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## Resource Efficiency in Developing and Emerging Countries

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In recent years, resource efficiency has developed into a key issue for the future. Consumption of scarce natural resources is rising rapidly around the world. This is leading not only to substantial rises in world market prices and increased supply risks, but also to greater environmental pollution and more conflicts over resource distribution. This paper examines the significance of resource efficiency for developing and emerging countries which, as at today, already consume more than two thirds of the world's natural resources. While developing and emerging nations are particularly hard hit by the adverse effects of increasing resource consumption, at the same time between 70% and 85% of the savings potential can be found within this group of countries. To realise these savings in the future will require a broad spectrum of strategies and policy instruments, including ambitious legal and economic regulation, specific measures to encourage investment, and the provision of information and consultancy services.

The depletion of natural resources is increasingly seen as a global threat to sustainable development. This ongoing rise in resource consumption is partly reflected in massive price increases on raw material markets. The environmental damage caused by both the extraction and consumption of resources is also viewed as a cause for concern. There is now a much greater awareness that our planet's natural resources are finite and that, as the population rises and economic activity increases, they are nearing their limits. As a result, resource efficiency, alongside climate change mitigation and biodiversity, has developed into a major topic in national and international environmental, economic and development policies over the last ten years.

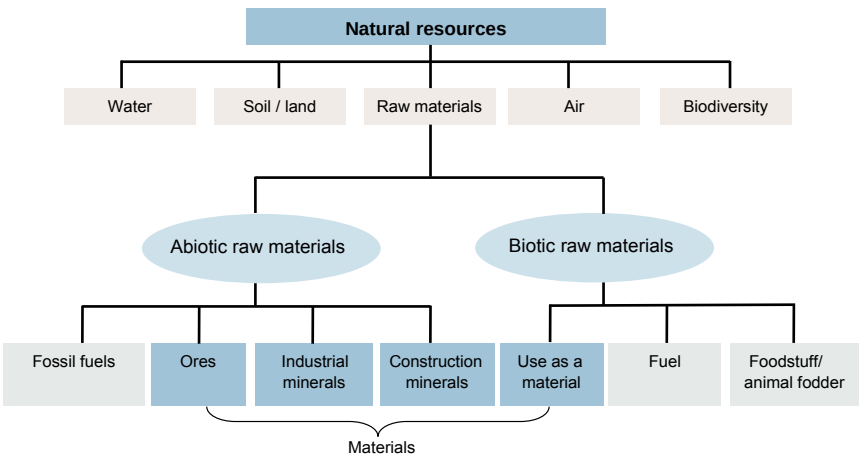
In Germany, the aim of doubling productivity in energy and raw materials by the year 2020 was embedded within the 2002 National Sustainability Strategy. This was followed by a strategy for securing raw material supplies (BMWi 2010) and the Resource Efficiency Programme (BMU 2012). The theme has also been increasingly addressed within German development policy (e.g. BMZ 2010, GIZ 2011). Improving resource efficiency is also at the top of the European agenda. Prime examples here include the Thematic Strategy on the Sustainable Use of Natural Resources (2005) and the EU Commission's Flagship Initiative for a Resource-Efficient Europe (2011). At the international level, the topic goes back to the Rio Summit (1992), and it gained further impetus from the Marrakech Process on Sustainable Consumption and Production (2003). More recent initiatives within the UN framework include UNEP's International Resource Panel (2007) and UNIDO's Green Industry Initiative (2008), which aims to support developing countries along the road to resource-efficient methods of production.

Using natural resources efficiently is a challenge of global proportions. In the past, this topic has frequently been addressed from the perspective of the industrialised countries (and especially from the angle of raw material supply security); in contrast, this paper focuses on the significance of resource efficiency for developing and emerging nations.

