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EUROPEAN POLICYBRIEF

WWWFOREUROPE WELFAREWEALTHWORK

An optimal policy mix for resource use

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INTRODUCTION

Objectives of the research:

reducing dependence on material resources

The research was directed at identifying a policy mix that allows Europe to achieve goals of GDP growth and beyond while reducing its dependence on material resources. Apart from the issue of reducing carbon emissions, we explore options for reducing the input of material resources (in particular: metals and industrial minerals, construction materials, fuels and biomass) in production and consumption.

We build upon the previous WWWforEurope Policy Paper (Aiginger, 2014) that calls for a new systemic approach to industrial policy „pushed by competition, pulled by goals beyond GDP" (p.9), geared towards increasing manufacturing in Europe (again), but combined with production-related and value enhancing services. „Products ought to be more durable, more consumer-specific (e.g. via digitalization), ecologically sustainable, and aligned with training, social innovation and larger resource efficiency" (Aiginger, 2014, p.13). Such an industrial policy should foster a long-run socio-ecological transition.

re-orienting Europe's productivity policies ...

There are „pull" and „push" forces at work to encourage such a socio-ecological transition in Europe, re-orienting its productivity policies from emphasizing labour productivity towards increasing the productivity of resource use, as has already been acknowledged early on by the EU (EC, 1993). The „pull" forces essentially amount to promoting an integrative policy vision that combines social, ecological and economic goals, offering attractive features for different kinds of stakeholders. The „push" forces are plenty, as we will try to demonstrate in our Key Observations section.

The German Advisory Council on Global Change (WBGU) in 2011 issued a major report under the title „World in Transition", stating the

re-orienting lifestyles in Europe ...

issue as follows: "The idea that all people should be able to enjoy a lifestyle that equals today's predominant lifestyle in the industrialised countries, characterised by the use of fossil energy carriers, cannot be realised. To avoid non-sustainable development paths, the developing and newly industrialising countries would have to leapfrog technological development stages. The industrial countries should therefore lead the way off current development paths to demonstrate that it is also possible to follow sustainable paths. A lifestyle must be found that is consistent with the guiding principle of global sustainable development. It must also allow the catch-up development of poorer countries, equally guided by the criteria of global sustainability, and allow for inclusion of the so far excluded 'bottom billion'." (WBGU and German Advisory Council on Global Change, 2011, 62).

This fundamentally changing global context and the need for systemic changes in policy and institutional settings have also been acknowledged by several other major institutions regularly reporting on the state of the world and the world-economy.

... requires a socio-ecological transition

UNEP, for example, states in its recent report on the green economy: "Indeed, most economic development and growth strategies encouraged rapid accumulation of physical, financial and human capital, but at the expense of excessive depletion and degradation of natural capital, which includes our endowment of natural resources and ecosystems. By depleting the world's stock of natural wealth – often irreversibly – this pattern of development and growth has had detrimental impact on the well-being of current generations and presents tremendous risks and challenges for future generations. The recent multiple crises are symptomatic of this pattern." (UNEP, 2011, 1).

The US National Intelligence Council which conducts regular strategic risk studies, also recognizes these issues, and states that „With the emergence of rapid globalization, the risks to the international system have grown to the extent that formerly localized threats are no longer locally containable but are now potentially dangerous to global security and stability. At the beginning of the century, […] a new generation of global challenges including climate change, energy security, food and water scarcity, international migration flows, and new technologies – are increasingly taking centre stage" (NIC and EUISS, 2010, 4). The Council also explicitly recognizes the fundamental challenges posed by increasing global demand for resources and fossil fuels and the importance of security of supply (NIC, 2008, 41-57). "Unprecedented global economic growth – positive in so many other regards – will continue to put pressure on a number of highly strategic resources, including energy, food, and water, and demand is projected to outstrip easily available supplies over the next decade or so. For example, non-OPEC liquid hydrocarbon production […] will not grow in step with demand. Oil and gas production of many traditional energy producers already is declining. Elsewhere – in China, India and Mexico – production has flattened. The number of countries capable of significantly expanding production will decline; oil and gas production will be concentrated in unstable areas. As a result of this and other factors, the world will be in the midst of a fundamental energy transition away from oil toward natural gas, coal and other alternatives (NIC, 2008, vii). "[…] an energy transition, for example is inevitable: the only questions are when and how abruptly or smoothly such a transition occurs. An energy transition from one type of fuel (fossil fuels) to another (alternative) is an event that historically has only happened once a century at most with momentous consequences." (NIC, 2008, xii)

A fundamentally changing global context ...

The two most important changes that are on-going refer, first, to the increasing international competition for resources, with large countries like China and – less visibly, because somewhat delayed, but no less relevant – India catching up and so far emulating the Western fossil-fuels-based resource-intensive development path. Second, there is an unprecedented rise in the price of natural resources. Both changes will create a context for European economic development that contrasts strongly with the 20th century context of Western dominance and a gradual decline in resource prices.

These structural changes tend to be underrated in many forward-looking scenarios and projections. In terms of available natural resources, Europe faces a future more uncertain than often recognized.

On top of these long term structural changes, there are currently very acute changes that complicate the situation for Europe: one is the aggressive exploitation of so-called "unconventional" sources of fossil fuels in particular by Canada and the USA, rendering lower energy prices for them. Another one is the political crisis over the Ukraine that may threaten Europe's gas supply, or make it more expensive. These are issues we cannot deal with in this Policy Brief.

... requires a long-run perspective on Europe's course of development

In our Policy Brief, we give particular consideration to changes in resource use that are already ongoing, or that already mark Europe's special course relative to other world regions, and its particular competitive advantages. The perspective of long-run transition requires looking at longer time periods also in the past; scenarios and projections that reach out several decades ahead need to be based upon observation periods extending back at least twice as long. This is established practice in the natural sciences, but not so common in economics. The energy and commodity data measured in physical units that we mainly use for representing resource flows are available in very long time series of acceptable quality. These data, in combination with demographic and economic data, will underpin the arguments presented in this Policy Brief.

