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factor y

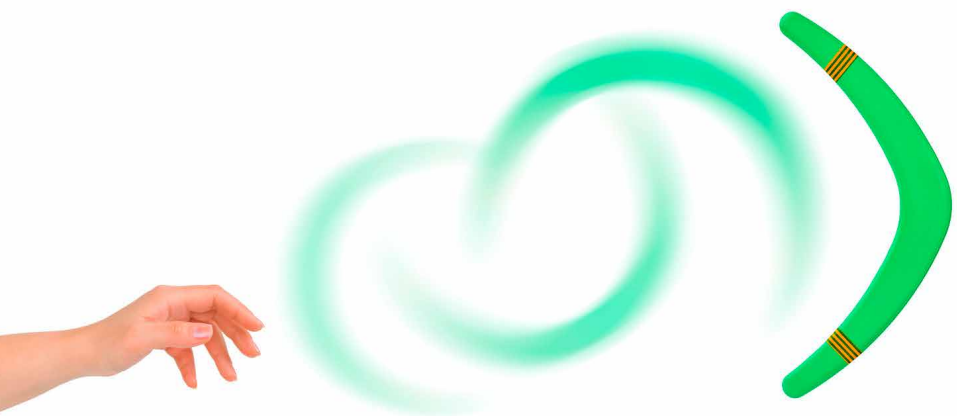
Magazine for a sustainable economy

Topic

REBOUND

About rebound, prebound and performance gaps

Rethink instead of rebound: a sufficiency revolution must precede the efficiency revolution Can a donkey be tragic? Curbing resource consumption by the use of equality Green cloud computing: rebound complex Leaving the comfort zone: smarter than smart technologies The most important reason is time



Bound to Rebound: Efficiency with consequences

The 2014 edition of WWF's Living Planet Report reveals that humanity is using 50% more natural resources per year than the planet can regenerate and yield sustainably. Furthermore, the mountain of our debt to nature continues to grow, whilst our stocks of resource are constantly diminishing. People in Germany have a particular responsibility, especially since each of us consumes twice the amount of resources as the global per capita amount available would allow. We are therefore living at the expense of other countries. But the Living Planet Report also contains good news: our ecological footprint has remained unchanged in recent years despite the fact that our prosperity has been increasing. This is a result of improved resource efficiency, with more value being created with fewer resources.

However, even with increased raw material productivity, we cannot reach the strategic sustainability goal that we have set: between 1994 and 2020, raw material productivity is likely to have increased by only approximately 82%.

If economic growth and prosperity continue to depend strongly on the consumption of natural resources, it will not be possible to limit the increasing conflict-laden demand for resources. The rebound effects are growing mercilessly, most efficiency gains are leading to fewer resource savings than expected.

How high are these rebound effects really? How are they measured and how can they be kept in check? After 30 years of research on rebound, there are still major scientific differences and a great need for further research.

This has also been recognized by the German Bundestags's Study Commission on Growth, Wellbeing and Quality of Life, which commissioned an expert opinion from our author Reinhard Madlener. In this issue of factory, he introduces the various categories and facets of rebound.

Tilman Santarius and Wolfgang Sachs are two additional experts on the rebound phenomenon. They argue for a sufficiency revolution prior to the efficiency revolution. Then there is Bernd Draser who looks at the tragedy of efficiency efforts, and Andreas Exner addresses the constraints of the prevailing system. Ralph Hintemann outlines how the rebound effects have developed during the digital revolution, and the working group of Folkwang University argues for a smart upgrade of things in order to raise awareness for resources. In an interview, Peter Hennicke, the former President of the Wuppertal Institute for Climate, Environment and Energy, who recently received the German Environmental Award, and the physicist and political scientist Stefan Thomas call for a realistic consideration of the rebound effect – as well as its limitation by sufficiency policies and by setting upper limits on consumption. Only with the help of such measures – and this is the key finding of this issue of factory – can we prevent rebound effects from delaying the most important effect of resource efficiency measures in the long run: the reduction of the global resource consumption.

We hope this factory issue provides you with many insights into rebound.

Ralf Bindel and the factory team

Translated from the German by: Miriam Eckers, Cornelia Enger and Bianca Gerards

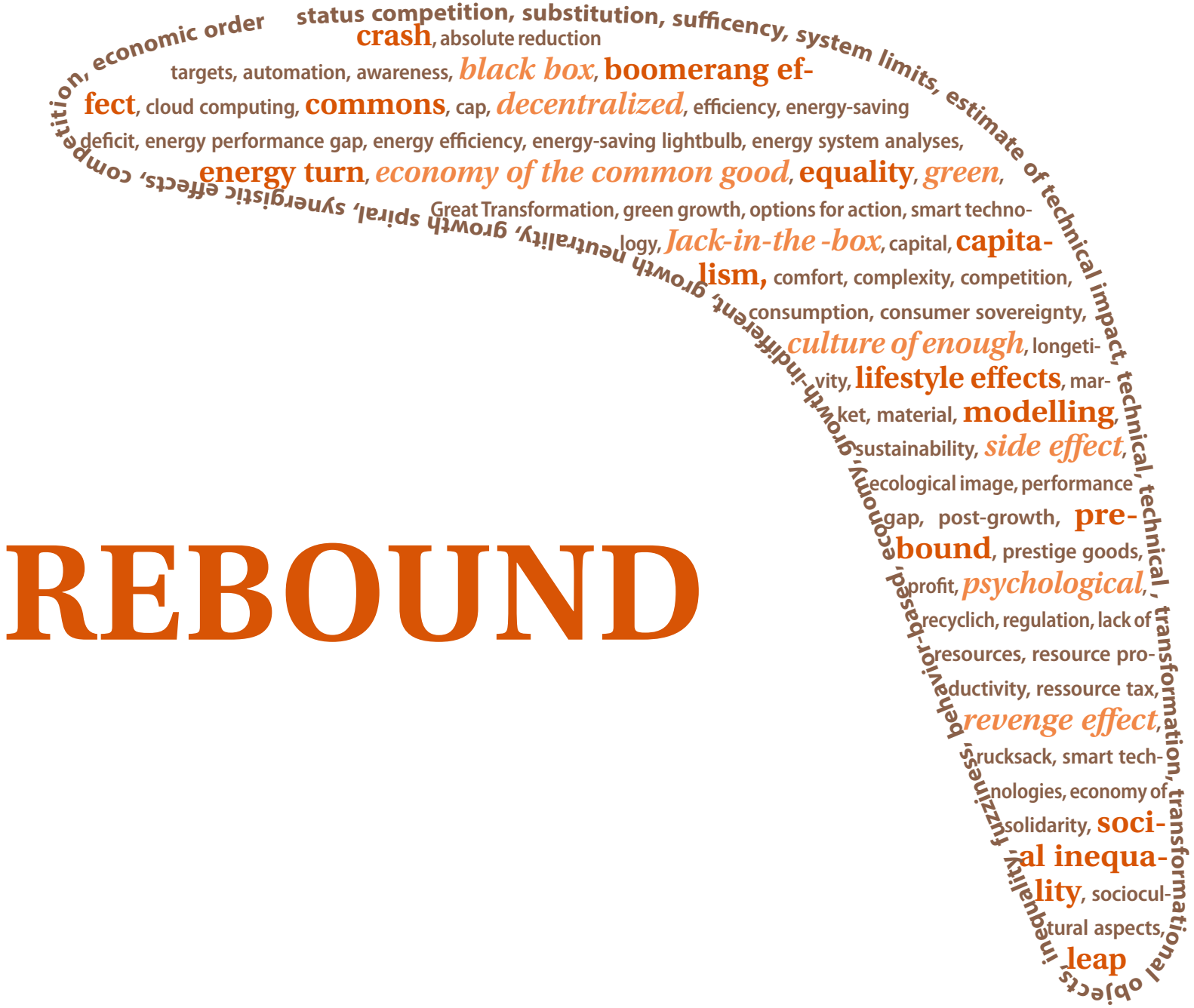
To help minimize the green rebound effect in your own life, just ask yourself this simple question before purchasing a product: "It's green, but do I really need it and do I need it in this quantity?".

Michael Bloch
Green Living Tips.com

Content

»There was once a boomerang that was a little too long. The boomerang flew off, but it didn‘t come back. The public, for hours, waited for that boomerang.«

Poems by Joachim Ringelnatz. On the website: ringelnatz.net, Buchfunk Hörbuchverlag GbR


REBOUND
status competition, substitution, sufficency, system limits, estimate of technical impact, technical, technical, transformation, transformational objects, inequality, fuzziness, behavior-based, economy, growth-indifferent, growth neutrality, growth spiral, synergistic effects, competition, economic order
crash, absolute reduction
targets, automation, awareness, black box, boomerang effect, cloud computing, commons, cap, decentralized, efficiency, energy-saving
deficit, energy performance gap, energy efficiency, energy-saving lightbulb, energy system analyses,
energy turn, economy of the common good, equality, green,
Great Transformation, green growth, options for action, smart technology, Jack-in-the -box, capital, capitalism, comfort, complexity, competition,
consumption, consumer sovereignty,
culture of enough, longetivity, lifestyle effects, market, material, modelling, sustainability, side effect,
ecological image, performance gap, post-growth, prebound, prestige goods, profit, psychological, recyclich, regulation, lack of resources, resource productivity, ressource tax, revenge effect, rucksack, smart technologies, economy of solidarity, social inequality, sociocultural aspects, leap

»The rebound effect alerts us to the necessity of a further step:

in order to be actually able to evaluate a product according to ecological considerations, it does not suffice to only take into account the material input ‚from the mine to the retailer'. Durability and the intensity of use also need to be taken into consideration.«

Friedrich Schmidt-Bleek, Grüne Lügen. Nichts für die Umwelt, alles fürs Geschäft – wie Politik und Wirtschaft die Welt zugrunde richten (Green lies. No benefits for the environment, only for business – how politics and the economy are destroying the world), Ludwig Verlag Munich 2014

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According to a study by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, the car scrapping premium which was supposed to support the automobile industry in 2009 to the tune of EUR 5bn apparently resulted in fuel savings amounting to 340 million litres, which equals 1 million tons of CO2 a year (that is, 1% of the total amount of car emissions). Approximately 2 million cars were scrapped and each purchase of a new car was subsidised in the amount of EUR 2,500. The income of the repair workshops decreased by around 4%; private consumption, not including car-related costs increased by 0.1%. Wikipedia, Umweltprämie

1/100

Two thousand years after the Chinese invented paper, producing it today only requires a hundredth of the amount of material and energy needed back then. However, people use more paper than ever before (about 440m tonnes in 2015). Neither the implementation of new media, nor the so-called paperless offices has led to a reduction in or the total elimination of paper. E-book readers are only more resource-efficient if you read more than ten electronic books per year and use them exclusively over a period of at least five years. www.faktor-x.info/wissenschaft/radermacher, Öko-Institut, E-Book- Reader, 2011

30

In urban traffic, car drivers spend around 30% of their driving time looking for a parking spot. By 2020, the market for shared parking will continue to grow annually by approximately 25% to a worldwide market volume of nearly EUR 2bn. The market for shared vehicles and mobility options will increase by 35% each year, and by 2020, the worldwide market value will amount to EUR 16bn. Roland Berger Strategy Consultants, Shared Mobility Study, notification of 7 July 2014.

