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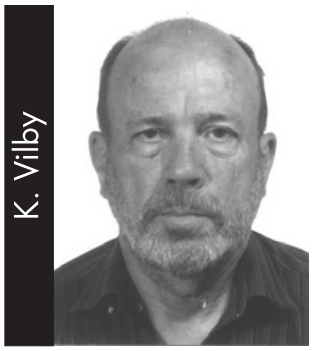
Guest editorial

Need to drive the global change



Engineers know that process outputs must equal process inputs in terms of mass flow. The same applies to whole production and consumption chains. In the globalized economy, however, no single engineer or company could fully control the throughput of a process network from resource extraction to manufacturing, use and final waste disposal. Responsibilities are often limited to sections of the material flow. Many influences drive the use of materials along the production and consumption chain, which may differ between countries and regions, in terms of price incentives, regulatory requirements, management standards and cultural conditions.

Most of the resources we use for our products become waste before the products are sold to consumers. Only part of the raw materials extracted or harvested enters the final product. The overwhelming part is the ecological rucksack of the product which is in fact released to the environment as solid waste or emissions to air and water.

Examples are manifold: it takes about 20 kg of abiotic raw materials to produce a 0.09 g chip, and 1500 kg of abiotic raw materials and 60 000 L of water to produce a 4-86 PC with a 15 inch monitor (Figure 1). The ThinkPad is much smaller and very lightweight and easy to bring along, but the production of the notebooks we consume in Europe creates millions of tons of waste, most of it outside Europe.

In some ways the situation is becoming very much like that of the colonial era. Metal mining and refining is, to an increasing degree, taking place outside Europe and it is associated with extremely high and ever-growing volumes of waste and emissions. It is the mining and refining of metals which contribute most to the ecological rucksack of electric and electronic products.

Other countries in the world are increasingly following European and American production and consumption patterns, but a global adoption of our development will be a major threat to the natural environment and to the world's resource and living base. It will also further accelerate the already very visible climate change.

Recycling is part of the solution but we are fooling ourselves if we believe that recycling can solve the problem. In a very advanced country such as Germany, recycled materials in 2000 contributed 15% of domestic material use, but seen in a global perspective and considering the total material consumption of the country, it is not more than 5–6%. More than 90% of materials used in production processes (from fuel to metals and minerals) are only used once and never recycled.

The focus has to be on minimizing the generation of waste along the whole chain of production processes. Whereas the focus in Europe has been on recycling of produced waste, and therefore recycling has become big business, the new focus has to be on reduction of material use long before products end up as waste.

It is important to recycle waste from electronic equipment, but it is even much more essential to look into product processes with the aim of reducing the huge amounts of water and raw materials used to produce a PC. Such reduction will also automatically reduce the amount of energy used in the production process.

The total material requirement of a western European citizen is about 50 tonnes per capita and year. This comprises all primary materials taken from nature, 60% from the domestic environment and 40% from other regions that supply our imports. The foreign hidden or rucksack flows of the imports mainly represent mining waste of metals and coal. The domestic unused extraction of mining contributes to mining waste, which exceeds the mass of controlled waste deposition by more than ten times.

A further characteristic of our physical economy is that the input exceeds the output. The materials additionally stocked year by year in new buildings and infrastructures amount to about 10 tonnes per capita. This is the major rea-

Fig. 1: The ecological rucksack of a computer comprises the cumulative primary material requirements which do not enter the product. Source: Seppo Leinonen, Basis NEC 80486 and Wuppertal Institute

son that impedes the establishment of a recycling economy. As long as the demand for materials for new goods outweighs the release of waste from the use phase it cannot be fulfilled even by a 100% recycling. A higher share of recycling inputs will only be reached when approaching an equilibrium between inputs and outputs, when the construction of new buildings and infrastructures will be compensated by the deconstruction of old ones. In the long run, the net addition to stock will become zero. Otherwise we would have to build our countries all over with constructions.

Currently, the majority of resource input is naturally non-renewable. In the future the material basis of our economy might be characterized by a more regenerative supply, although not necessarily through the increase of biomass harvest, as the global land available for agriculture and forestry sets rather strict limits. Rather, the requirements for minerals will have to be reduced by a factor of 10 within this century. In order to reach this target, the use of fossil fuels for combustion needs to be phased out, and the reduction of the net addition to stock will also help to reduce the primary mineral demand significantly.

