer participant shares a case from his/her real work experience; the peer-trainees analyze the case and provide advice based on the lessons learnt during the training. Duration: approx. 90 minutes.

The composition of these elements follows an overarching logic of content for the training, which starts with a general perspective of planning and policy formulation (case work 1 and 2), goes down to concrete action level exemplified for enterprises (case work 3) and ends up with the overarching question of how to monitor and evaluate the impacts of a REAP (case work 4).

The following scheme specifies the concrete elements of the training.

Title of training element	Goal of training element	Main teaching messages	Input by trainers	Course of action for trainees
Introductory lecture	Trainees understand main concepts and challenges of RE.	• Importance of RE in green economy / sustainable development • Concepts for RE (circular economy, decoupling etc.) • Approaches for programming RE • Policy instruments and incentives	Lecture Slide presentation	Reflection by participants in open debate, corner game, station work etc.
Case Work 1: Analyze plans / programs regarding their relevance for RE	Trainees understand the concept of entry points and integration of RE.	• Different activity fields offer different entry points for RE approaches / tools. • Some activities offer good potentials for adjustment in order to promote RE.	Introduction Working materials Wrap-up boards	Some activity fields of existing plans of Ganama (example in box 3) will be analyzed regarding their relevance for RE along certain categories.
Case Work 2: Devise new action fields which improve RE	Trainees reflect substantial options for RE integration.	• RE approaches have to be applied to plans / programs in a hand-tailored way. • How can existing policy approaches be made more RE relevant?	Introduction Working materials Wrap-up boards	The activity fields of case work 1 will be analyzed regarding options for adaptation to better reflect RE and for new activities fields necessary to strengthen the overall RE orientation.
Lecture on Resource Efficiency at enterprise level	Trainees understand management approaches and tools for RE at enterprise level.	• Various tools are available, which promote resource efficiency at enterprise level (efficiency check, Environmental Cost Management, EMAS, etc.). • Different tools offer different potentials and depend on specific requirements.	Lecture Slide presentation	Preparation for next case work
Case Work 3: Framework development for an efficiency check	Trainees understand the principles of an efficiency check at enterprise level.	• Efficiency checks comprise a set of guiding questions and criteria.	Introductory instructions Working materials Wrap-up boards	Trainees develop categories and guiding questions for checking RE in an enterprise. The results are being compared with 'real' efficiency checks.
Lecture on indicators	Trainees understand systematics and potentials of RE oriented indicators.	• The DPSIR concept offers good orientation of RE indicators • Indicators have different function and depend on different requirements	Lecture Slide presentation	Preparation for next case work

Title of training element	Goal of training element	Main teaching messages	Input by trainers	Course of action for trainees
Case Work 4: Monitor and evaluate achievements in RE	Trainees understand M&E as crucial element of the process approach for RE.	• RE measures have to be monitored regarding their effectiveness. • Different types of indicators exist to describe successes.	Introduction Working materials Wrap-up boards	Based on assumed objectives of the REAP, appropriate indicators will be devised and discussed.
Peer-to-peer advice	Trainees are able to apply the knowledge gained to new and real cases	• Each case provides specific challenges. • General concepts and available tool boxes allow promotion of appropriate RE approaches.	Trainee shares own case from day-to-day work, Trainer provides methodology and framework for cooperative advice.	The case shared by a trainee is intensively discussed among the rest of trainees. Advice is offered and debated with the first trainee.

As discussed, the trainees undertake case work in self-organized subgroups. This is the venue for gaining practical experiences through exposure to concrete challenges. These will form the basis when gaining insights during the wrap-up phase.

The structure and content of a case work are exemplified by the 'Case Work 1: Analyze plans/programs regarding their relevance for RE'. The trainees receive a selected set of activity fields of the four existing plans/programs of Ganama as mentioned in the case construction in Box 1. Within a matrix, the participants have to rank the given activities along their relevance for resource efficiency in general and the envisaged REAP in particular.

Suggestions for the Implementation of the Training

A concrete training course will be composed of all or selected elements as explained in the previous section. This module-like structure provides some flexibility to 'hand-tailor' an individual course depending on available time, the concrete target group and envisaged main teaching points. The maximum duration of the full course will amount to two days. Shorter versions of the course can be designed down to a minimum of 1/2 day duration. Box 3 illustrates an example for an agenda for the full version of the training.

The training is especially relevant for supporting capacity development within the framework of bi- and multilateral development cooperation. The best impact will be achieved if the training is not conducted separately, rather embedded into other ongoing cooperation activities. This connectivity will enable synergisms between training and practical application.

Ideal frameworks for the training are projects/programs of bi- or multilateral development assistance with relevance to RE. These could be programs on institutional development for urban and industrial environmental policy, programs for green economy promotion or for sustainable industrial development. GIZ appreciates indications of interest in this respect and offers to adjust the training to the specific situation of a particular program.

Another option for embedding the training would be in international processes on green economy and sustainable development, such as relevant programs promoted by UNIDO and/or UNEP.

To apply the interactive methodology, the training is limited to a number of trainees of approximately 25 per course. Since the group will be split in subgroups, two trainers/facilitators are required, who have to be trained in the Harvard Case Method. This can be done within a 'train-the-trainers' course prior to the first application. A newly composed course should usually undergo a test-run with knowledgeable observers to optimize content and structure of the course.

Box 3: Example for an agenda

Day 1	
8:30	Registration & distribution of training materials
9:00	**Opening of the Training Course**
9:10	Introduction of participants Introduction to course and methodology
9:45	**Introductory lecture on RE**
10:45	Tea break
11:15	**Corner game: Reflection of Lecture**
11:45	Introduction to Ganama and Case Screenplay
12:00	Lunch break
13:00	**Case Work 1: Analyze plans / programs regarding their relevance for RE** – Introduction – Case work – Wrap-up & Discussion on how this relates to participants' context – Example
14:30	**Action learning: Group Juggle**
15:00	Tea break
15:30	**Case Work 2: Devise new action fields which improve RE** – Introduction – Case work – Wrap-up & Discussion on how this relates to participants' context – Example

Day 2	
9:00	Energizer
9:15	**Lecture: Resource Efficiency at enterprise level**
10:00	Tea break
10:30	**Case Work 3: Framework development for an efficiency check** – Introduction – Case work – Wrap-up & Discussion on how this relates to participants' context – Example
12:00	Lunch break
13:00	**Lecture: Indicators for RE**
13:30	**Action Learning: Secret Code**
13:45	**Case Work 4: Monitor and evaluate achievements in RE** – Introduction – Case work – Wrap-up & Discussion on how this relates to participants' context – Example
15:15	Tea break
15:30	**Peer-to-peer advice**
17:00	**Course evaluation** – Smileys – Evaluation Sheet – Short discussion
	Closing remarks **Distribution of certificates**
17:30	End of the course

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