300,000,000,000

By 2050, resource extraction will increase to this amount due to the industrialisation process of the threshold countries and the growth in the global population. Without additional gains in efficiency, today's global oil consumption of approximately 2.5 billion tons will increase to 30 billion tonnes, the worldwide car fleet of 500 million cars will grow to 4.5 billion vehicles and the global resource extraction of 50 billion tonnes will amount to 300 billion tons. H.Rohn, N. Pastewski, M. Lettenmeier, Ressourceneffizienz (resource efficiency), Frauenhofer Verlag 2013

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There has been a twenty-fold increase in labour productivity over the last 200 years. It grew by about 22.7% in Germany between 1991 and 2011, while the number of working hours per employee decreased by 9%. The increased productivity has led to a disproportionate output of goods and services – but not to less work: a far cry from Milton Keynes' idea of a 15-hour work week, German full- and part-time employees work an average of 37 hours per week. Weizsäcker, Faktor Fünf (to the fifth power); German Federal Institute for Population Research), Arbeitsproduktivität (labour productivity), 2012

4k

The resolution of displays and hence the energy demand for displaying and transmitting pictures are growing. 4k digital televisions have a minimum resolution of 8 megapixels. The new Apple iMac 27-inch display has a resolution of 5k. The amount of data transmitted is four to five times as great as before. This represents a burden on bandwidth and sets new aesthetic standards. This is why the battery and processor performance of modern smartphones and tablet computers has to increase incessantly.

Translated from the German by: Vanessa Kammerer

5,000

Computed tomography (CT) or magnetic resonance imaging (MRI) have significantly improved diagnostic possibilities. These devices are expensive – they each cost one million euros or more – so it is economically imperative to have them running continuosly. In the meantime, about 5,000 CT and MRI devices are in use in Germany and the number of examinations has massively increased over the past ten years; in fact, many of them would not have been necessary. U. Schneidwind, A. Zahrnt, Damit gutes Leben einfacher wird (to make a good life easier), Oekom Verlag 2013, p. 121

>15-40

Companies maximize profits more than consumers do. Production-related income and substitution effects result in companies exploiting the full potential of rebound effects. Generally speaking, rebound effects will be higher on the level of companies and sectors of industries than on the level of individual households. In a study published in 2013, long-term rebound effects from 25% to 60% were calculated for 30 industrial sectors in the USA. In four studies, rebound effects of between 24% and 80%for freight traffic were identified.

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Over the past 30 years, dozens of empirical studies on the microeconomic rebound effect in industrialized countries have been published. These were evaluated in five meta-analyses. From these analyses, a direct rebound effect for end consumers or private households between 10% and 30% can be extrapolated. This percentage of resource conservation through efficiency is lost due to rebound. Indirect rebound effects by means of the consumption of real income growth in the amount of 5-10% of spending on energy have to be added. Tilman Santarius, Der Rebound-Effekt: ein blinder Fleck… (the rebound effect: a blind spot…) In: Gaia, 23/2 (2014): pp. 109-117

3-30

The amount of the rebound effect revealed in several studies is no indicator for their significance. It is, however, an indicator if one multiplies it by the percentage of energy consumption in the corresponding segment and country. Thus, the rebound effect of space heating in terms of the OECD average is between 20% and 55%. A share of 25% in Germany corresponds to a significance index figure of 650. This is considerably lower than the index figure of 2520 for motorized road traffic (rebound effect: 3% to 90%; 28%share in Germany) and the index figure of industrial production (rebound effect: 30% to 150%; 29% share in Germany), but it is higher than the index figure of air traffic at 240 (rebound effect: 40% to 300%; 0.8% share in Germany). R. Madlener, Tabelle aus laufender Forschung des FCN (table from ongoing research of the Institute for Future Energy Consumer Needs and Behavior (FCN)), 2014

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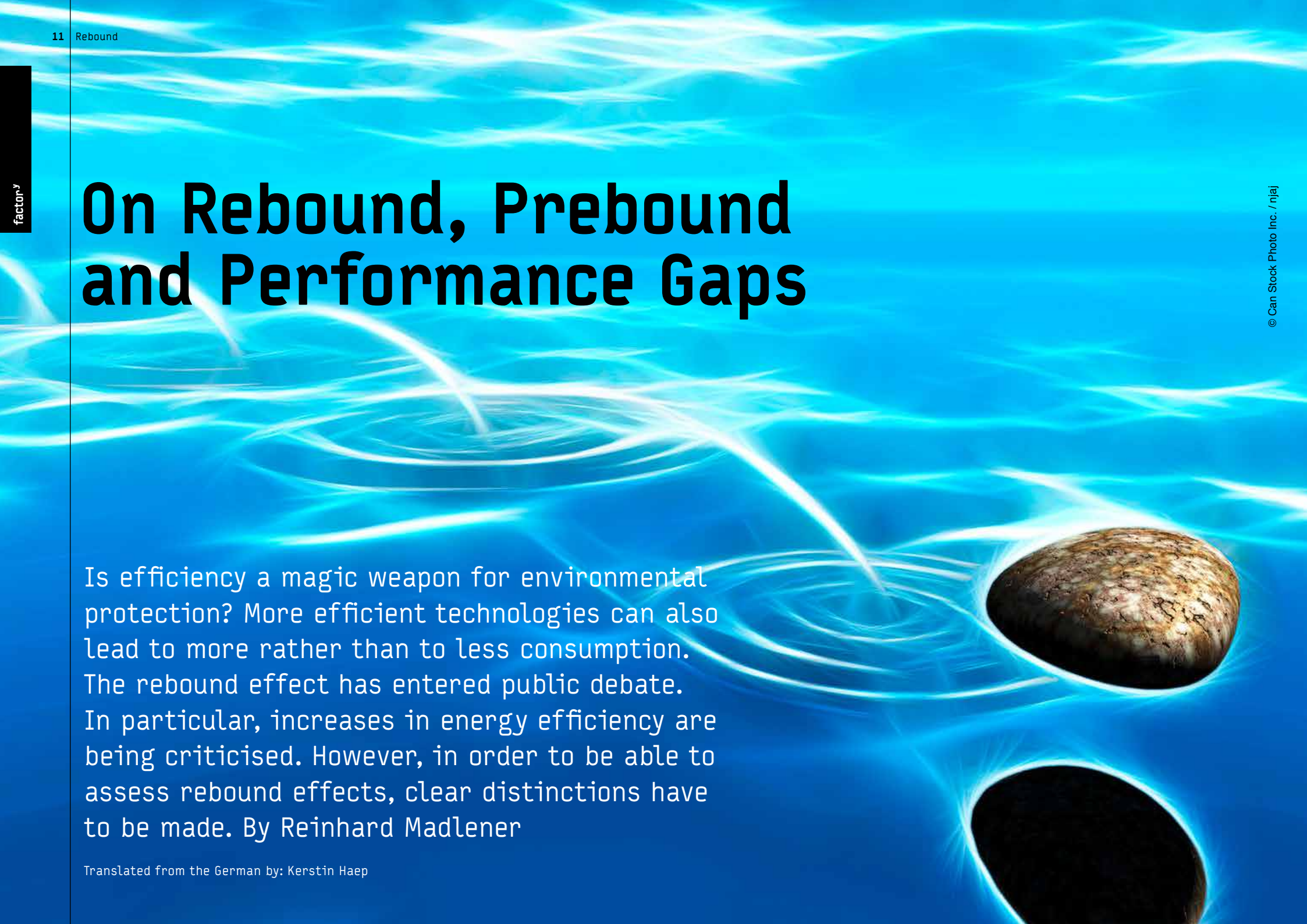
There are many rebound effects and definitions. In 2006, Madlener and Alcott listed 28 different definitions. The discrepancies in the basic assumptions lead to different models, calculations and results. Basically, there are three forms of effects to be distinguished: direct (substitution, income and output effects, mental rebounds), indirect (secondary effects, mental accounting & moral licensing, embodied energy) and macro economic effects (effects on the market price and on new markets). Erik Poppe, Der Rebound-Effekt: Herausforderung für die Umweltpolitik (the rebound effect: challenges for environmental policy), 2013

»The rebound effect is a political problem because it raises the question of a good model of prosperity and global justice.«

Erik Poppe, Der Rebound-Effekt: Herausforderung für die Umweltpolitik (the rebound effect: challenge for the environment policy), master's thesis written at the Otto Suhr Institute of Political Science at the Freie Universität Berlin (Free University of Berlin), 2013.

On Rebound, Prebound and Performance Gaps



Is efficiency a magic weapon for environmental protection? More efficient technologies can also lead to more rather than to less consumption. The rebound effect has entered public debate. In particular, increases in energy efficiency are being criticised. However, in order to be able to assess rebound effects, clear distinctions have to be made. By Reinhard Madlener

Translated from the German by: Kerstin Haep

In recent years, the issue of rebound effects has become increasingly significant in scientific and political debates in Germany as well as internationally. This is a crucial step because the government regards increases in energy efficiency as a proven and cost-effective means to reduce the use of fossil fuels and therefore also the amount of greenhouse gas emissions. Hence, it is important to understand the opposing trends of these expected savings as well as the influence of this methodology and of the system boundaries (and also of possible distortions of the estimates) on the size of the rebound effect. Regarding energy policy, this means that the policies are neither as effective nor as cost-effective anymore as they would be if the rebound effect amounted to zero.

Despite a more than 30-year-old debate over different concepts in the scientific literature, the definitions and uses of the term 'rebound' still vary widely. Nevertheless, measuring rebound effects allows us to evaluate how expected or rather professionally-calculated energy savings are impeded (rebound effect between 0 and 100%), eliminated (rebound of 100%) or even overcompensated (rebound of more than 100%, also called 'backfire') due to behavioural responses to more cost-effective energy services that result from technical efficiency improvements. For example, people who drive vehicles that are more energy efficient have a higher mileage (this was empirically verified for Toyota Prius drivers and is a fact that should not be neglected). Another example is the additional consumption of heating energy following energy- efficient building renovations (for example, because of unmet personal needs or against one's better judgement – that is, for example, when people keep heating and ventilating the way they used to despite more efficient insulation and new heating technologies).

It Depends on The Measure

The term 'rebound' must be differentiated from the 'energy performance gap' (EPG), a term referring to the difference between the calculated energy requirements and the amount of energy actually used, for example, following the energy-related renovation of a building. This difference is always indicated as a percentage. Another important measure in the context of energy policy is the 'energy savings deficit' (ESD), which refers to shortfalls in expected energy savings after an energy-related renovation process. The ESD is indicated in per cent as well. Such measures help to distinguish between behavioural effects (the question here is whether there is a difference between the conscious behaviour of a person prior to and after the increase in efficiency) and technical effects (which may also be related to deficient technology or imprecise technical calculations).