### What is resource efficiency?

Resource efficiency, energy efficiency, raw material efficiency and material efficiency are all terms which are used in the public debate on this issue without there being consistent clarity over the scope of the term "resource". Natural resources cover a broad spectrum (see Figure 1). Natural resources, in the more narrow sense of the term, comprise biotic raw materials such as biomass (from vegetable and animal sources), and abiotic raw materials such as fossil fuels, minerals used in industry and construction, and metallic resources. There is a sub-category "materials" which consists of, firstly, abiotic non-energy raw

**Figure 1: Natural resources**



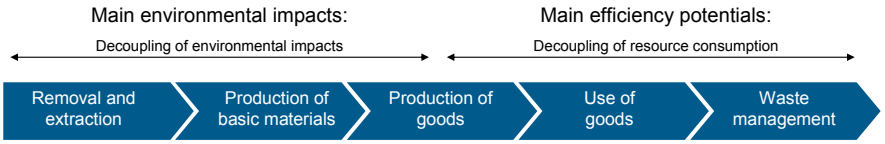

Source: BMU (2012)

materials and, secondly, biotic resources for material use. In a wider sense, natural resources also encompass environmental media – water, air, soil/ land and biodiversity. Whereas Germany's Resource Efficiency Programme uses the narrow definition, the European Commission also considers natural resources in their wider sense.

Resource efficiency is generally defined as the efficiency with which natural resources are used, either at a national level, or within given sectors, companies, or individual production processes, i.e. the value added per unit of resource input. Resources serve as inputs to production processes and form the basis of economic activity and material prosperity. This input-based definition of resource efficiency has sometimes been extended to include the avoidance of damage to the environment (Faulstich et al. 2009). Although this leads to a blurring of the boundaries between resource policy and environmental policy, it means that, when evaluating products and processes from a holistic, life-cycle perspective – i.e. an assessment which covers each stage of the value chain, including extraction, processing, use, and dismantling and/ or recycling – one cannot avoid giving this aspect due consideration (see Figure 2).

Furthermore, efforts are being made at a global or national level to decouple economic activity from resource utilisation and also from environmental impact (Fischer-Kowalski et al. 2011). The former should be achieved primarily through productivity improvements, i.e. using a smaller quantity of natural resources per unit of economic production. The latter can be attained as long as the level of environmental impact reduces or remains stable as economic activity grows.

**Figure 2: Main environmental pressures and efficiency potentials along the value chain**




Data source: SRU 2012

## Resource efficiency in developing and emerging countries

### Sharp increase in resource utilisation – and the trend is upwards

Despite a 38% improvement in global resource productivity, the worldwide consumption of biomass, metals, minerals, and fossil fuels has almost doubled over the last thirty years, rising from 39 billion tonnes in 1980 to 67 billion tonnes in 2008 (Dittrich et al. 2012). China and other emerging economies have industrialised and expanded their infrastructure; and as a result, the demand for metals and for minerals used in industry and construction has grown at an above-average rate. In the context of resource extraction worldwide, the share of non-renewable resources presently stands at around 70%; evidence of our economy's dependence on fossil fuels, metals, and minerals.

Developing and emerging countries are today responsible for over two thirds of the world's total direct consumption of resources. Asia, being the world's largest producer of energy and materials, consumes over half of the resources extracted globally; in 2008, China alone was responsible for almost 30% of global consumption. Africa and Latin America consume 7% and 11% respectively, while the proportions consumed by Europe and North America have fallen to 15% and 14%. However, if we look at consumption on a per capita basis, a different picture emerges: at 8.7 tonnes, Asia is certainly ahead of Africa (5.3 tonnes), but still well behind Europe (14.7 tonnes) and North America (27.5 tonnes). Low-income countries use an average of just 3.7 tonnes per head of population, and their consumption is predominantly comprised of biomass, such as foodstuffs, feedingstuffs and charcoal.