KEY OBSERVATIONS

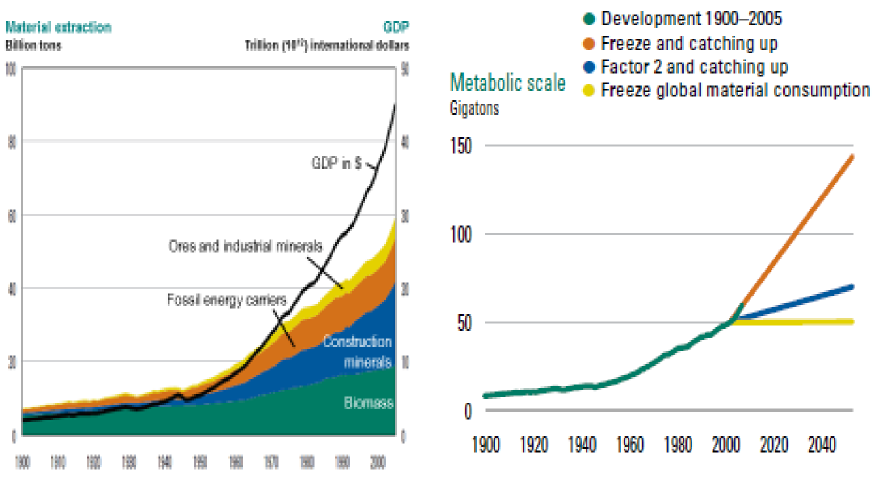
Unprecedented rise of global resource extraction and use

Since the turn of this century, there has occurred the steepest rise of annual global resource extraction ever. Currently, the world economy is extracting annually more than 70 billion tons of biomass, construction materials, metals and fossil fuels from the earth, up from about 12 billion tons in 1970 (Schaffartzik et al., 2014). In particular, the growth in global resource extraction (and use) exceeds world population growth, substantial in itself, since the mid-1990s (Figure 1).

UNEP-IRP calculates a trend scenario, based upon population projections and assuming a continuation of catching up in resource use rates per person (metabolic rates) on the part of emerging economies to the level of industrial economies: this would result in a further tripling of global annual resource extraction by the year 2050, a pace not considered feasible (UNEP- IRP, 2011, pp.26). There are a number of indications that the world economy approaches certain physical ceilings: the growth in agricultural yields per hectare has fallen below population growth rates (Haberl et al., 2011); global wild fish catch is stagnating since the 1990ies (FAO, 2014, Chatham House, 2012); the amount of crude oil sold on the world market is stagnant since 2005, despite rising demand and prices (Murray and King, 2012); the ore grades of many metals are rapidly declining, across all major producer countries (see Giurco et al., 2010, Kerr, 2014, Figure 5), and even the access to sand as major construction material is becoming more difficult (Blasberg and Henk, 2014). While many argue that these obstacles can be overcome by additional major investments (World Bank and IMF, 2011) this will further impact upon prices and success is not guaranteed.

A further continuation on the current track of resource use is not feasible globally

Figure 1: Global annual resource extraction (in billion tons and tons/capita), and global GDP (in constant 1995 Gheary-Khamis $)



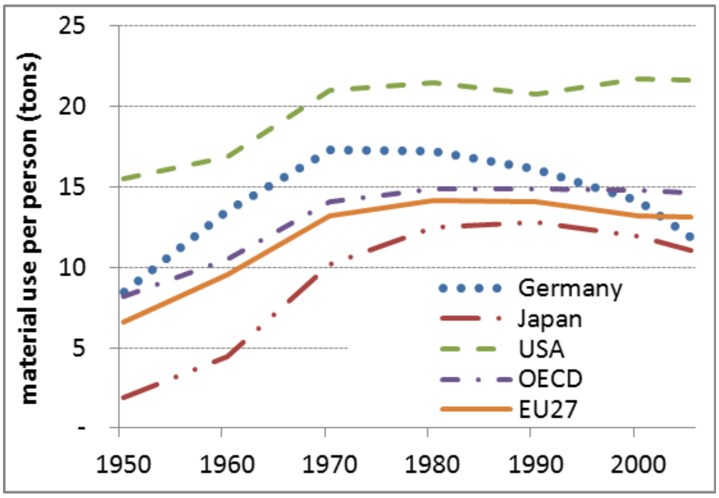
Source: UNEP-IRP (2011)

As shown in Figure 1, growth of global GDP (at real 2000 prices) since the 1950s has been much faster than growth in resource use; thus, there has been a substantial rise in resource productivity (see also Steinberger and Krausmann, 2011), in the sense of higher value added per ton of material input. This is also denoted as „decoupling" of resource use from economic growth and nourishes the hope that in the future it might be possible to reduce resource use (and the associated environmental impacts) while still maintaining economic growth (UNEP-IRP, 2011, UNEP-IRP, 2014).

Decoupling of resource use from economic growth

As demonstrated by our analysis in the context of the WWWforEurope project (Fischer-Kowalski et al., 2013), decoupling is a feature characterising in particular advanced high-income industrial economies. There we can observe what has been termed the „1970ies syndrome" (Wiedenhofer et al., 2013): since the early 1970ies, after decades of quantitative growth, per capita resource use has more or less stagnated or even declined, while income has kept rising (see Figure 2). All this takes place on a very high level of material use and consumption, of course – a level that according to the UNEP scenarios above cannot be emulated by the rest of the world without seriously surpassing planetary boundaries (Rockström et al., 2009).