The wider perspective is a dematerialization of economic growth, which will bring both environmental and socio-economic benefits (Bringezu 2006), and which is a necessity in order to avoid a major global environmental break down. Our ecological rucksacks have to come down in size. We cannot continue to base our life on areas and resources that are so much bigger than the globe can provide, if all the world's 8–9 billion people demand the same material living standards as we have.

Furthermore, we should stop shifting our problems to other regions and not only in terms of shipping non-recyclable and hazardous waste. Having depleted their own domestic resource deposits, industrial economies such as the European Union increasingly rely on imported resources. Of course, they do also deliver exports to other parts of the world, but the net balance of foreign trade indicates that its ecological rucksack is growing. In other words, the EU and other industrial economies increasingly produce at the ecological expense of other regions, mainly developing countries. We sometimes talk about burden-sharing, but basically we are transferring a big share of our environmental burden to other parts of the world.

Developing countries undergoing industrialization and rapid economic growth suffer from severe local and national pollution and other environmental problems, both from the products they consume themselves and from the production and export of commodities and industrial products to the West, often with below standard technology. In our part of the world, these waste and pollution issues are less visible; for us the resource flows are 'hidden flows'.

In contrast, the problems are very visible in many poorer countries. They result in air and water pollution, landscapes devastated by mining, problems with solid waste and extremely unhealthy working environments for millions of people involved in the production of consumer goods for Europe.

It is official EU community policy that the protection of the environment shall be based upon the precautionary principle and that, according to EU treaty paragraph 174.2: 'environmental damage as a priority should be rectified at source and that the polluter pay' (EU 2006); but the fact is that we in the EU in very many cases follow a policy and practice that makes people in other parts of the world pay what should be our costs.

It has become more and more obvious, that it is necessary to save the ecology of the world in order to be able to save the economy. An ecological breakdown will harm all sectors of the global society, and although the poorest will be the first to suffer the consequences will be global. What the Stern (2006) report has shown for the climate issue, in general also applies to impacts of total resource use.

The lesson for regions such as Europe is that global environmental problems are also European problems and vice versa. Such problems therefore are not solved through outsourcing of resource-intensive and polluting production, export of waste, or dispersion of residuals through air and water. The problems will all come back.

Changes are necessary – and possible – to drive the ongoing global change towards a more sustainable development. The necessary changes involve policies and practice in many sectors, such as the energy sector, but efforts to prevent waste by reducing material use in all types of production from cradle to grave (or better: from cradle-to-cradle) are essential and not given sufficient attention.

The EU Commission has developed thematic strategies on the use of natural resources as well as the prevention and recycling of waste (EU Commission 2005a, b). The latter is still very much focused on recycling. The former should go further. The resource strategy is regarded as an important framework to enhance the decoupling of wealth creation from the impacts of resource consumption. It emphasizes the life-cycle perspective and mentions that we should not shift our problems; however, concrete targets and operational measures still need to be designed.

Policy development towards sustainable resource use will depend on three essentials: (1) goals, targets and indicators on where to go (the latter not only for measuring progress but also for orientation); (2) improved information for all relevant actors at different levels; and (3) effective incentives for the actors to move (Figure 2).

In the EU and at the international level, the key role of increased resource efficiency has been acknowledged at higher policy and business levels. A broad discussion, however, on how the future could look in terms of everyday life and the associated resource requirements and waste produced is largely lacking. To promote the discussion and give guidance for the various actors, countries should develop medium to long-term *targets* of materials and energy productivity, and absolute resource consumption. They should consider the appropriate balance of foreign trade, including the ecological rucksack, as well as the share of renewables and the proportion of sustainable cultivation of renewables. Current EU and OECD activities on material flow analysis (MFA) and the measurement of resource productivity may serve as a basis for orientation and further development. Joining forces between waste and sustainable production and consumption departments seems promising, as well as the orientation on targets already established by some OECD member countries (e.g. Japan, Germany).