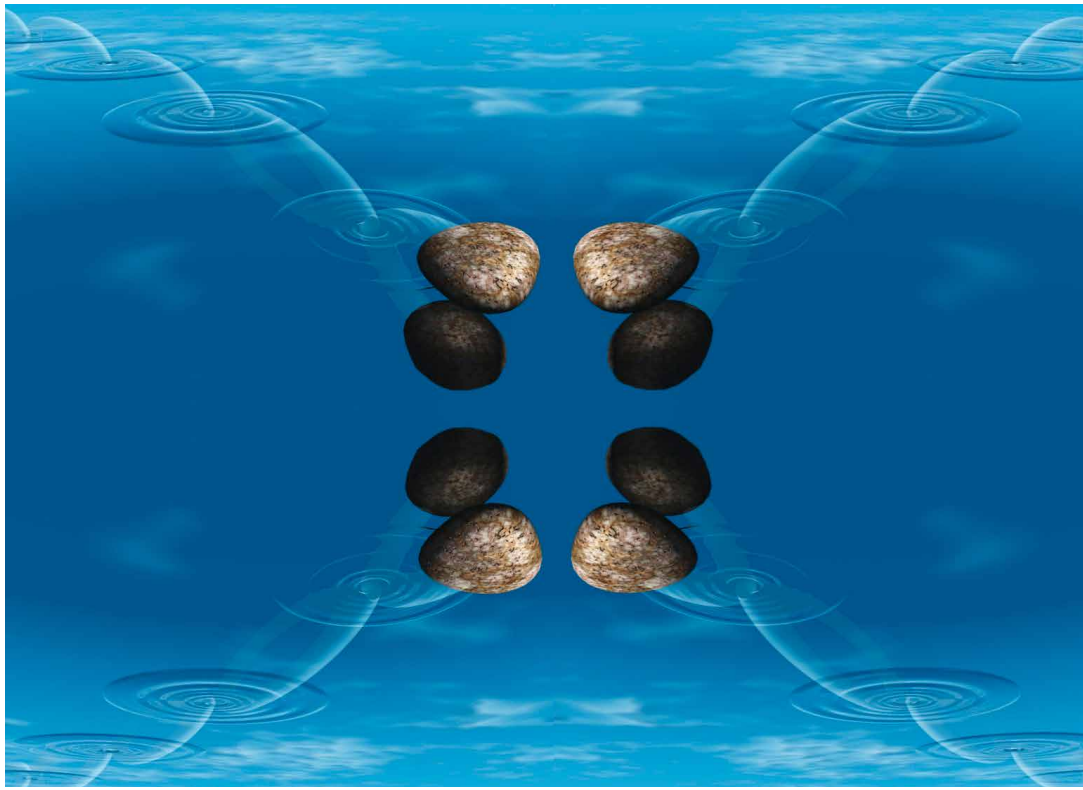
'Prebound' – a term coined by Ray Galvin (Sunikka-Blank and Galvin 2012) – refers to the phenomenon of having used less energy (even prior to the increase in energy efficiency) than had been calculated and expected. 'Rebound effects' are often typical for energy-efficient buildings, while it is rather 'prebound' effects that tend to be seen in poorly insulated buildings. This leads to at least two conclusion. First, energy and CO2 savings that can

be realised through energy-related renovations are quite difficult to predict on the basis of previously calculated savings. Second, non-technical energy savings that can be realised through changes in behaviour have the potential to clearly surpass energy savings achieved by means of technical improvement, which has significant relevance for optimal policy development.

Sociocultural Effects and 'Rebound'

'Rebound' is also an important topic from a social point of view, as conflicts between energy policy and sociopolitical interests might arise. If the rebound effect, for example related to space heating, is higher for tenants and the low-income class than for homeowners and the high-income class (Madlener and Hauertmann 2011 showed that, in Germany, both scenarios occur), it must be discussed whether rebound effects should be reduced in favour of low-income tenants or rich home owners – and whether they should be reduced at all. Having said that, it becomes clear that the discussion about rebound effects also implies ethical, moral and social dimensions. Sociocultural aspects constitute another intriguing field of research in the context of rebound effects.

Over the next few years, the Institute for Future Energy Consumer Needs and Behavior (FCN) at the RWTH Aachen University in Germany intends to carry out extensive research on rebound effects within the framework of the developing virtual institute 'Transformation – Energy Transition NRW' (coordinators: the Wuppertal Institute and the Institute for



Advanced Study in the Humanities (KWI) of the University of Duisburg-Essen, Germany.)

Ultimately, this should clarify the extent of rebound effects within different sociocultural groups (a project group of the Centre for European Economic Research, the University of Stuttgart in Germany and the Fraunhofer Institute for System and Innovation Research ISI has carried out important preliminary work in recent years; see HYPERLINK "http://www.zew.de/rebound" www.zew.de/rebound). The aim is also to examine the spatial distribution of rebound effects.

Not One or Two Effects …

Rebound effects include direct effects (increased demand for energy services that have become cheaper due to increased energy efficiency – a price effect), indirect effects (increased demand for other energy and resource consuming products and services, because one energy service has become cheaper as energy costs are saved due to increased energy efficiency – an income effect) and macroeconomic effects (increased energy efficiency has the potential to change supply and demand in the economy as a whole, and leads to structural changes, and also usually to growth which encourages the consumption of resources).

If the macroeconomic rebound effects are considered not only on the level of the national economy but also globally, the research methodology becomes very complex and demanding. Through increased interdependence of national economies as a consequence of advancing globalisation, global rebound effect is, in any case, a factor that should not be underestimated. An energy efficiency policy in one country could provoke rebound effects in other countries, which ultimately could lead to an increase, instead of a decrease, in energy consumption. This should be thoroughly considered when exporting energy-efficient commodities.

Rebound and Resources

Furthermore, energy rebound effects could lead to additional consumption of non-energy resources and could, as a result, shift the problem (note that on a micro-level, although the use of a particular energy service saves energy compared to the situation before the improvement in efficiency, an increase in material consumption may result).

Thus, resource efficiency as a whole or rather the absolute decoupling of economic growth and non-renewable resource consumption must also be borne in mind.

Finally, the energy and resource consumption (including precious materials and rare earth elements) as well as the economic and social impact of using renewable energy technologies represent an aspect of the energy transition that is still insufficiently explored but also has rebound potential (by means of energy technologies that were not attractive enough commercially until they showed an increase in efficiency).

In this context, it is crucial to, first of all, find out, by means of energy systems analysis (Life Cycle Cost Analysis, Life Cycle Sustainable Assessment, etc.), where and how the energy transition also leads to negative effects (for examp-

le, child labour in Malaysia), and then to minimise these effects accordingly.

Despite the complexity of rebound effects, it is certain that it will be easier to find solutions to the enormous energy and resource policy challenges with a profound transformation of society towards sustainable development and an improved transparency of the consequences that result from our own actions than by merely using technological fixes and trusting blindly that technical progress is predominantly only a positive development.

Prof. Dr Reinhard Madlener directs the Institute for Future Energy Consumer Needs and Behaviour (FCN) at RWTH Aachen University. In 2011, he wrote the expert report on rebound effects for the 'Growth, Prosperity, and Quality of Life' study commission established by the German Bundestag (the lower house of the German parliament).

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factory

»Gains in resource efficiency are not always enough to achieve a reduction in resource inputs and the associated environmental pressures.

It is possible that lower costs due to efficiency gains may lead to increasing demand for resources and consumer goods, and may thereby be cancelled out or even over-compensated (the rebound effect). Measures to improve resource efficiency must therefore be accompanied by a paradigm shift that no longer equates prosperity with quantitative growth in the sense of 'having more', but is concerned with better satisfaction of human needs by shifting the focus to 'qualitative growth'.«

German Resource Efficiency Programme (ProgRess), Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), May 2012.

Rethink rather than rebound: a sufficiency revolution must precede the efficiency revolution

Commitments to efficiency are no miracle cure to ensure a transformation towards more sustainability. By means of sufficiency policies, however, even rebound effects can be limited.

By Wolfgang Sachs and Tilman Santarius

Translated from the German by: Judith Stenzel

Sufficiency is the strategy of omitting. Since the invention of the atomic bomb, mankind has realised that not everything that is possible should also be done. Based on this insight, Hans Jonas defined the following moral imperative in the 1970s: "Act so that the effects of your action are compatible with the permanence of genuine human life." Today, the global economy constantly violates this principle – it has become a threat to the biosphere that includes all living organisms on earth.

What is 'real human life' apart from the pure survival of the human species? A debate on social values is necessary to answer this question. In times of rapidly advancing individualisation and globalisation, it seems promising to avoid this discussion. This is why the strategy of efficiency is so attractive. It promises that, due to the extensive transformation of technology, it is not necessary to question present economic practices or lifestyles at all. Does driving a car harm the environment? It does not matter, proponents of efficiency argue, if future cars consume as much fuel per kilometre as public means of transport do today. But there is a problem with this approach. If driving is cheaper and morally acceptable, people will perhaps drive more often and longer distances. This phenomenon is called the rebound effect.

SUVs with hybrid engines

Financial rebound effects are already well known: The money saved by using more efficient technologies is spent for more consumption or further investment – which leads to additional energy and resource consumption.

Some may find it surprising that rebound effects can even occur if an efficiency improvement does not result in savings. The point is that material rebound effects are possible because the manufacture of more efficient devices and products already eats up a share of the energy potentially saved while they are used. In addition, there are psychological rebound effects because more efficient products do not only have different technical features but also a different symbolic meaning.

Sport utility vehicles (SUV) were vilified as 'suburban tanks' or 'climate killers' until recently because of their excessive weight and horrendous fuel consumption. But once equipped with a hybrid engine, they are suddenly regarded as paragons of ecological motoring. In fact, a significant increase in efficiency of a particular product can lead to a shift of social norms and individual attitudes concerning its use. Yet, without sufficiency, this shift oftentimes leads in the wrong direction.

After all, increases in efficiency cause growth spurts and growth compulsions throughout the economy. For economists, this is a commonplace. Obviously, every increase in productivity strengthens the economy and boosts growth. And while the correlation between labour productivity and growth is unquestionable, there is a similar correlation between the increase in energy efficiency and growth.

In fact, this is one of the main arguments of the supporters of 'green growth'. The stronger the 'carbon productivity' of the economy, the more growth can be achieved. However, if the

rebound effects of these growth and demand effects are taken into account, it is impossible to avoid the insight that technology and innovation initiatives alone are not enough to reduce resource consumption and lower greenhouse gas emissions by a factor of 10 in developed countries. What is more, the promotion of 'green growth' may result in increased rebound effects because the consumption of green products can then be misinterpreted as a personal contribution to environmental protection. It is obvious that the 'efficiency revolution' in technology has to be preceded by a 'sufficiency revolution' in social institutions. Otherwise new technologies will do no more than loosen yet another of Prometheus' bonds.

Capping rebound effects

Efficiency enthusiasts rarely agree with this point of view. People who are caught in the old expansion game of the modern age perceive absolute reduction targets as a limitation of the 'consumer sovereignty' and, therefore, they aim to increase resource productivity. But an increase in productivity for whom or for what? For the great diversity of species? For the dignity of employees? For the durability of products? No, for none of them.

It is said that the consumption of resources relative to the gross domestic product needs to be more productive. The increase in resource productivity is seen as a decoupling of the growth curve, whereby the need for economic growth is often overlooked. The term 'decoupling' also refers to the constant

growth of economies. It is hence not surprising that 'absolute decoupling', a decline in resource use accompanied by economic growth, is failing. It is only occurring in some exceptional cases. Hence, the policy of sufficiency is neutral with respect to economic growth, focussing instead on the wellbeing of the population. However, the growth neutrality of sufficiency is resistant to all kinds of rebound effects.

The concept of sufficiency can be applied in many domains, but in all of them the concept of a 'cap' comes into play based on the idea of setting a 'cap' on the consumption of resources. Specifying caps on a collective basis is essential for combatting rebound effects. No matter how valuable caps may be on an individual level, they cannot replace caps on a collective level. Sufficiency is not just a matter of personal interest, but is also relevant on the institutional level.. Sufficiency based merely on the level of the individual cannot ensure the avoidance of material and growth-related rebound effects. It may even cause an increased shift of resource consumption to other consumers in other countries.