Figure 2: The 1970s syndrome of stagnating resource use in high-income industrial countries (1950-2005)



Source: SEC database 2013 (Schaffartzik et al., 2014)

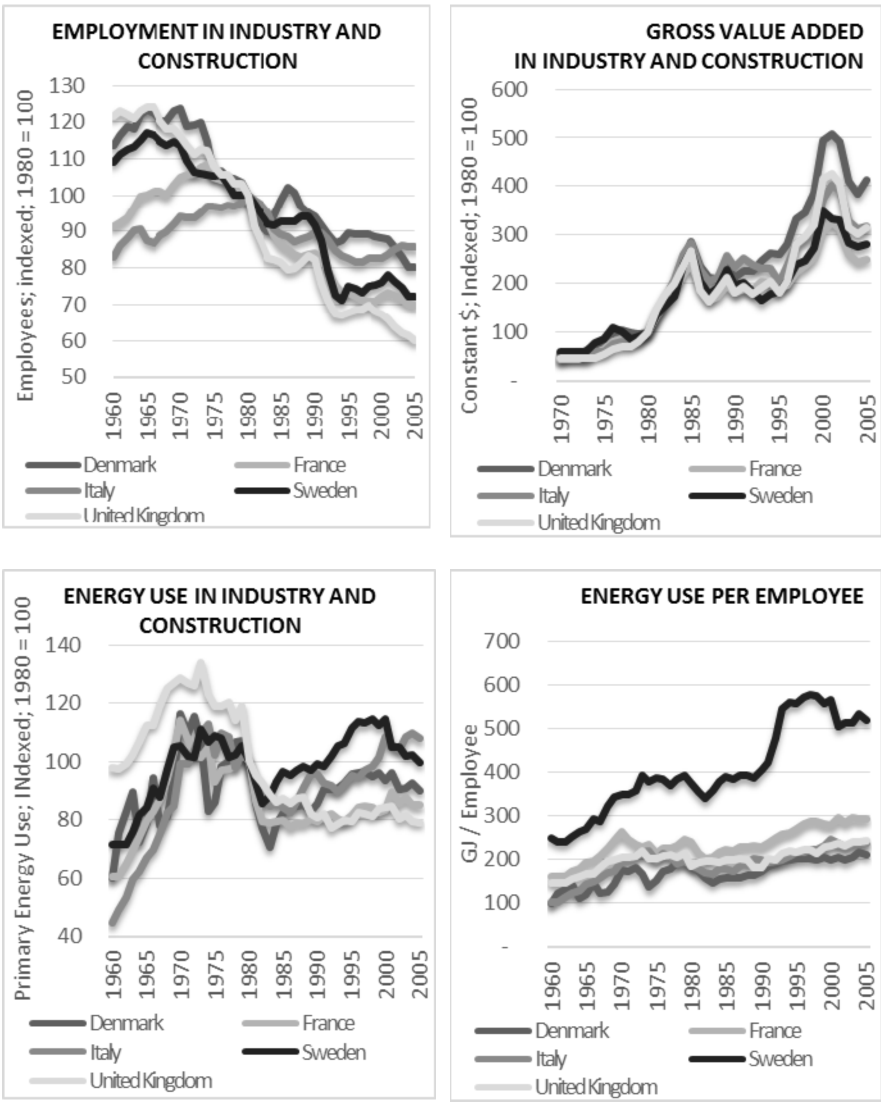
This trend change among the high income industrial countries, away from the sharp increase in resource use (energy as well as materials) marking the post WWII decades, is remarkable and has been subject to closer scrutiny. As Figure 2 demonstrates, it can be observed in all high-income industrial countries: in Japan, where resource use never exceeded a fairly moderate level, it decreased even in the course of the Asian crisis (a trend that seems to continue), in the United States, marked by much higher resource consumption, resource use per capita has remained stable for the past 40 years, like in the OECD area altogether. In the EU 27, we can even observe a slight decline in resource use. Thus, in the past four decades, the increase in resource (and energy) use on the part of high-income industrial countries was essentially driven by population growth, while the material resource intensity of everyday life showed signs of saturation.

The 1970s syndrome in Europe: beginning stagnation of resource use

Why did this enhanced decoupling between material and monetary flows happen? One of the reasons is that after decades of rapid infrastructure build-up a certain saturation in construction activity, and of infrastructure in particular took place – as is revealed by material use data (Schaffartzik et al., 2014).

Industrial energy use declining, but saving labour remains policy priority

Figure 3: Gross value added, employment and energy use in industry and construction for selected European countries, 1960-2005



Source: Draxler, 2014

Another reason was industry's response to the 1970s oil price shocks: it invested into energy efficiency and achieved substantial improvements that reduced demand for fossil fuels (Draxler, 2014) which also lowered material intensity, as fossil fuels claim a substantial share of material input. Later years, as Allwood et al. (2011) have shown in an extensive meta-analysis of the literature on material efficiency, are characterised by strong business and economic barriers against directly employing material efficiency strategies, favouring a lock-in with production systems based on cheap energy and business models oriented towards growing sales encouraging planned obsolescence. This is still reflected in recent surveys of European companies (N=600 000) whereby only one quarter of innovations is directed at reducing material use (EIO, 2012, p.6f). A more in-depth analysis of the „1970s syndrome“ in industry for selected European countries (DK, FR, I, SE and UK) showed that while gross value added of the industrial sector in these countries had been rising substantially (in real terms) between 1970 and 2005, employment had declined (Draxler, 2014). This indicates that the main thrust of industry's efforts had been directed towards saving labour, and to some extent at saving energy after the price signals of the early 1970ies, but that savings of materials (non-energy commodities) have occurred rather as an unintended by-product.