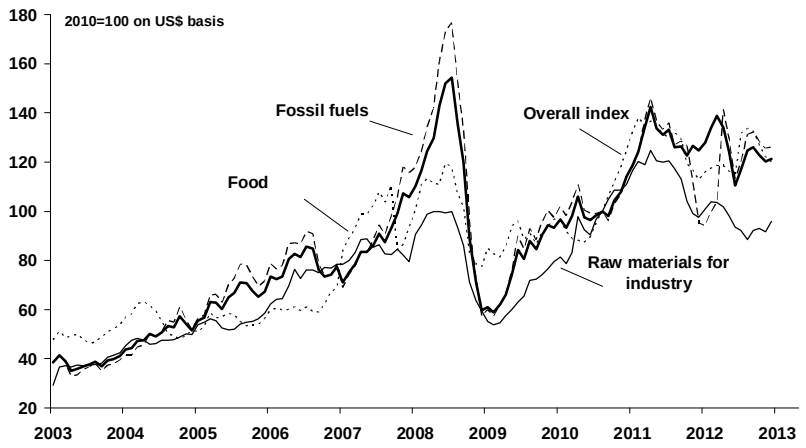
If the standards of living in developing and emerging economies become more closely aligned to the levels of industrialised countries, and appropriate efficiency strategies are not introduced, there will be a dramatic increase in the consumption of energy and materials. Equalisation with the average standard of living in OECD countries would lead to a resource consumption figure of 180 billion tonnes by 2050 – almost three times the present level. Furthermore, continued growth in the global population (which is expected to reach an estimated 9 billion by 2050) will, together with the expansion of the middle class, serve to intensify competition for increasingly scarce resources (including water, foodstuffs, and productive areas for agriculture and forestry) and increase the danger of national and global conflicts over the distribution of resources.

### Risks to price and supply stability threaten economic development

Since the millennium, the acceleration of economic growth in the emerging countries has been reflected in rising raw material prices (see Figure 3). Despite sharp fluctuations (which are partially a cyclical phenomenon), the overall index of world market prices for food and beverages, industrial raw materials and fossil fuels has more than trebled over the period between 2003 and 2013. Strategic metals and metals for high-technology applications – used, for example, in electronic devices, fuel cells, wind turbines, photovoltaics and other new technologies –- have also demonstrated substantial price volatility, and prices have increased significantly. The strategic metals price index published by the German Federal Institute for Geosciences and Natural Resources (BGR) has, on a US dollar basis, increased over the last ten years by a factor between five and six. Estimates suggest that demand over the next twenty years for many high-tech metals such as indium, gallium and tantalum will far outstrip current levels of production (Angerer et al. 2009).

Future trends in global raw material prices are difficult to predict. They will depend both on demand-side factors such as the global economic cycle, new technological developments and the rate of economic growth in large emerging countries, and on supply-side conditions as well. Supply constraints and risks to price stability pose a threat not only by virtue of increasing shortages and rising production costs, but also because, on the supply side, certain raw materials (such as some fossil fuels and metals) are concentrated in just a small number of countries which, furthermore, are often politically unstable. Countries which export raw materials such as Chile, South Africa, Zambia and Namibia certainly benefit from price increases on individual raw materials through increased export earnings and additional state revenues; but, for most importing countries, adjusting to these prices leads to substantial costs, both social and economic. For example, volatility in foodstuff markets and rising foodstuff prices threaten not only to create balance of payment deficits and jeopardise macroeconomic stability; in the poorest countries they can also lead to food crises, poverty, and hunger.

**Figure 3: HWWI Index of raw material prices on world markets**




Data source: author's own representation, based on Wirtschaftsdienst, http://www.wirtschaftsdienst.eu/archiv/index.php?mode=rubrik&rubrik=7

### Environmental pollution from increased resource consumption

Furthermore, the ecological dimension is playing an increasingly important role in resource extraction and consumption. The global increase in resource utilisation is accompanied by local and global environmental effects – some of which have a massive impact – at every stage in the value chain. These include detrimental effects on ground water and surface waters due either to high levels of water consumption or contamination, extensive land use and loss of landscape, major interventions in local ecosystems, toxic effects on humans and the environment, and energy-related emissions. The mining, extraction and primary processing of metals, for example, requires increasing amounts of energy due to falling concentrations of ore; whereas in the case of limestone, a mineral raw material, it is primarily production processing (cement manufacture) which demands a high level of energy use. Cement production is responsible for roughly 8% of global greenhouse gas emissions. Burning coal, gas and oil contributes over two thirds of the world's greenhouse gas emissions. Both now and in the future, it is predominantly the developing and emerging countries – which frequently lack adequate environmental standards and are extremely vulnerable to climate change and environmental pollution – that must bear the consequences of this global use of resources.