On the other hand, collective agreements cannot provide effective protection against this shift in consumption or the after-effects of excessive consumption. Some of the key successes of environmental policy emanated from the spirit of sufficiency: unleaded petrol, the Montreal Protocol on Substances that Deplete the Ozone Layer, the Stockholm Convention on POPs, the German abandonment of nuclear energy, and even the designation of nature reserves – the very first environmental policy measure. But CO2 emissions are obviously of a different type because they penetrate every aspect of business and they require sustainable technologies everywhere. Only commonly agreed caps on carbon dioxide emissions, which represent one of the goals of sufficiency, can revolutionise efficiency and, at the same time successfully control the rebound effects. The widely discussed topic of taxes on energy and resources, which could compensate for savings resulting from increased efficiency, are, strictly speaking, a sort of 'light' sufficiency.

Capitalism can survive only if it can acquire a new operating system

What exactly does sufficiency policy entail? In order to be prepared properly for the challenges of the coming decades, the following aspects should be taken into consideration: a resource-saving solar energy system, underpowered cars, a reduction in European air traffic, zero additional utilisation of land, organic farming and an exit strategy for floating fish factories. In addition, the following social aspects should be taken into account: the sharing, of apartments and gadgets but also all types of co-production, both electronic and manual.

Such projects already exist, but a top priority is to make them accessible for everybody. They all contribute to the culture of 'enough'. If they increase and cover entire sectors, the rebound effects will decrease.

'Exit' and 'change', 'transformation' and 'post growth' are terms which indicate that the policy of sufficiency considers itself to be a part of a larger change.

In general, a policy of sufficiency only makes sense if it offers opportunities, for example, a city with low traffic that is worth living in, farming without chemistry but of a high quality or a decentralised but efficient regional economy. To put it in a nutshell, what we are aiming for is a common welfare economy that is linked to nature and that respects the needs of people. Capitalism survives only within democracy if its system changes and includes ecological and social added value, even if it does not seem possible in some areas. It is a broad field, but eventually the main point is to build a society based not only on money but also on solidarity with people and other living creatures. It is probably the most important recommendation for the framework of the efficiency enthusiasts not to forget about this aspect.

Prof. Dr. Wolfgang Sachs is a senior researcher at the Wuppertal Institute for Climate, Environment and Energy. He was the chairperson of the board of Greenpeace Germany, lead author of the IPCC and was in charge of the study Sustainable Germany. Tilman Santarius was project director at the Wuppertal Institute for Climate, Environment and Energy until 2009, an expert at the Heinrich Böll Foundation until 2011, and until recently a visiting scholar at the University of California in Berkeley.

»Shall I judge you more strictly than I judge myself?

We meant to do good, but it turned out badly.
This happens to the pure striving of the Noble.
For he cannot execute the task himself, he alone,
So much of the passion, the evil selfishness of
the others who serve him as tools, rubs off,
that once the task is completed, he is merely a
distorted picture of himself, rather than the
man of the act.«

Unofficial translation of Ein Bruderzwist in Habsburg (Family Strife in Hapsburg) by Franz Grillparzer (Austrian play writer), Act 4, completed in 1848, first published and performed in 1872. Taken from: Sämtliche Werke. Ausgewählte Briefe, Gespräche, Berichte (Selected Letters, Conversations, Reports). Edited by Peter Frank and Karl Pörnbacher, Munich: Hanser, 1960-1965. Volume 2, p. 428.

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Can a donkey be tragic?

Technological development and its adverse consequences for the environment and for people can hardly be reasonably regulated; there is a way back only after accidents. In order to further understand rebound, another story needs to be told, a philosophical ‘aestheticisation ‘of the imprecise.

By Bernd Draser

Translated from the German by: Vanessa Kammerer

When the Oracle of Delphi prophesied that it was Oedipus' destiny to kill his father and marry his mother, Oedipus tried everything in order to escape his fate. He left his father, his mother and his hometown of Corinth and started a new life as the king of Thebes.

This summarises the first part of Sophocles' tragedy Oedipus the King. But Oedipus did not have all the information needed to make a good decision, even though to him it seemed like the best solution. He met his birth father, without knowing who he was, on his way to Thebes and killed him. After his arrival in Thebes, Oedipus freed the city from a crisis and was rewarded with the throne and the queen who, also unbeknownst to Oedipus, was his own mother. Oedipus' first step to becoming a tragic hero was his unswerving attempt to prevent the oracle's prophecy from coming true – and by doing so he fulfilled it.

The term 'rebound' is used in the fields of pharmaceuticals and mechanics, in the financial world and in basketball. Since the 1990s, it is also used controversially in sustainability science, when efficiency gains, which are technically supposed to reduce the absolute ecological effects, only manage to do so on a limited scale or in fact to cause the exact opposite effect.

The Oedipus analogy shows that the rebound effect is the tragic dimension of the sustainability system, which focuses on the increase in efficiency and productivity.

From Rebound to Backfire

Entanglements which cause rebound effects can be interactions of an economic, material and also of an ethical nature, which do not receive enough attention, since they are difficult to quantify. This effect is much older than the expression itself and was first described as a paradox by the English economist William Jevons during the mid-19th century. Back then it was used to refer to the more efficient use of coal, which led to an increase instead of a decrease in consumption. Not only is this effect classical but also intrinsically human – overly human and in a pure classical form, it also appears in Sophocles' Oedipus the King.

The ethical rebound effect, which is often revealingly referred to as psychological, is very delicate. By moralising sustainable lifestyles, the moralist is not only allowed to advance but also to consume more – since it is regarded as ethical – without feeling bad about it. There are plenty of common examples. People who use energy-saving light bulbs are tempted to leave the light on much longer; along with the material increase in consumption, the saved energy is easily overcompensated. Somebody who drives a car with an eco-friendly image is similarly tempted to drive further and more often with the feeling of ethical superiority. Combined with the production of these cars, this equally results in a backfire, thus a rebound effect of more than 100%.

Jean-François Lyotard introduced the term 'grand narratives' (metanarratives); these are concepts of world interpretation that create a system that is expected to be appropriate for the interpretation of all. These are salvation-his-

torical narratives such as the Christian, the Systematic Philosophy of Hegel and Marx and the philosophy of science, etc. Each of these conveys its own thorough interpretation of the world and from these interpretations derives its own measures in order to reconcile the world with the narrative. The discrepancy between the anticipated aim and reality, in other words the discrepancy between the simplicity of the 'grand narratives' and the diversity of reality – this tragic discrepancy corresponds to the rebound effect.

The Effect of the Model

Especially in terms of technology, a metanarrative is required for the rebound effect. This is because technological solutions can be very sophisticated in themselves; but on a macro level, interactions with the environment are thought through only in a rudimentary way. In the context of its own grand technical and instrumental narrative, technology revolves around hermetic thinking, rarely reaching the level of interactions. A smartphone, for instance, is a masterpiece in terms of high technology incorporated in the smallest of spaces; but it is doubtful whether the total quantity of devices as well as their interactions with the environment have played a significant role in the design process. During the latter, it is the first criterion of a sustainable industrial design to attach the appropriate value to the dimension of interactions, which can also be called 'cyclical'.

Seen epistemologically, the rebound effect represents the distortion that is endemic in all model building. It definitely has an epistemological value because it ignores everything that should not be considered in the model and thereby reduces complexity. This distortion only becomes a problem if the model loses its model character and confuses the reduced complexity with the meaning of the narrative. This is the case with metanarratives. Technical-instrumental thinking tends to confuse technical feasibility with the proof of the action's correctness. In this case, disciplines such as technology assessment intervene as a corrective to readjust what is distorted.

The Promise of Efficiency

Narratives that do not only offer more transparency but also a higher epistemological value are those that reveal what they are because of their aesthetic character. One example is Oedipus the King, a tragedy by Sophocles. Again, there is a grave crisis that strains the community of Thebes – the plague. And again, it is an oracle that announces that a crime is the reason for the plague. Oedipus had already helped the town once to overcome a crisis when he solved the riddle of the sphinx. Back then, the correct answer was: "It is the human being." Decades ago, we found the same answer, namely that the alarming changes in nature are anthropogenic in nature.

So when Oedipus, the detective-like riddle solver, tries to find the reason for the crime, each successful step tragically backfires on him. He realises that he himself is the wanted sinner, not as a human being but as an individual, he personally, without any intention of committing a crime or violation – but nevertheless completely responsible.

And just like Oedipus, each of us as an individual has the responsibility to bear in mind the rebound effects and to reconsider our own actions with respect to them. In this way, we not only acquire sovereignty as individuals but we insist on the non-redeemable nature of individuality, which cannot be forced into shape by any model, which cannot and must not be conceptually pinned down.

The rebound effect is tragic in two senses. On the one hand, it describes the opposite of what was the intention of an action – this is tragic in so far as it represents the fateful involvement in overly complex interactions. On the other hand, we cannot wish it entirely away because its disappearance would mean the extinction of what Adorno calls the non-identical, the resistant self of each individual. Where a rebound effect is ascertainable there we are still safe from the tyranny of the great narratives. There, we are still master of the models, not yet their subject – but the models are evolving.

This approach can only be concluded with Nietzsche: "Can a donkey be tragic? – To perish beneath a load that one can neither carry nor cast off? … The case of the philosopher." And it is not only the case of the philosopher.

Bernd Draser teaches philosophy at the Ecosign Academy for Design in Cologne, Germany. His last topic in the factory issue entitled HYPERLINK "http://www.dict.cc/englisch-deutsch/Sisyphus.html" Sisyphus was 'The Comforting Beauty of Failure'.

»Nobody spends another person‘s money as wisely as he spends his own. Nobody uses somebody else‘s resources as carefully as he uses his own. So if you want efficiency and effectiveness, if you want knowledge to be properly utilised, you have to do it through the means of private property.«

Milton Friedman’s speech at the opening of the Cato Institute, 6 May 1993

Curbing Resource Consumption by the Use of Equality

Equality is a key factor to approaches of a solidary post-growth economy and of commons. With this factor the existing non-sustainable economic order as well as rebound effects can be overcome.

By Andreas Exner

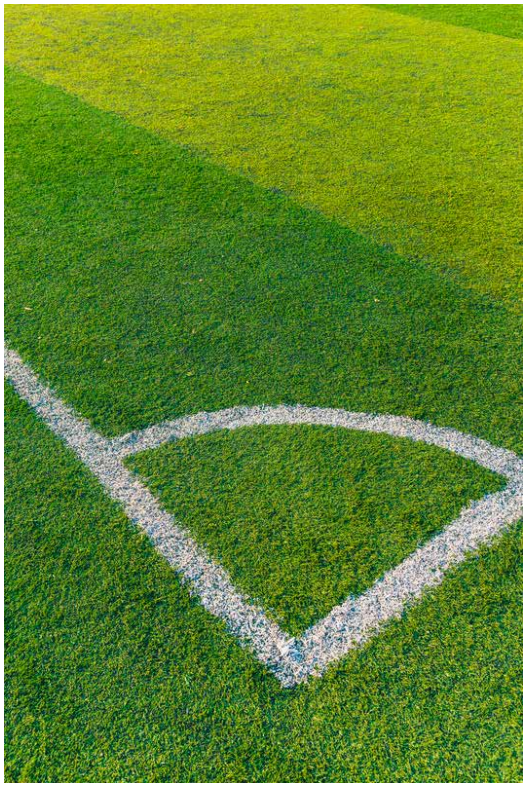
Translated from the German by: Bianca Beier and Judith Stenzel

In the debate about a sustainable and fair economy, growth and rebound effects are often used as evidence to show that the current economic order does not allow for a resource-efficient economy. A frequently asked question is what actually stimulates economic growth in a way that the related increase in resource consumption has negative consequences for the environment and quality of life. The current discourse is shaped by two narratives: the technicist narrative blames inefficient technologies for the problematic growth; the anti-consumerist narrative makes growing consumption responsible for the increasing use of resources. The technological argumentation focuses especially on a further increase in efficiency and the replacement of non-renewable energy sources with renewable ones. A positive aspect of the technological solutions is the hope that increased resource efficiency, related to a single product, will lead to a decrease in resource consumption. It is therefore concluded that resource consumption, with regard to society as a whole, and the associated environmental damage can be reduced with appropriate technological processes. The anti-consumerist narrative also seems convincing at first. It is assumed that if consumers buy less, production will decline. Environmental pollution would thereby be expected to decrease, too.