Finally, domestic resource extraction and use could have been reduced by outsourcing resource-intensive industrial production to emerging economies while still increasing domestic material consumption fed by imports. Currently, a good deal of research is devoted to this issue. As Schaffartzik et al. (2014b) show in their analysis of physical trade (measured in tons at the border, not in monetary units), European countries, after a post-WWII phase where the weight of imports (mainly raw materials) had been rising much faster than the weight of commodities exported, have since the early 1970s shifted towards a higher but more or less stable positive balance (meaning that in terms of weight imports dominate exports) while the monetary trade balance remained more or less even. This confirms a shift towards industrial outsourcing, but on a relatively stable level since the 1970ies

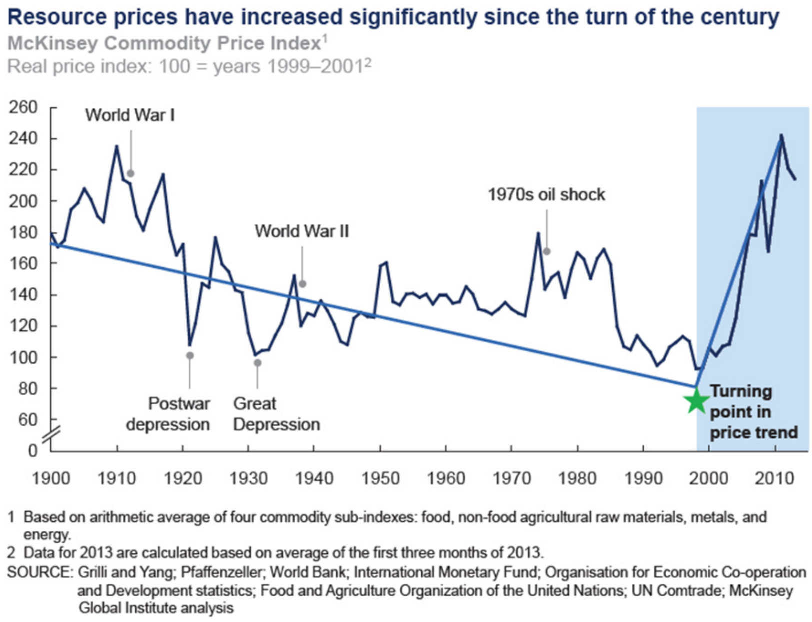
A relatively recent line of research attempts to link global resource use required to satisfy a given level of national final consumption, an approach known as material, energy or carbon footprinting (Hoekstra and Wiedmann, 2014). It applies multi-regional input-output analysis, quantifying all economic activity and material/energy flows across international supply chains and attribute the upstream flows to the respective final consumption (Wiedmann et al., 2013, Tukker et al., 2014). These studies point in the direction of a continuing rise of material consumption in Western economies, also during the last two or three decades. The findings are, however, not yet consolidated and vary substantially between methods and models employed (Schaffartzik et al., 2014a, Inomata and Owen, 2014).

Global resource prices on a continuing rise

Nevertheless, there is now a relatively new situation: Resource prices that had been, apart from a few peaks due to wars and the 1970s oil price shocks, systematically declining throughout the 20th century, are now for more than a decade on an upward trajectory, as documented by Worldbank statistics and highlighted in a recent report from McKinsey & Co.

In its trend survey of 2013, McKinsey calls for a „resource revolution". Trends in resource prices have changed abruptly and decisively since the turn of the century: since 2000, they have more than doubled. Over the past 13 years, the average volatility of resource prices has been about three times higher than in the 1990s. „This new era of high, volatile and rising resource prices has been characterized by many observers as a resource price ‚supercycle'. Since 2011, prices have eased a little from their peaks, prompting some to question whether the supercycle has finally come to an end. But the fact is, despite recent declines, on average commodity prices are almost at the level of 2008 when the financial crisis began. Talk about the death of the super-cycle appears premature" (McKinsey Global Institute, 2013, p.1).

Figure 4: Changing trends in resource prices

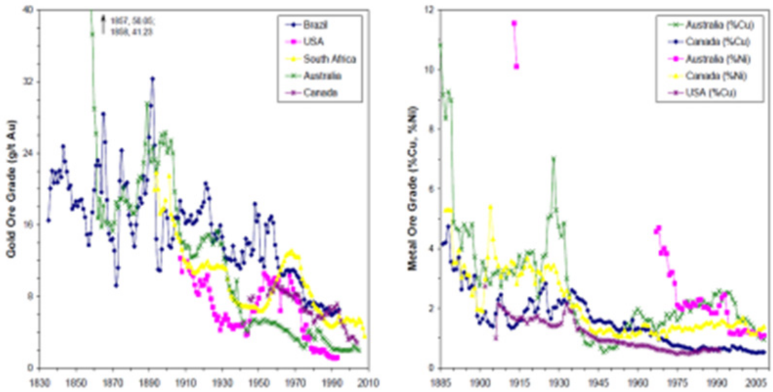


Source: McKinsey Global Institute (2013, p.6)

Rising demand coincides with new supply limits

It is the combination between a rapid rise of demand (in particular from China, with India in the loop) and mounting technical and political obstacles to further resource exploitation that Mc Kinsey sees as the reasons for expecting the supply with natural resources to remain volatile, and prices high. While high prices should stimulate additional investment, the latter risks being discouraged by lack of infrastructure and logistics as well as political instability in many supply areas. In the case of a number of key metals, McKinsey connects price rises also to „limited new discoveries". (McKinsey Global Institute, 2013, p.2). This is illustrated by a recent worldwide survey carried out by a team of Australian mining specialists (see Figure 5).