### Huge risks on one side, enormous savings potential on the other

According to a study from McKinsey (Dobbs et al. 2011), there is substantial potential for increasing resource efficiency in the areas of energy, steel, water, and land. Exploiting this potential could save up to 30% of the global demand estimated for the year 2030. There is scope to save over 100% of the increase in demand forecast for the year 2030 in land use, over 80% of the increase anticipated for energy, 60% of that forecast for water and over 25% of that for steel. The overall scope for savings available in developing and emerging countries is estimated to be very high, representing between 70% and 85% of the total worldwide potential. Over three quarters of the global savings potential can be achieved by taking measures in fifteen areas which have been identified as priorities. These areas include:

- Building energy efficiency
- Large-scale farm yields
- Food waste
- Municipal water leakage
- Urban densification
- Iron and steel energy efficiency
- Smallholder farm yields
- Transport efficiency
- Electric and hybrid vehicles
- Land degradation
- End-use steel efficiency
- Oil and coal recovery
- Irrigation techniques
- Road freight shift
- Power plant efficiency

About 70% of the measures in these areas have an internal rate of return above 10% at today's prices. However, due to a wide variety of obstacles, some 40% of the savings potential can only be achieved with difficulty, and hence suitable guidance needs to be put in place at a national or global level.

There are substantial regional variations in savings potential: in Africa the greatest scope for improving efficiency lies in the use of water and land, while the main potential savings areas for emerging countries such as China are energy and steel.

## Potential measures to promote resource efficiency

Even in times of rising prices, the existing potential for improving resource efficiency is not automatically realised through market mechanisms. Although price increases offer some incentives for greater efficiency in the use of natural resources, there are numerous barriers and obstacles to overcome, especially in developing and emerging countries. These include a lack of access through local banks to equity or debt capital, a lack of technological know-how, the non-availability of certain technologies, and information deficits.

A broad spectrum of tools is available to promote resource efficiency. These include legal, economic and information tools (e.g. Reuscher et al. 2011; GIZ 2011). There are potential intervention points along the entire value chain, from extraction, processing and use, right through to dismantling and/ or recycling. From the developing and emerging countries' perspective, the following measures are of particular interest:

### Establishing/ expanding a legal framework for resource efficiency

The opportunity which is traditionally open to legislators is to prescribe efficiency in the use of natural resources by enforcing standards for processes or products. However, in most developing and emerging nations this approach is only in its infancy, and is often difficult to implement because of the weakness of state institutions. To avoid overtaxing the limited administrative capacities available, suitable standards should be developed based on priority. This should start with those areas which have the greatest savings potential, e.g. specifications for heating, air conditioning and lighting in buildings, for implementing efficient methods of irrigation in agriculture, or for minimum levels of efficiency in power stations.

Legal stipulations carry mandatory force and are targeted with relative precision; but they are generally considered to be inflexible and to discourage innovation, as they are based on the present state of technology. Hence their primary contribution is to disseminate the best available technology (BAT). How-

ever, in the majority of developing and emerging countries, this would still be an improvement on the status quo. The more advanced emerging nations could also implement dynamic standards, using Japan's Top Runner programme as a model. Under this scheme, energy efficiency standards are set for different groups of products. These standards are geared towards the most energy-efficient products currently on the market, and are updated in line with technical improvements. Yet even dynamic standards can create rebound effects, i.e. efficiency gains may be reduced or even completely offset by increased demand or demand variations.