Decision makers in government organizations, industry and non-governmental organizations require *information* not only on the performance of the economy as a whole but also

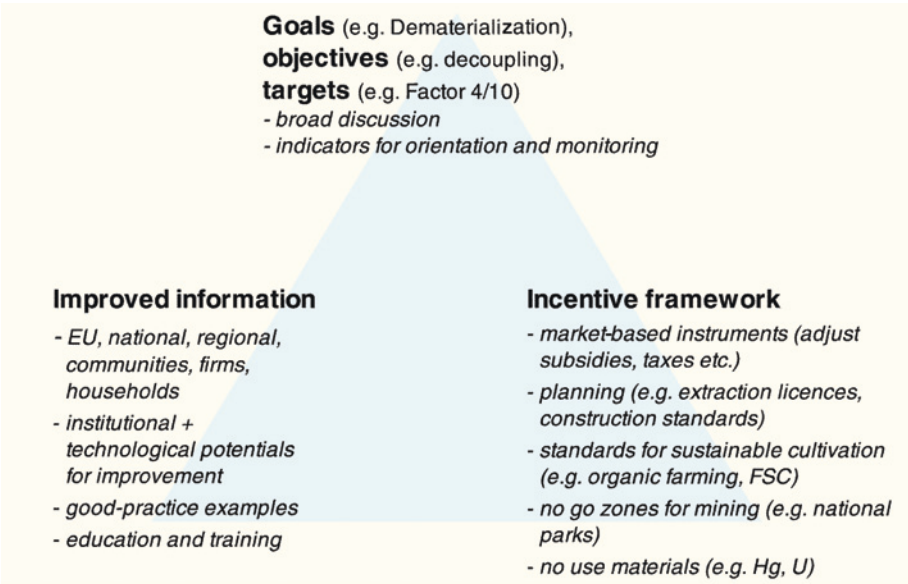


Fig. 2: Three triggers for driving global change towards sustainable resource use.

on the material use and resource productivity of industry sectors, and the technological and institutional potentials for improvement. Here research is ongoing in order to broaden the basis of knowledge generation. We need to know more about how to save energy and materials while increasing the utility of services and products; how to make more use of solar and other renewable energy with minimal requirements of mineral resources and land use; how to optimize the use of organic residuals for material recycling and energy recovery; how to limit the use of non-food biomass to sustainable patterns of regional and global land use. To answer these questions, technological alternatives are important, improving process and product design, but management and organizational options are at least of similar importance (optimizing the use of products, managing material flows on both a regional and a global level).

Increased finance for research and development of sustainable resources in production and consumption will become more and more important, not only for the environment, but also for resource security, the mitigation of resource conflicts and the competitiveness of industry.

We need not wait for new mind settings, or for new politicians. Rather we need to set the right *incentives* for the relevant actors to let them adjust their behaviour towards the right direction. Some countries have started to explore new institutional settings, especially to increase resource efficiency in production and consumption. The Japanese government initiated research on institutional options to foster materials efficiency. North-Rhine Westphalia (one of the German Länder) has successfully introduced an efficiency agency to support small and medium enterprises in order to find potentials for cost reduction by minimization of waste, energy, water and material consumption. The German government has adopted the model at the federal level within the broader design of a materials efficiency programme for the manufacturing sector. So far, these activities have focused on direct material use. In future, the effects on life-cycle-wide total resource requirements and potential shifts to other regions will have to be monitored, too. Some countries have already implemented economic instruments (e.g. UK aggregate tax) in order to increase the price of primary resources in order to set incentives for higher efficiency, reduced waste disposal, increased recycling and innovation. The European Topic Centre on Resource and Waste Management (ETC-RWM, http://waste. eionet.europa.eu/) is going to review the effectiveness of relevant instruments, which may contribute to further development of an appropriate incentive framework towards sustainable resource use in the future.

Recycling will remain an important strategy within a broader framework for sustainable resource use. However, it needs to be complemented by more profound measures of dematerialization aiming at a significant increase in resource efficiency. Using less material in production will not only reduce waste generation, it will also reduce costs for industry. Material costs of manufacturing still clearly exceed labour costs. Instead of firing people it makes more economic sense to reduce material use.

More and more companies become aware of the opportunities of increased resource efficiency. The overall trend of the economy has already embarked towards this direction. However, the lagging attempts need to be enhanced, and national governments such as in the UK and Germany have started programmes to guide industry towards exploring their potentials for improvement. It is also a huge challenge for the waste management business to create new business fields beyond recycling and enter the dematerialization arena. The long-term perspective is clear. Waste management will further develop towards resource management. In the end this may even include consultancy services for manufacturing industries on how to reduce resource requirements.

If Europe really wants to become the most competitive economy of the world increasing resource productivity will be key. It does make sense from an economic point of view and it provides the unique opportunity to reduce the waste load to the global environment and proceed towards a more equal burden sharing worldwide.

Following this approach will help to drive global change towards sustainable development.

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