Figure 5: The decline of ore grades of gold, copper and nickel mines worldwide during the past century



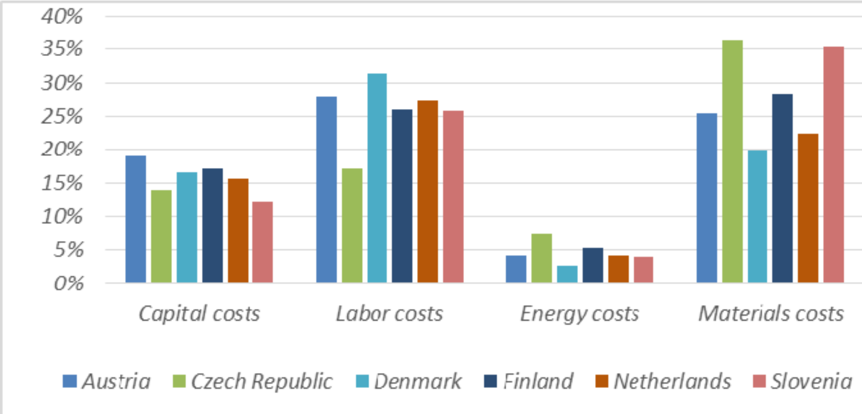
Source: Giurco et al., 2010, p.28, based on Mudd 2010, 2009, 2007

As has been shown by UNEP-IRP's metal reports (UNEP-IRP, 2013), most of the rare metals that now have become crucial for many applications, in particular in information and communication technologies, are found as trace metals in the course of mining the larger metal stocks. Thus, their supply is also subject to declining ore grades. At the same time, technical substitution between these metals does not appear to be a promising solution, not only because of their very specific technical properties, but because of the fact that demand is increasing for practically all metals that theoretically exist, many of which had never been registered before and are very rare in the Earth crust (Graedel et al., 2011). Reck and Graedel (2012) also argue that current recycling technologies are in no way able to cope with the highly sophisticated technological applications prevailing.

High share of materials costs in European economies

These changes in price levels of raw materials should be expected to have substantial repercussions in the economy. While energy costs only account for a small share in the cost structure of European Economies, costs of materials claim a share equal to that of labour cost or even higher, as our analysis of selected European economies shows. (Figure 6). (It should be noted though that, „materials“ costs not only include raw materials; in the production chain they encompass the input of semi-manufactures and the embodied labour).

Figure 6: Factor costs for selected European Economies in 2004
(Costs as share of total production)



Source: EU-KLEMS database ed. 2008, own calculations

For our analysis, we have chosen a sample of different European countries, but the results are pretty much alike: in all countries, materials costs exceed 20% of total production cost, and they exceed the cost of capital and energy. Only in high-income countries like Austria and the Netherlands, their share is slightly surpassed by labour costs. In the sector of agriculture, the share of materials costs exceeds 40% everywhere; in manufacturing and construction, their share is 50% or more in most countries (EU-KLEMS database ed. 2008). Thus it is not straightforward why the focus of corporate cost reduction is so strongly set on saving labour cost.

RECOMMENDATIONS FOR POLICY-MAKERS

An inspiring vision of systemic change is needed

In the face of the structural challenges described, successful new resources policies, as much as energy and climate policies, require a vision of systemic change. Such a vision may refer to specific problems that otherwise cannot be solved, but it must also appeal to many societal stakeholders as attractive and inspiring. More of the same, and incremental improvements, are neither an attractive nor a promising approach. As meanwhile many academic observers, business people, public administrators and part of the public at large recognise, there needs to be change in the form of a socio-ecological transition or transformation, and Europe should take a lead in this endeavour.

Building upon the experience of the 1970s: In the context of that time, the oil price hikes were perceived as a new challenge by large parts of society, confirming the need for profound change. Industry anticipated a possible shortage of supply and a major rise in energy cost (which, in effect, did not last very long) and embarked on energy saving strategies. Foreign policy and the security system were alarmed at apparently new threats and challenges. The media and the public at large had not only been confronted with an international student movement that for the first time questioned the established cultural model of progress, attacked consumerism and demanded more freedom and democracy, they were also shocked by the widely received Club of Rome report on the „limits to growth", an intellectual and political challenge.

The new spirit of the 1970s appealed to a wide range of stakeholders and changed their behaviour

This new „spirit" was taken up by major policy makers, as stimulus and support for new visions of society (e.g. President Carter's Global 2000 Report, study author Barney, 1980), viewed as problematic, but also refreshing opposition to established institutions, and led to practical measures such as the introduction of a „car-free" day per week, the daylight saving time or „energy-saving vacations". As reflected in the data, this systemic „turmoil" made a difference: in Western industrial societies, energy and material use moved from its progressive increase towards a more or less stable per-capita level. In the decades thereafter, there was a major „roll-back" in policy terms, but this did not reverse the change in energy and materials use.

Lessons for the present?

The present situation is in some ways alike. There are serious threats to fossil fuel supply, both in terms of supply security and price. These threats are again (or have most of the time been) connected to major general security challenges. Prices of a large number of natural resources are increasing rapidly, a trend that already lasts much longer than the oil price hikes in the 1970s. There is broad media coverage of issues like climate change, increasing resource scarcity and the retreat of biodiversity, and the European public perceives these problems as real. On top of this, there has been, and to a certain degree still is, a major economic crisis. What seems missing, though, is a plausible political vision of where to go – except for re-gaining economic growth as fast as possible.

On the energy and resources front, one can find at least a few elements of a plausible political vision.

Energy Transition

policy measures for an energy transition are beyond the scope of this Policy Brief

One of them is the energy transition, the „*Energiewende*", a turn away from fossil energy carriers towards alternative sources. Using sun- and wind-energy as major sources (not biofuels, though) means also a major reduction of material intensity of the economy: fossil fuels currently account for a quarter or a third of material resource use in Western societies. Reducing their share will provide substantial relief in terms of transport (sea and road), and as a consequence for transport infrastructure investment and maintenance. This is rarely discussed from the angle of resource policy, and it need not particularly be pursued as such, as long as it happens for climate policy reasons. It is beyond our task here to discuss policy measures for achieving such an energy transition – carbon pricing in itself is a very complex policy field (for a review see van den Bergh and Botzen (2014)). Further down, though, we will explore the impact of an energy transition on the use of other material resources.