### Levies to encourage greater efficiency in the use of resources

Another possible approach, especially in emerging countries, is to apply levies (taxes and fees) on the use of resources. The aim of these charges is to "price in" the external costs of resource utilisation, and to provide price signals – in line with source pricing elements – which will encourage the saving of resources. Price controls are less precisely targeted than legal requirements, but they are more innovation-friendly and less susceptible to rebound effects.

Levies can be raised at every phase of the value chain. Levies imposed at the start of the value chain set price signals which are aimed primarily at increasing efficiency in extraction and production; however, they also have an influence on incentive structures in the later phases of the value chain (e.g. energy taxes, taxes on construction materials, or charges for water usage). Alternatively, levies can also be imposed at the end of the value chain. A relatively simple approach, but one which has yet to be put into practice, is to introduce differentiated rates of value added tax (graded according to material intensity, as an example). Another possibility is to introduce levies in the recycling and disposal area (e.g. landfill taxes, charges for wastewater and waste disposal, or bottle deposit charges).

### Financial promotional measures

Because external costs are not priced in, and also because the initial investment can be high, resource efficiency measures do not pay for themselves on an individual basis. Furthermore, it is difficult for companies in developing and emerging countries to obtain equity and external capital, especially in the SME sector. Some of the reasons for this are: local financial sectors are frequently underdeveloped and have virtually no experience of innovative financial products in the resource efficiency area; project and credit risks are difficult to estimate; and private risk capital is in short supply.

In order to overcome these financing difficulties and encourage companies to be more innovative, incentives can be offered: grants towards investment costs, loans at subsidised interest rates, or tax relief provisions. Once again, such actions should be taken first of all in those areas with the greatest potential for improving resource efficiency. To reduce food losses, for example, financing could be provided for new cold stores. Other effective options include providing financial support for the rehabilitation of facilities in the energy sector, or for energy-efficient, sustainable buildings.

### Consultancy services to overcome information deficits

Lack of information is a frequent obstacle to resource efficiency. This relates firstly to entrepreneurs: the available savings potential, particularly in small and medium-sized operations, frequently goes unrecognised, and the investment required – which would be self-financing – is not forthcoming (Wied and Brüggemann 2009). Competent consultancy services are needed to develop this type of efficiency potential. This can be promoted by expanding national consultancy organisations, for example by using the German government's material efficiency agency as a model.

Secondly, information deficits also affect consumers, as inadequate information makes it difficult to choose and buy resource-efficient products. The use of labels and identification marks, which provide product information in a condensed form (on building efficiency, for example) can provide a solution here. Labels and identification marks mainly target the consumer but also create incentives in the earlier stages of the value chain. However, resource efficiency labels are arguably at best an option in the more highly developed emerging countries.

### Using state purchasing power

Finally, another important approach is to apply regulations which target resource efficiency when awarding public contracts. Public procurement represents a significant economic factor, especially in developing and emerging countries. In this respect, governments can exert a substantial influence on the market through their own consumption. A crucial factor in improving resource efficiency is to use life cycle costs instead of procurement costs when comparing products and services.

## Conclusion

Although developing and emerging countries are responsible for a high proportion of the direct consumption of resources on a global basis, they are still well behind the industrialised nations on the basis of per-capita consumption. If, as developing and emerging countries catch up in economic terms, their standard of living draws close to that in the industrialised nations, global demand will be driven substantially higher in the future. In view of, firstly, the significant risk this poses to sustainable development, and secondly, the as yet unexploited potential which exists in developing and emerging countries, increasing resource efficiency constitutes a major challenge. Capturing this efficiency potential requires suitable tools and strategies, ranging from ambitious legal and economic regulation, specific measures to encourage investment, and the provision of information and consultancy services. Given current trends in resource consumption, these measures are needed urgently. They should be implemented first of all in those areas where the potential is greatest and where action will prove most cost-effective. International development cooperation can act as a catalyst here, and thereby make an important contribution. ■

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