A closer examination reveals that these assumptions are questionable. The technology-oriented strategy of increasing efficiency does not take into account the so-called rebound effect. Empirical evidence has shown that the rebound effect is a parallel development of decreasing resource consumption per product unit or transportation kilometre with rising consumption overall.. Even the argument of consumption does not seem plausible: since the 1980s, wages, salaries and their share of national income have dropped in many industrialised Western countries, while resource consumption increases.

Both statements show a common deficit. They do not have a sense or the right concepts for the existing economic structure and its specific form of social relations because profit and the resulting comprehensive market orientation are typical for the current form of production.

An ecological consequence of this economic approach is the functionalisation of concrete desires that are inherently limited. However, the capital employed must grow; the competition in the market demands a surplus of money. A company that – due to a lack of profitability – is unable to invest in new and more productive machines, marketing, a streamlining of operational processes and higher qualified employees will be defeated in competition by more profitable companies. In addition to this growth compulsion resulting from competition, the internal drive to grow has an effect, too. It does not make any sense to generate an equally high amount of revenue with the help of an investment if the purpose of production does not primarily serve the satisfaction of needs.



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A Reduction in Resource Consumption Makes New Investments Possible

The limits of both positions are evident. Technology does not solve the problem of sustainable economic activity insofar as expenses spared through the saving of resources appear as increased funds for new investments that ultimately materialise in new means of production or new products. This leads to a counteraction or even an overcompensation of increases in efficiency. Consumers are affected similarly: They will develop a stronger demand as efficiency of new cars or processing power increases. In doing so, they are not driven by a competition in the market but by the pressure to preserve and increase their status.

A position that blames the ecological crisis on consumption but does not consider the consumption's economic function and integration fails to recognise two things: First, the central motivation for capitalist action is not consumption but profit. This motive presupposes consumption but comprises the increase in capital through the accumulation of money surpluses (in the form of profits, rent and stock dividends). These surpluses in the form of profit emerge precisely as the part of national income that is not consumed, but as the part that is subsequently being invested instead. A consumption that 'eats up' the entire national income would simultaneously annul profit as well as other production under capitalist conditions.

The Prerequisite for Sufficiency

What path towards sustainability should be chosen if technological development alone does not go far enough and consumption as such is not yet seen as the actual obstacle to sustainability? The answer can be found if one considers the mechanism of growth compulsion, the competition for profit that results from the competition between companies for their economic survival.

This competition inevitably occurs if companies do not discuss their production and instead act recklessly with respect to each other. And this cannot

be any different in a marketplace. An apparent alternative is an authoritarian state planning of the market similar to the socialist model where competition appears to suspended on the surface but continued in a 'negative form'. A proper alternative could be a democratic and needs-oriented regulation of production without government intervention. Entirely new economic practices and a ' ' are necessary for this latter journey to a historically new form of society.

On a secondary level, the competition between consumers plays a role in growth compulsion as they accumulate symbolic capital in the form of prestige goods. Especially on the lower rungs of the social ladder, this competition occurs at the most basic level as the struggle for employment. The social ladder, which stretches from investors to unemployed people, is persistently being extended under the influence of competition as the latter systematically rewards the rich and punishes the poor. The more economic and cultural capital an individual has at its disposal, the likelier it will succeed in the competition and will be able to further accumulate capital.

The competition for status between investors and business owners and, on a secondary level, also between wage earners, is the subjective driving force of growth compulsion, which logically can only be confronted by reducing social inequality. This is an essential, albeit not yet a sufficient condition for sustainability. This concludes the brief analysis of the causes and consequences of growth. But is the desire for a new economic order in the form of sufficiency in practical terms more than a vague hope?

Not necessarily. Economic practices that do not follow the logic of competition and profit maximisation but are oriented towards specific needs and can therefore be realised within the framework of sufficiency, are increasingly discussed under the rubric of a solidarity economy or in terms of the commons. They include, for example, community-supported agricultural projects and food co-ops, down to networked democratic cooperative associations. Historical examples date back as far as the first decades of Israeli kibbutz settlements at the beginning of the 20th century.

While overall, Israel was developing into a capitalist society, the economically important kibbutz sector was following an alternative path until the 1980s. The diverse subsistence-oriented practices, which, from a global perspective, are still part of many, if not most people's everyday life, are also subsumed within that same alternative category.

Social proximity reduces natural resource consumption

According to studies on the consequences of social equality, quality of life can be increased considerably just by reducing income gaps in a national economy. However, GDP does not have any statistically measurable influence on the quality of life in richer countries. Moreover, in countries with greater social equality, costs of sales promotion account for a smaller share of GDP, whereas development aid accounts for a larger share. Furthermore, their Global

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Peace Index scores indicate that they are more peaceful compared to poorer countries. Therefore, higher quality of life requires neither an increased economic performance nor the – on average higher –natural resource consumption associated with economic performance but greater equality. When comparing rich countries with each other, important indicators of a society's ecologically positive relationship to nature correlate positively with social equality. The number of vehicles per capita in a country correlates with the level of social inequality, whereas there is no correlation between this number and the GDP per capita. The size of flats in newer buildings correlates negatively with the level of social equality. However, the average cycled kilometres per person and the percentage of bicycle tours in relation to all rides correlate positively with this variable. When comparing rich national economies with each other, the direct consumption of materials correlates positively with increasing social inequality.

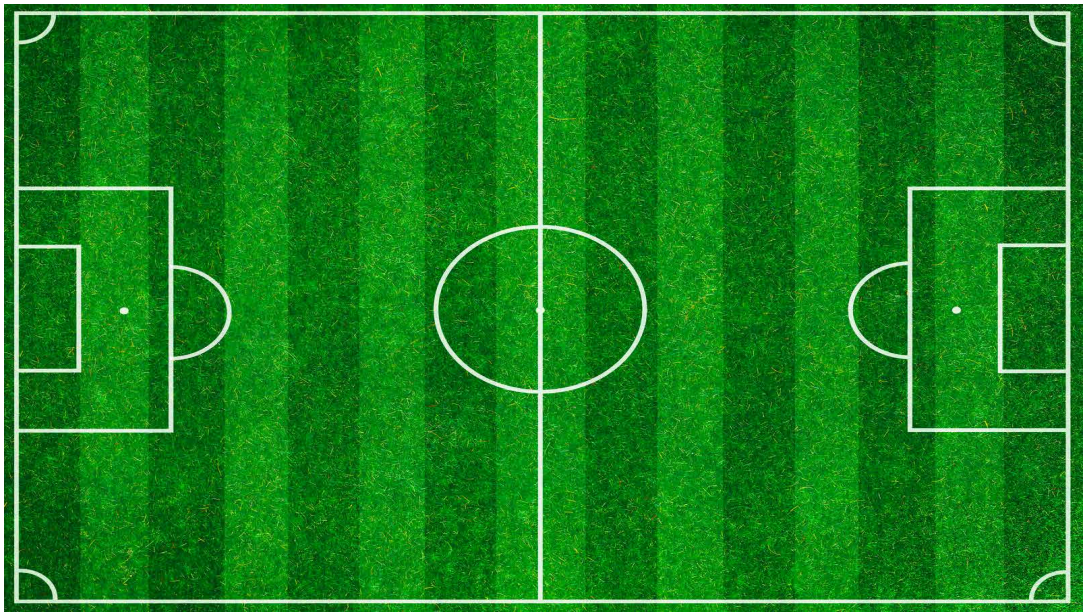
Moreover, greater equality would alleviate the difficulties of an overall shrinking economy considerably. In an unequal society, the people who are already socially disadvantaged are burdened the most by such a decrease. As the level of social equality determines the quality of life, societies with greater equality are better situated to achieve more prosperity for everybody with fewer products than societies with less equality do.

Therefore, a considerably higher taxation of property, high-income earners and capital gains is necessary for social and ecological reasons. However, simultaneously, government policies and social movements should aim at changing the economic order.

This can be achieved by supporting businesses and projects that at most must align themselves to the market in a democratically restricted and socially regulated way. They must aim as much as possible at fulfilling the actual needs of the population and producing items on the basis of solidarity. In the end, democratically run cooperatives and similar types of organisations exhibit a higher degree of pro-social and democratic attitudes on the part of their members.

The aforementioned is only a precondition for this type of economy and is in no way already a sufficient condition for its realisation. Within the confines of an economic order characterised by the marketplace, no stationary economy is possible, let alone one that is shrinking, without resulting in massive social distortions. Cooperative management based on equality in the end requires the extensive replacement of the market with forms of democratic, needs-oriented regulation beyond governmental planning measures.

Andreas Exner is an ecologist and social scientist based in Graz and Vienna. He is currently the co-director of the project 'Green Urban Commons' in the Department of Political Science of the University of Vienna and he conducts research in the field of community gardening. He was in charge of research projects funded by the Austrian Climate and Energy Fund 'Save our Surface', 'Feasible future' and 'Resilience Austria'. The anthology with the title 'Critical Metals in the Big Transformation' ('Kritische Metalle in der Großen Transformation') edited by Andreas Exner, Martin Held and Klaus Kümmerer will be published by Springer in 2015.