Circular Economy

provides an attractive vision of eco-efficiency, re-usable and repairable products and complete recycling

In a Circular Economy all materials used can either be safely returned to the environment or are entirely recyclable

Future resource security can potentially be strongly improved

Currently, there are various initiatives gaining momentum under the auspices of the attractive metaphor of „Circular Economy". This term applies to natural resources and implies their careful use and re-use; taken seriously, it also implies a stable (as opposed to growing) amount of material input that by re-use and recycling will actually be able to satisfy future demand. The notion of a Circular Economy stands for an economy in which material flows consist either of biological materials, which after disposal are available for ecological cycles, or of materials designed to circulate within the socio-economic system with reuse and technical recycling as a key strategy (UNEP, 2013, GEO5). Many authors consider this to be a promising strategy to meet the environmental and economic challenges of the early 21st century and to define targets of sustainable resource use (Allwood et al., 2010; Chen and Graedel, 2012; Ellen MacArthur Foundation (ed.), 2013; Hislop and Hill, 2011; Mathews and Tan, 2011; Moriguchi, 2007; Preston, 2012. First labelled by the Chinese government in 2005 and put into law 2008 in order to signal its vision of a different approach to natural resources, wastes and emissions, the Circular Economy is meanwhile promoted by many governments and international organisations (e.g.EC, 2012, PRC, 2008, METI, 1991). In response to signs of resource depletion and sharp increases in both prices and related volatility of raw material supply, promoters of the Circular Economy further argue that increasing the circularity of the physical economy is indispensable for maintaining future resource security (e.g. Hislop and Hill, 2011).

Policy must address the input side of production, prescribing a minimum share of secondary (recycled) materials to be used

According to a recent analysis (Haas et al., 2014), EU 27 exceeds the world economy in terms of circularity by a small margin, because of a higher recycling rate. Nevertheless, current „circularity" amounts to an unimpressive 38% of processed materials (that is, the share of all materials used that is either biodegradable or recycled). Circularity would be increased by gaining a higher share of energy from non-material sources (sun, wind), by a shift towards using more biodegradable materials and by expanding re-use and recycling (with appropriate R&D concerning design). While recycling is usually looked upon as a waste management policy, it would be much more effective as regulation of the input side: by requiring a certain share of the material input to come from secondary sources (i.e. from re-use or recycling). This should apply particularly to metals, but also to construction materials. Such a policy would boost the market for secondary and recycled materials, stimulate innovations in recycling technologies and reduce public costs for waste management. Such a regulation would be much easier on the European level, creating a level playing ground for companies, than it is on the level of nation states that currently hold the competencies for such regulation but hardly use them.

The concept of a Circular Economy must be inter-linked with other socio-economic goals to gain societal momentum

Circular Economy as a vision appeals to business and may stimulate innovations, but so far it is lacking appeal to a broader array of stakeholders and has no wider implications for socioeconomic change.

Resource productivity

The latest vision from EU-DG Environment calls for improvements of resource productivity (EC, 2014), as does the European Resource Efficiency Platform (EREP 2014). A country's resource productivity (RP) is defined as its GDP divided by its raw material consumption (RMC in tons). Material consumption refers to all materials used with the exception of water and air, i.e. biomass, fossil fuels, construction materials and industrial minerals/metals. In the material flow methodology, RMC contains domestic material consumption (DMC), defined as domestic material extraction plus imports minus exports, plus the balance of raw materials contained in imports minus those used for exports; it thus includes the upstream material flows of traded products (indirect consumption). An increase in resource productivity occurs if GDP grows faster than direct and indirect material consumption, in which case there is a „decoupling" of economic and material growth. Resource productivity in Europe has been growing for many decades, at rates between 1% and 2% annually (Steinberger and Krausmann, 2011). The most recent Commission Staff Working Document (European Commission, 2014, p.8) assumes a BAU scenario up to 2030 in which resource productivity increases by 0,9% p.a. (a slowdown from the current rate). This BAU scenario would imply a rise in material consumption (RMC). Against this BAU scenario, the Commission sets a „transition scenario" where the trend growth of resource productivity observed in the past (about 2% per year) is maintained; this would lead to a 30% increase in resource productivity by 2030, while material consumption marginally declines in absolute terms. In the current preliminary version of the paper, this 30% increase in resource productivity is proposed as a non-binding target for the EU Member States which are to have „complete flexibility over what action they take" (p.9), as no specific actions are proposed. Finally, a „rapid acceleration scenario" is outlined which assumes a 2,5% p.a. RP advance and leads to an overall 40% improvement of RP by 2030. This scenario is not pursued further as it is „less good for growth" because „resource policies have to be put in place that have costs for the economy." (European Commission, 2014, p.12).

Current proposals suggest a non-binding target of a 30% increase in resource productivity …

... but no specific actions

Targeting resource productivity is the most appropriate way to achieve resource savings without harming economic growth: in Europe and other high-income countries, the higher GDP growth rates, the higher resource productivity growth (Steinberger and Krausmann, 2011b, Gan et al., 2013). Resource productivity targets such as the one proposed in the transition scenario above are almost self-fulfilling in the face of the price increases for raw materials, but might still be under-achieved if the expectations for GDP growth prove too optimistic. On the other hand, this strategy has two major disadvantages. One of them is that it does not target environmental benchmarks directly. For environmental reasons, a reduction of materials extraction and use by the high income countries is required, as much as a reduction of carbon emissions is required for climate protection reasons (BIO Intelligence Service et al., 2012).

Creating "ping pong" dynamics between increasing resource

As von Weizsäcker and Ayres (2013) argue, an increase in resource productivity is necessary, but not sufficient for ecological sustainability. The reason for this is the so-called "rebound effect"

productivity and rising resource prices

(also known as the Jevons paradox), saying that higher efficiency tends invite to additional consumption. According to Ayres and Warr (2009), energy consumption rebound is actually the fundamental mechanism driving economic growth. In order to undercut rebound effects, von Weizsäcker and Ayres (2013) propose raising the prices of critical resources in small, but predictable steps, based upon the percentage of efficiency gains observed in the previous year. Thus, the cost of energy and resources would by definition remain stable on average. The public revenues gained by this policy should be used to reduce the cost of labour. In this way, all players would have a steady incentive to increase resource productivity, and the squeeze on labour cost would ease. Two additional measures are considered to buffer unwanted side effects: raising social transfer payments to low- income families, and a mechanism of recycling revenues collected from resource-intensive branches back on a per-job basis in order to prevent them from dislocating to countries with low resource prices.

Compensating measures for low-income families and resource-intensive industries

Transition to sustainable resource use

In the still ongoing modelling exercises undertaken within the WWWforEurope project, we sought to explore scenarios of sustainable resource use (Kratena and Sommer, 2014). They directly refer to the crucial issue of the amount of materials use related to the production and consumption of European countries – like also previous Staff Working Documents by the European Commission, preparing the Roadmap to a Resource Efficient Europe had done (EC, 2011a, b, and c).

Targeting resource use per person to achieve a material lifestyle at a level that is globally sustainable in the long run

The focus, though, is on resource use per capita: the idea is to explore the possibilities of creating a material life style at a level that is globally affordable (see also Hoekstra and Wiedmann, 2014). It is important to refer resource use to people rather than to monetary quantities: people require food, shelter, clothing, mobility and entertainment. Reference point should be a pattern of materials use that would be globally sustainable in the long run. The fact that overall resource use in Europe would be declining because of its low fertility rate in combination with very strict immigration regulation, for example, would in terms of global sustainability not provide much relief: the European standards of life style would still provide a model for the rest of the world to emulate and stimulate high global resource consumption. On the other hand, less strict immigration policies would lead to population growth in Europe, with a proportional population decrease somewhere else, and therefore increase European resource use at the expense of other places. A vision of sustainable resource use must consider both the direct and the indirect effects. That is why our model uses as target variable domestic material consumption (DMC) per person, in physical terms (kilograms, tons).

The DYNK model links physical energy and material flow data to production and consumption activities

Kratena and Sommer (2014) describe three different resource use scenarios for Europe, derived from global UNEP scenarios that suggest that the ongoing global convergence process of material use per capita can only continue at a substantially lower level than high-income industrial countries now display (UNEP-IRP 2011). A disaggregated dynamic New Keynesian (DYNK) model covering

59 industries and five income groups of households is used to analyse the conditions and policy environments consistent with the corresponding resource use path in each scenario. The DYNK model links physical energy and material flow data to production and consumption activities which are determined by economic growth, technical change and relative prices. The model is closed by including parts of public expenditure as endogenous variables in order to meet the mid-term stability programme for public finances in the EU 27.

***Baseline scenario*: Resource use and emissions per capita remain stable at un-sustainably high levels until 2050**

The *baseline scenario* builds upon the base year 2005; it takes into account data till 2012 and makes assumptions for the period to 2050 about the development of exogenous variables, such as import prices (especially for energy), interest rates, house prices, as well as including detailed population and labour force projections. Concerning household debt, it is assumed that the debt-to- durables ratio converges back to the pre-crisis level. The average growth rate of GDP at constant prices between 2012 and 2050 is projected at 1.4% p.a., and the growth rates of total factor productivity (TFP) have been set constant: there is no acceleration of TFP growth. In the BAU model run, the indicator DMC per capita stays almost constant at 16.5 t, in line with the UNEP-IRP (2011) trend scenario and Fischer-Kowalski et al. (2013). Emissions of greenhouse gases (GHG) slightly rise at the beginning, staying almost constant thereafter.

***Best practice scenario*: shifting technological change from labour/capital saving to energy/resources saving …**

… leads to employment creation and small reductions of material use per person

A *best practice scenario* relates to the observation in Fischer-Kowalski et al. (2013, see also Figure 2 above) that in some European countries (UK, France and Germany) specific circumstances (such as the German re-unification) had pushed structural and technical change into a more resource saving direction in the past decades, such that their DMC/cap declined. This scenario assumes such exogenous shocks to occur also in the other European countries, which is implemented in the model by shifting the focus of technological change from labour/capital saving to energy/resource saving (without any change in the overall TFP growth). This shift could also be the outcome of certain policies, such as investment in R&D or taxation of energy and resources, but this is not made explicit in the model. In effect, there is more employment creation, which in turn increases disposable household income. Energy demand and greenhouse gas (GHG) emissions rise less in this scenario than in the BAU scenario, while DMC/cap is slightly reduced to 15.5 t/cap (no more because of rebound effects from increased household income).