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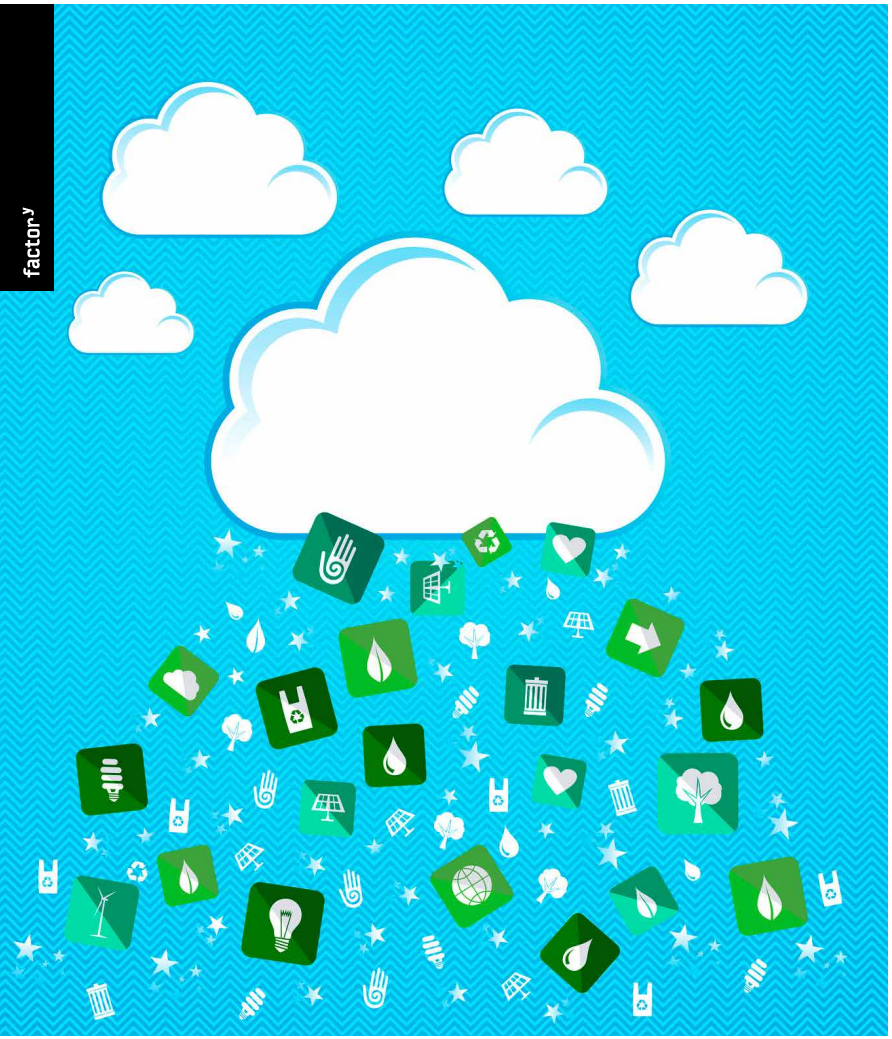
»Utopian? Or course. Because we are stuck in another rationality, like the Vikings in Greenland who did not want to eat fish, so they disappeared from the face of the earth.

They would not have been saved by waiting for somebody to come to power who would make fish-eating acceptable. Somebody like this would have never come to power. They would have been rescued if they started eating fish, and in doing so, started to change the rationality of their society. Bite by bite. Step by step.«

Friederike Habermann, Ohne Wachstum kein Kapitalismus, (No capitalism without growth) Frankfurter Rundschau, 4 September 2014, guest contribution to Degrowth 2014, http://www.fr-online.de/gerechtigkeit/friederike-habermann-ohne-wachstum--kein-kapitalismus,28235374,28315898.html



Green Cloud Computing: The Rebound Complex

Not central, but decentralized! Data is handled differently than energy insofar as the displacement of digital services to servers consumes fewer resources and reduces the constant replacement of end devices. This contrasts with a rebound in the form of the increasing use of mobile clouds.

By Ralph Hintemann

Translated from the German by: Zarina Brückner, Bianca Gerards, Erik Hansen, Anna Lena Vohl & Konstantina Perdikoulia

Cloud Computing has been the buzzword in the IT sector for three or four years.

It has become indispensable not only for magazines, fairs and IT congresses, but also in advertising for iPhones and the like. Cloud computing is celebrated as an efficiency technology which has been able to increase flexibility and, simultaneously, to save money, energy and other resources. This development was enabled by the joint use of central IT resources. But what is behind all this? What are the advantages of cloud computing? And what about the environmental impacts of this technology?

The Cloud and its Benefits

Cloud computing means that data and programmes are no longer saved on a local computer, but are stored at and run from a distant data centre. As the actual location of the computing power remains unknown, so to speak 'clouded', it is called a cloud. According to the specific demand, largely standardized IT resources are provided and used quickly and comfortably over the Internet. The range of services varies from offers of memory, network and server capacities ('infrastructure as a service') to complete software solutions over the Internet ('software as a service'). The service in-between, 'platform as a service', is attractive for organisations in particular. This concept means that further computing power and so-called middleware are provided to the customer.

A cloud can be used in various ways. The customer only pays for what he needs. If his demand rises, he can obtain additional capacity in an instant. This is a huge advantage for young and fast-growing companies or organisations with a highly seasonal pattern. Usually, it is not necessary for the user to install software. If Internet access is provided, the cloud's resources can be accessed from all over the world. Contractual relations are short and if a change of provider is necessary, it can be effectuated easily. In comparison to classic IT concepts, only a small amount of effort is required on the part of the provider and the user.

These advantages are the reason why the cloud market is developing very dynamically. For Germany, annual growth rates of 40% and more are predicted (see Figure 1).

While companies and authorities use all types of cloud services, private end consumers focus mostly on 'software as a service' in the form of web applications such as e-mail programmes, social networks or online gaming. In addition, online storage services such as Dropbox, Apple Cloud Services or TelekomCloud Services have been used more and more in the past few years. These services are publicly available to all users, which is why this type of cloud is called the 'public cloud'. In the professional field, however, there are also other solutions where IT systems are run for example, in private data centres which are called private clouds. Mixed forms of private and public cloud (hybrid clouds) are also common.

What about cloud computing and the environment?

Cloud data centres are often constructed in an extremely efficient way; the merging of services allows advantages

in size and the end devices of the users have to meet only very few requirements, which is why they can be designed in a slim and energy-efficient way. Even programmes that impose high requirements on the IT performance can be used with energy efficient devices such as slimmed down computers (thin clients), smartphones and tablet computers. Business applications in particular have an extremely high potential for saving energy and other resources. However, up to now there have been only few reliable studies concerning this topic. Considering the embodied energy needed for the production of hardware, the renowned Lawrence Berkeley National Laboratory in California estimated that by using cloud computing, the technical savings potential could be at 87% of the energy consumption. Taking e-mail communication as an example, scientists expect that the 3.5 million e-mail servers that are currently operated by U.S. companies and public authorities could be replaced by fewer than 50,000 servers in cloud data centres.

A study by the University of Reading in Great Britain, however, also shows that working with the cloud is not always an advantage. Programmes that require a lot of processing power and memory but that need only little data transfer, such as Excel and Outlook, can be offered more efficiently in the cloud. Word processing in the cloud, on the other hand, often requires frequent user interaction and could use more energy.

Furthermore, the ecological advantage of using a cloud depends to a great extent on how the connection to the cloud is made. Especially with regard to mobile access to the cloud,

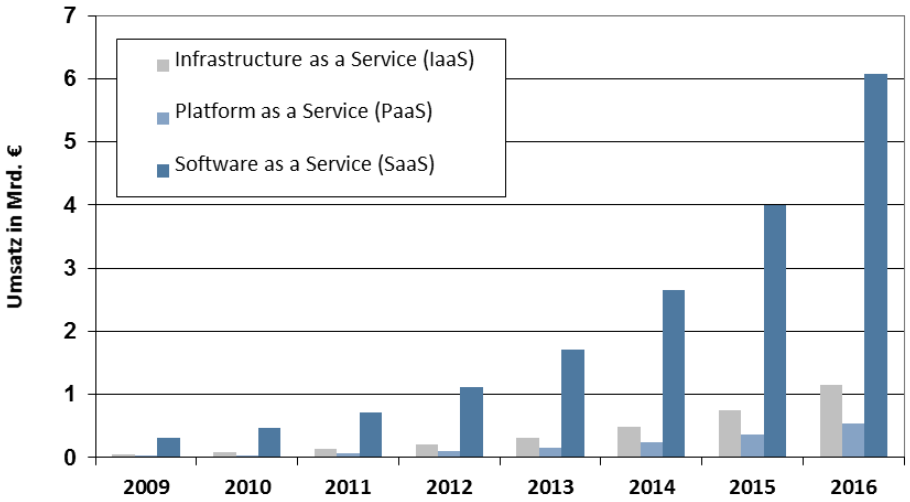


Figure 1: development of the cloud market in Germany (Source: presentation by Borderstep according to eco/Arthur D. Little)

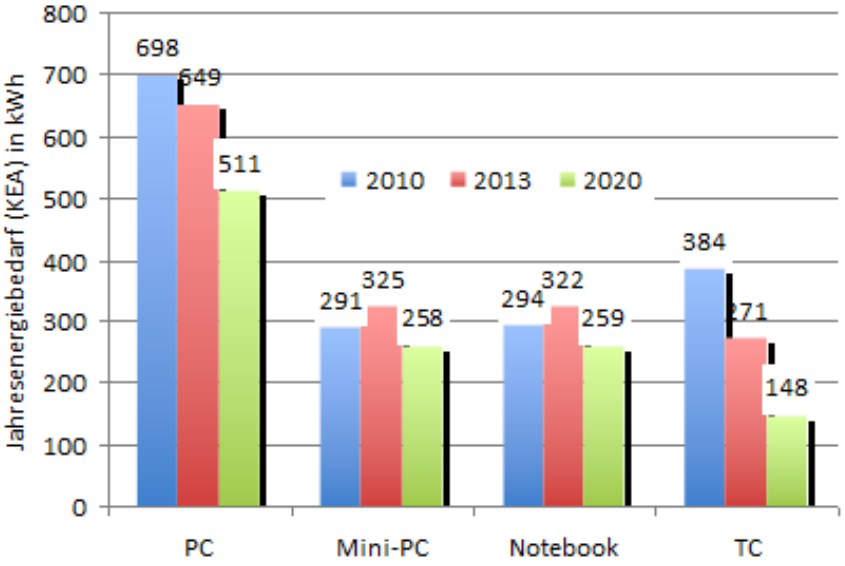


Figure 2: cumulative energy demand per office computer per annum in kWh in Germany (incl. production and use of computer centre, without monitor) in a business-as-usual scenario

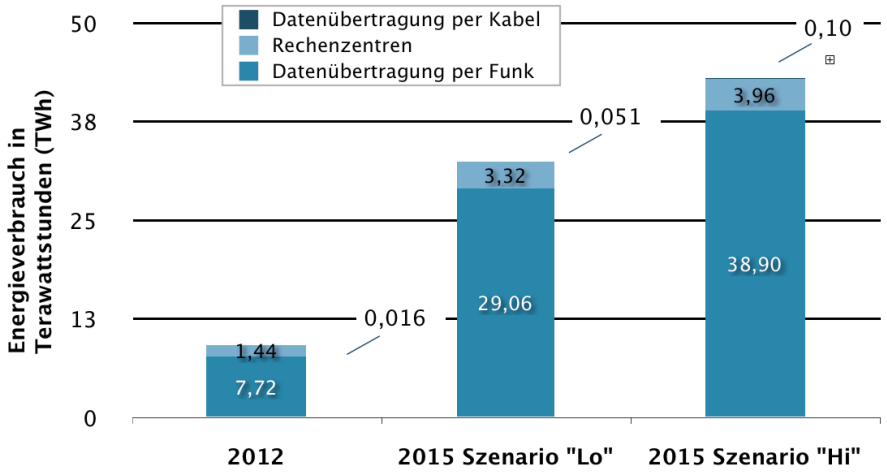


Figure 3: development of the worldwide energy demand of mobile cloud use

the result is often negative. According to calculations of the Centre for Energy-Efficient Telecommunications (CEET) of the University of Melbourne, data transmission makes up the greatest share of energy consumption of cloud services at more than 80% (Figure 3).

So far, there is no research that makes the entire ecological impact of cloud computing varieties comparable. In this context, we face substantial methodological challenges. These result from the high number of possible combinations of different end devices, different possibilities for data transmission and diverse cloud applications in computer centres. If slim end devices like thin clients are used for typical office applications via cable networks, there are some arguments for using a cloud as it is ecologically more favourable compared to the use of a high-performance end device. In a study by the Borderstep Institute, different end devices for use in offices were compared and the expected development through 2020 was estimated. Particularly because of an increasingly efficient use of server computing power and a significantly longer useful life of thin clients, such end devices score best according to energy consumption throughout the life cycle.
The thin client solution is also the most advantageous in material input per office computer. However, to the normal client the resource requirements his cloud use causes are not very transparent. Even the evaluation of personal devices is often hardly possible.