***Radical reduction scenario*: carbon price raised to 250 €/t CO_2, with revenue used to lower social security contributions…**

For a scenario of radical reduction of resource use per capita, Kratena and Sommer (2014) introduce a price for CO_2 (tax or auctioned permits) where the revenues are redistributed via lower employers' and employees' social security contributions. The price for CO_2 is taken from a scenario in the EU roadmap for radical GHG emission reduction (European Commission, 2011a); it starts with 25 €/t CO_2 in 2011 and increases linearly to 250 €/t CO_2 (in 2005 prices) in 2050. As a result, GDP growth is dampened compared with the BAU scenario, mainly due to the double price effects on products that contain energy as well as on energy products that are

…decreases material use per person by 20% and GHG emissions by 50% while creating employment

co-benefits of a decar-bonisation strategy for materials use

Strong visions promoting a socio-ecological transition

consumed. These price effects build up and in the long-run counteract the price-decreasing impact of lower social security contributions and lower labour cost. Energy and DMC per capita decrease by the same amount in this scenario, but GHG emissions decrease even more. Like in the EU Roadmap scenario for GHG emissions, the total impact on emissions consists of an energy efficiency effect as well as of a de-carbonisation effect. GHG emissions decrease by almost 50% until 2050, and DMC by about 20%. The interlinkages between the different categories of DMC can be observed, as the material flows of minerals for industry, for metal production and for construction decrease all by the same amount as the material flows of energy. A policy of GHG reduction therefore has important spill-overs for DMC reduction. The DMC per capita declines in this scenario to 12 t/capita, which is what Fischer-Kowalski et al. (2013) obtain for the case of the ‚best practice' scenario. The economic impact of the CO_2 price with redistribution of revenues is different in the short- and in the long-run. Until 2020, employment increases although the GDP impact is negative, whereas beyond 2020 the impact on employment as well as on GDP becomes more strongly negative compared with the 'trend scenario'. The negative GDP impact does not mean that GDP actually declines, but that the average annual growth rate of GDP is lower, i.e. not all DMC and emission reduction is a result of decoupling. The DYNK model is characterized by convergence towards a long-run full employment equilibrium and short run disequilibria, brought about by institutional rigidities, like liquidity constraints. In the aftermath of the crisis and with household and public debt de-leveraging until 2020 the impact of revenue neutral environmental taxes is positive, partly on GDP and more significantly on employment. In the log-run, when the economy converges to full employment, the costs of environmental policy dominate the simulation results. This is exactly the New Keynesian philosophy, which is built into the model: in the short-run in a situation of unemployment equilibrium, it works like a Keynesian model, whereas in the long-run the properties are similar to a CGE model. This model run illustrates very well the strong co-benefits of a de-carbonisation policy for savings of resource use, even without any additional policy efforts directed at resource savings as such. In general, the scenario shows that absolute decoupling is possible and compatible with mid-term positive effects on the labour market. In a next step, the following policy options will be analysed: (i) high rates of re-use and recycling of material in key industries, and (ii) structural change in agriculture following a change in diets.

A transition to sustainable resource use provides a broader vision than the concepts reviewed above. It is oriented within a framework of planetary boundaries and international development; it encompasses control of climate change as well as stable employment. First scenario exercises on the basis of a model that captures the physical as well as the monetary aspects of socio-economic development suggest that policy efforts encompassing a multi-criteria array of attractive futures for Europe, such as reducing its dependence on material resources, stimulating innovations in design and recycling that improve Europe's competitiveness, maintaining its pivotal role in global climate protection and developing and employing a well-educated and creative labour force have a fair economic chance - but they require the political courage to embrace a socio-ecological transition.

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RESEARCH PARAMETERS

Objective of the research

In the face of the financial and economic crisis and long-term challenges from globalisation, demographic shifts, climate change and new technologies, Europe needs to redefine its development strategy. The objective of WWWforEurope – Welfare, Wealth and Work for Europe – is to strengthen the analytical foundation of this strategy. It goes beyond the Europe 2020 targets of smart, sustainable and inclusive growth and lays the basis for a socio-ecological transition. The new development strategy aims at high levels of employment, social inclusion, gender equity and environmental sustainability.

The research programme

WWWforEurope will address essential questions in areas of research that reflect vital fields for policy action to implement a socio-ecological transition:

- It will deal with challenges for the European welfare state, exploring the influence of globalisation, demography, new technologies and post-industrialisation on welfare state structures.
- It will analyse the impact of striving towards environmental sustainability on growth and employment and provide evidence for designing policies aimed at minimising the conflict between employment, equity and sustainability. This involves using welfare indicators beyond traditional GDP measures.
- It will investigate the role that research and innovation as well as industrial and innovation policies can play as drivers for change by shaping the innovation system and the production structure.
- It will focus on governance structures and institutions at the European level and the need for adjustments to be consistent with a new path of smart, sustainable and inclusive growth.
- It will explore the role of the regions in the socio-ecological transition taking into account institutional preconditions, regional labour markets and cultural diversity and examining the transitional dynamics of European regional policy.

This research will be conducted within a coherent framework which from the outset considers linkages between research topics and highlights how different policy instruments work together. The results of all research areas will be bound together to identify potential synergies, conflicts and trade-offs, as a starting-point for the development of a coherent strategy for a socio-ecological transition.

Methodology

The project builds on interdisciplinary and methodological variety, comprising qualitative and quantitative methods, surveys and econometrics, models and case studies.

PROJECT IDENTITY

Coordinator	Karl Aiginger, Director, Austrian Institute of Economic Research
Consortium	Austrian Institute of Economic Research Budapest Institute Nice Sophia Antipolis University Ecologic Institute University of Applied Sciences Jena Free University of Bozen/Bolzano Institute for Financial and Regional Analyses Goethe University Frankfurt ICLEI - Local Governments for Sustainability Institute of Economic Research Slovak Academy of Sciences Kiel Institute for the World Economy Institute for World Economics, RCERS, HAS KU Leuven Mendel University in Brno Austrian Institute for Regional Studies and Spatial Planning Policy Network Ratio University of Surrey Vienna University of Technology Universitat Autònoma de Barcelona Humboldt-Universität zu Berlin University of Economics in Bratislava Hasselt University Alpen-Adria-Universität Klagenfurt University of Dundee Università Politecnica delle Marche University of Birmingham University of Pannonia Utrecht University Vienna University of Economics and Business Centre for European Economic Research Coventry University Ivory Tower Aston University
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