Most of the time, it is not clear how much energy and other resources are required during the transmission of data or the operation of data centres. However, initial steps to change this have been made: in Germany. The Blue Angel environmental label is awarded to data centres, and Greenpeace rates the largest cloud providers worldwide. The fact that such information is necessary and important and also leads to a change in the behaviour of cloud providers is shown by the fact that Apple – which was still labelled the industry's black sheep by Greenpeace in 2012 – has developed into the industry's role model according to the most recent Greenpeace report. By now, some of the big cloud providers – including Apple, Google and Facebook – have committed to operating their data centres using renewable energy.

The Rebound of the Cloud

An essential phenomenon that has to be considered when rating the energy and resource efficiency of cloud services is the rebound effect. This effect describes how the savings potential of new efficiency technologies is only partly reached or is not reached at all because the increased efficiency leads to an increase in use.

It is hardly possible to determine the exact extent of rebound effects in cloud computing. However, it is clear that cloud computing will lead to an overall increase in energy and resource demand. Greenpeace predicts that the worldwide energy demand of cloud services will increase by more than 60% by 2020. Especially the mobile use of cloud services is increasing – the CEET predicts that the energy demand of mobile cloud use will increase about four-fold in the period between 2012 and 2015 (see Figure 3). The hope of counterbalancing the increasing resource demand of data centres and the Internet by using slimmer and more efficient end devices is a pipe dream. A study by the Swiss Federal Laboratories for Materials Science and Technology (Empa) shows that, taking into account the entire lifecycle, a decrease in resource use per end device

is possible but this decrease is offset by an ever-increasing number of devices in households.

The Future Lies in the Cloud

Cloud computing will shape the future of the IT world. Even though the cloud itself can be very resource efficient, the

resource demand will continue to grow due to the strong increase in its use. Overall, there is only little reliable information on the energy and resource demand of cloud computing up to this day, even from a scientific point of view.

For most users of cloud services, the resource requirements are as yet entirely opaque.

Dr. Ralph Hintemann is a senior researcher at the Borderstep Institute for Innovation and Sustainability in Berlin. His field of research covers innovation strategies, sustainable future markets and the diffusion of new products and technologies.

Cloud Computing and Data Protection

One of the key challenges regarding cloud computing is data protection. Sensitive personal data or important corporate data are stored ‘somewhere’ in the cloud. Worldwide data protection

directives and laws, however, differ quite significantly. In order to fight terrorism, the USA even created a legal basis for access to any data stored by US companies. Thus, data protection in the cloud has not just been an issue of profound discussion since the NSA scandal. For many companies it has become a top priority to know where their data is stored or to make sure it is stored and processed in Germany or at least within the EU. According to a recent study of the Borderstep Institute, this is one of the main reasons why the German market for data centres is growing at the moment.

»The exemplary analysis of earlier attempts at decoupling growth from resource consumption shows that adaptions of behaviour and technologies primarily occurred because of changes in institutions and policy frameworks.

On the one hand, the absolute amount of resource consumption was reduced by determining caps (and in this way, rebound effects were prevented).

On the other hand, adoption periods were chosen in a way that technological innovations and changes in lifestyles were able to develop. Consequently, stable or even growing prosperity and increasing growth became possible.«

These are some of the conclusions presented in the 2013 final report of the Study Commission on Growth, Wellbeing and Quality of Life. (Bundestags-Enquete Wachstum, Wohlstand, Lebensqualität, Abschlussbericht 2013, Kap. 5.7 Folgerungen, S. 453)

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Leaving the Comfort Zone: Smarter than Smart Technologies

How to work against rebound effects with the help of psychology. The more comfortable and convenient products and services become, the less consumers think about the consequences of using them. Transformational products remind us that comfort comes at a price.

By Matthias Laschke, Sarah Diefenbach and Marc Hassenzahl

Translated from the German by: Bianca Gerards, Vanessa Kammerer

More and more technical equipment is becoming part of our everyday life. The security check at the airport definitely shows the quantity of ever-present smart devices that make our lives more convenient: an e-book reader, at least one mobile phone, a laptop, an external hard drive and perhaps a small tablet are placed on the conveyor belt. However, we do not only surround ourselves with technology when travelling, but our homes are also filled with high-tech appliances. The light in the entrance hall turns on and off automatically, the heating can no longer be operated manually and if you want to open a window, the ventilation system considers something else to be more efficient.

All of these smart technologies are supposed to make life a bit easier. They promise convenience and comfort and take a lot off the user's shoulders that they had to worry about before. Route planning is a good example. Today, navigation systems guide us turn by turn to our destination. But what do we lose by using the ubiquitous support of technology? Could we still live without those smart devices? Knowing how to read a map is no longer necessary, but it trains the feel for distances, time and speed and it provides a completely different perception of the environment. This perception would be different if we strictly followed the instructions of the navigation system. The ability to read a map, presuming the possession of a good atlas, means to be able to find our way around anywhere. The successful detouring around a traffic jam turns into a source of pride: "Thanks to me, we didn't get stuck!" Also, the joy of having reached the destination successfully is different if we can ascribe the accomplishment to ourselves and our own actions. Experiencing competence also enables the formation of intrinsic motivation, which means the action itself becomes meaningful, independent of an extrinsic goal (Deci & Ryan, 2000). Technology might deprive us of all of these possibilities.

The easier it is, the less aware we are

It makes perfect sense to make use of supporting intelligent technological equipment in regard to many activities. But the type of support makes a great difference. While writing this article, my word processing programme provides well-intentioned, often almost invisible support. It corrects words that our fingers have typed incorrectly. It changes words like 'wil' into 'will' and 'THat' into 'that'. However, this well-intentioned assistance also supports the bad habit of repeating the same orthographic typing errors.

The well-meant help, however, unfortunately fosters bad habits as well, because in this way, typing mistakes gradually become permanent motor programmes. One will only notice this – or not – when typing outside one's safe environment and thus sending an e-mail full of mistakes. Fortunately, word processing programmes use their intelligence to detect mistakes, but in the long run, they would be a greater help if they only marked them and the users had

The Forget-Me-Not lamp. Photograph by Matthias Laschke.

The optimised water consumption in the course of one year with the help of the Shower Calendar: Photograph by Matthias Laschke.

to correct them themselves. Instead of correcting the word by one mouse click, a good alternative would be to manually correct all the words the programme has marked wrong (it still is quite a smart helper).

In this way, the user would retain the use of his or her skill, consciousness, action and competence. Our so-called Transformational Objects (Hassenzahl and Laschke, in 2014) follow this kind of logic. They do not try to make up for certain behaviours, but instead attempt to enable people to behave differently by unsettling them and showing them alternatives; they are able to transform people.

The Forget-Me-Not lamp, for example, is designed to help people to reduce their electricity consumption (and hence to behave sustainably). When touched, the lampshade opens like a blossom and the light goes on. Then, over the next 30 minutes, Forget-Me-Not starts to close and its light is gradually dimmed. It might be getting light outside, so that the lamp is no longer needed. Maybe one goes on to a different task and does not need the lamp at the new working place. If the full light intensity is really desired again, one can touch the 'blossoms' any time and the process begins anew. Unlike ordinary light sources, Forget-Me-Not creates a new light consumption behaviour through interaction

with the user. The behaviour the lamp evokes helps to achieve the goal of saving energy.

Here, the lamp incorporates a simple strategy: After having switched on a lamp, you should ask yourself from time to time if you still need the light or if you can switch it off.

The more aware we are, the more active we become.

The goal of the interaction with the lamp is to make people adopt this easy strategy and even apply it to other situations. Thus, the Forget-Me-Not lamp would not only have an impact on apartments that are brightly illuminated, but also other activities where energy should not be wasted. Another technology that tries to compensate for its users' behaviour by saving energy is the energy saving light bulb.

The user himself does not have to do anything and does not even notice. If you take the idea of mechanisation and compensation one step further, you will get to the dream of an intelligent home, the 'smart home,' which takes care of everything for its residents and which is almost more intelligent than they are. However, when it comes to the subject of resource conservation within the 'smart home,' the not-so-smart resident does not understand anymore.

He delegates responsibility to technology instead of thinking about his options himself. Being a little cold could be the reason for putting on a jumper or for moving a bit, but the only solution the 'smart home' provides is to adjust the temperature of the room. The resident loses his awareness of resource consumption and his options for action. This can have sobering consequences. Research shows that the use of energy-saving light bulbs actually leads to higher power consumption rather than to saving electricity (Tsao, Saunders, Creighton, Coltrin & Simmons, 2010). Why should you switch off the thrifty light bulbs? And if you already use such efficient light bulbs, switching on an additional lamp in the house would not make a big difference. It is a pleasure to be in a well-lit room, isn't it?

Another transformational object in the area of resource conservation is the shower calendar. It enables its users to save water when taking a shower and consists of a display in the shower. When you push a button, a large coloured dot appears in a calendar matrix with the respective date. The dot represents 60 litres of water. When water is being used, it shrinks, either until the user turns the water off or he or she has used up the 60 litres. In the case of the second scenario, the small dot stays on the screen, indicating a shower has been taken. The concept attempts to add an aesthetic aspect to water conservation. At the same time, the users of the shower have fun competing and there is an incentive to exchange views about ways of saving resources. Instead of being helped by a water-saving shower head that compensates for water consumption, the users learn to use water sparingly and responsibly.

In this way, responsibility and fun are not delegated to a technology but are experienced by a competent user.

This fact was also observed in a study (Hassenzahl & Klapperich, 2014) in which users made coffee both by hand and with a fully automatic coffee machine. Although making coffee by hand requires more time and might potentially cause negative feelings, it is generally perceived as more pleasant and as a clear experience of competence. Automatic coffee making, however, is seen as less meaningful and rather dull.

Rebound is the revenge of smart technologies

It is clear that automation and compensation due to smart technologies undoubtedly involve (unwanted) side effects. They can deprive the users of certain skills and make them less aware of their actions' consequences. This entails the risk of a rebound effect: products designed to use energy more efficiently, for example, may encourage greater consumption which would contradict the original objective of saving energy (for an overview, see Santarius 2012 or the article on Page 11 of this issue of factory). Edward Tenner called the irony of an initially smart technology that eventually has negative consequences 'revenge effect' (Tenner 1997). Apart from ironic revenge, technology also deprives users of the experience of competence and the happiness resulting from having mastered challenges by themselves. Their own actions become meaningless. In the end, smart products potentially cause dumb users. The resulting rebound effects and the low level of happiness might be the justified irony and the price for the comfort achieved by using technology.

Possible rebound effects, however, do not justify the conclusion that no change in behaviour can be reached by developing technology (see Gillingham, Kotchen, Rapson & Wagner 2013). It is more important to use psychological knowledge about human behaviour when developing technology and thus to consciously counteract unwanted side effects such as rebound effects. Technology developers need to become aware of their devices' responsibility. Comfort may seem to be good in the beginning, but does not necessarily prove to be the best choice in the long run. If you really want to enable users to act responsibly, comfort and automation should only be used moderately.

It is more promising to raise awareness of opportunities to exert influence and to indicate alternative ways of action.

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»The 21st century will require us to rethink our ideas about growth.

It is not just a matter of the classical economic growth parameters, but of growth that safeguards sustainable prosperity. In this context, criteria such as security, quality of life, health and sustainable use of resources will play a crucial role. We must learn to redefine the concept of growth for the 21st century.«

German Chancellor Dr. Angela Merkel, video podcast of 6 February 2010,
www.bundesregierung.de/nn_670562/ Content/DE/Podcast/2010/2010-02-06-Video-Podcast/2010-02-06-video-podcast.html

The most important reason is time

No country in the world can afford to forgo improvements in energy and resource efficiency and lose savings due to rebound effects. Energy experts Prof. Dr. Peter Hennicke and Dr. Stefan Thomas point out that timid efficiency policies cause stronger rebound effects, which, however, must not prevent the efficiency revolution from taking place.

Translated from the German by: Anna Lena Vohl

Mr. Hennicke, Mr. Thomas, rebound effects have become an important issue in the public debate. There are many demands, for example in the course of growth criticism, to renounce energy and resource efficient processes and products in order to avoid rebound and backfire effects. What do you think about this?

Stefan Thomas: The few people asking for this confuse rebound effects, growth effects and impacts of lifestyle and increased luxury, all of which have different causes and effects. Actually, the term rebound effect – whether it is a direct, indirect or macroeconomic effect – should only be used if the increase in efficiency causes an increased use of energy and material that again reduces the savings to some extent. It is hardly ever the case that an increase in efficiency causes increased total consumption (backfire).

Peter Hennicke: Therefore, it is negligent to inveigh against enhanced energy policies that don't exist yet and are being elaborated right now, because renouncing the efficiency revolution would lead to disastrous consequences for the protection of the climate and resources: there is evidence that climate change would become worse and the lack of resources more severe! This is due to the fact that economic growth and increasing consumption as the strong drivers of the economy, based on the exploitation of natural resources, continue to have an impact. Nevertheless, the large number of means available should be used to limit rebound effects. And these means should be incorporated in necessary efficiency and sufficiency policies that try to limit impacts caused by factors such as growth, increased luxury spending and lifestyle, all of which affect the environment in a negative way.

Data on rebound effects is not being systematically collected. Nevertheless, it would be interesting to know at what level the effects are for the most important products and services?

Thomas: There are many analyses of direct rebound effects, which, on average, make up about 10% of the energy saved, but there are no generally accepted figures on the total rebound effect. And since there are both methodological and data problems, such figures will never be available, even if a lot of effort is put into the modelling of rebound effects. Based on the studies available, we roughly estimate that the total effect amounts to 25% at maximum. This means that 75% of the energy saved due to energy efficiency can actually be conserved. However, this also means that undesirable rebound effects inducing greater energy consumption should and can be limited as far as possible by implementing more intelligent energy saving policies. We can't afford to waste the kilowatt-hours we have saved.

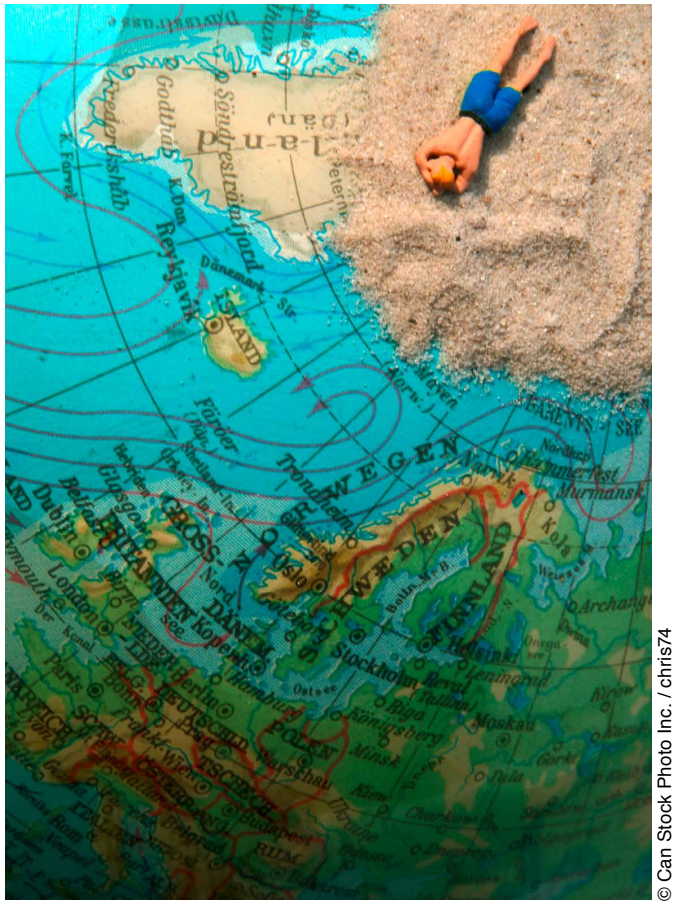
Are there any differences between the Western economic area and the growing economies in China and India regarding rebound effects?

Hennicke: As long as their economy is growing faster than its efficiency, it won't be possible for developing and newly industrialized countries to avoid moderately growing energy consumption and therefore an only relative decoupling from economic growth in the

foreseeable future. What is desirable and feasible, however, is to significantly reduce the current growth rates of primary energy consumption – by an increase in efficiency. The globally dominant, new middle classes in newly industrialized countries such as China and India become additional drivers of energy and resource consumption in the medium term when imitating Western lifestyles; therefore, the Global North and South have to make an effort together to limit undesirable, non-sustainable impacts of lifestyle. Since, over the medium term, the globally dominating new middle classes in newly industrialised countries such as China and India will become important and additional driving forces of energy as well as resource consumption by imitating Western lifestyles, the Global North and South have to struggle together to contain the undesirable, unsustainable effects of this lifestyle.

The technical facilities connected to energy transition consume valuable resources like critical metals which tend to carry a heavy ecological rucksack. Should the energy policy preferably rely more on conventional technologies and wait for an improvement of resource efficiency?

Hennicke: The only possible answer to this question is to accelerate energy transition through a simultaneous increase in energy and material efficiency. This reduces the demand for new technical facilities for energy supply. It also means that the substitution and recycling of critical metals, such as rare earth elements, through the accelerated use of efficiency technologies and renewable energy should be given more attention than before. This could be done, for example, through the use of reluctance motors instead of permanent magnet motors. This applies, however, to all branches of production, especially in the field of information and communication technology, that make use of critical metals far more than others – so far hardly ever with substitution and a recycling strategy. It is obvious that an energy transition merely intended for climate protection at the expense of the necessary resource transition for the protection of resources and nature would be a highly problematic shift of the issue. However, a cleverly controlled and successful energy transition ought to be the exact opposite. It is a crucial first stage and a collective learning domain for the implementation of the resource transition and for a 'Great transformation', as has been recommended by the German Advisory Council on Global Change [WGBU].



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Are there also desirable rebound effects?

Thomas: Undoubtedly there are some, especially regarding the macroeconomic effects, particularly in newly industrialised and developing countries. When poor households reduce their relatively high energy costs by using more efficient devices, they can improve their standards of living by using their income in a different way. Replacing firewood with more efficient cooking devices lowers environmental degradation, but it often leads to a higher consumption of fossil fuels. The general rule is that, when saved energy costs in production or consumption are used in growing and verifiably 'green' business areas and fields of application – for example, renewable energies, education, culture, health protection and medical care – this covering of a necessary social requirement is evidently highly desirable, even when the energy consumption could increase in these domains.

The fact that in wealthy societies new and more energy-efficient products, such as electrical appliances and cars, are purchased in increasingly rapid cycles – in many cases to at least partly maintain or improve one's social status – can lead to overall higher resource consumption over the lifetime of a consumer (from cradle to grave). An increase in sales volumes is definitely in the interest of economists and politicians. In terms of resource and climate protection, a life cycle that is as long as possible would be sensible even though the old products consume more electricity or petrol than the new ones. How do you plan to prevent this growing consumption?

Thomas: To emphasize it once again: more rapid purchase cycles of new and energy-efficient products are not attributable to the increase in efficiency, but to the autonomous or frequently marketing-induced change of preferences and consumption behaviour. If this happened without a product-specific increase in efficiency, the consequences would be even more undesirable. Resource protection begins with the design of products that can be modularly dismantled, as well as jointly used and that are, if possible, completely recyclable. Durability and extended use are possible options for overall optimisation with the goal of reducing the consumption of non-renewable resources and energy throughout the life cycle to the reuse. The premature replacement of products for efficiency purposes is, as a general rule, rarely advisable. It is more a matter of maximising efficiency in the case of a purchase that is taking place anyway.

More sustainable lifestyles and upper limits of consumption are often recommended for limiting rebound effects and growth. Which measures could be implemented and how?

Thomas: Upper limits of consumption already exist. In accordance with Article 3 of the EU Energy Efficiency Directive, the member states announced their goals for 2020 even though they are not yet binding. It would be conceivable to set upper limits for energy companies regarding their sales volume and to make the quantity concessions tradable, as the German Advisory Council on the Environment suggested. This, however,

still requires analyses as to whether and how it could work. For more sustainable lifestyles, consumers need political support, for example in the form of a product design that promotes sustainable use, assistance with the reduction of living space to the needed size, or the provision of new services that render certain manufactured goods superfluous and thereby reduce resource consumption on the whole.

Both Ernst Ulrich von Weizsäcker and Friedrich Schmidt-Bleek suggest a resource tax reform in order to control the rebound effect while energy and resource efficiency are increasing. This would mean that once efficiency has increased, energy and resource costs would rise. What do you think about that?

Hennicke: The means used in an ecological tax reform, for example, a tax on energy that rises in parallel with increasing energy productivity, can limit the income effect (individual alternative spending of money saved from lower energy costs). The way this tax revenue is used is much more important, though. If the revenue is used to promote an even greater increase in efficiency and to encourage more resource-light production sectors, for example, service sectors such as education, culture and care, it is possible to limit unwanted rebound effects or even to reverse the effect so that consumption decreases. We don't think that a general 'resource tax' would be feasible due to the sheer variety of resources. However, taxes on individual resources – for example the taxes on aggregate materials in Great Britain – do make sense. Whether they sufficiently limit the rebound effect is questionable, though. Guidelines for the use of recyclable building material like in Zurich or a stricter regulation of fleet fuel consumption for cars can make a substantial contribution to saving resources.

Is it possible to achieve this great transformation into a resource-efficient, greenhouse gas neutral German society without an increase in efficiency and new technologies?

Hennicke: There are several different scenarios which show that, theoretically, a CO2-free energy supply without nuclear energy will be technologically possible in Germany in this century – though probably not until 2050. Usually, highly ambitious primary energy savings of between 40 and 50% are calculated for 2050 because only when combined with a veritable efficiency revolution will it be possible to completely convert the electricity, heating and transport sectors to renewable energies and to make them economically feasible and socially acceptable.

This is why this kind of study points out that it could be possible to completely decouple greenhouse gases from economic growth.

Whether the implied technologically possible increase in efficiency can actually be achieved also depends, in our opinion, on the establishment of innovative 'polycentric governance' in the area of energy efficiency policy. For this reason, the Wuppertal Institute has developed the concept of a Bundeseffizienzagentur (German Efficiency Agency) and an Energiesparfond (energy saving fund). But the government hasn't found the courage yet to implement such an

ambitious paradigm shift. The complementary sufficiency policy would be even less politically feasible at the moment.

In order to address the necessary political innovations before we face an ecological and economic crisis, economically and socially convincing implementation research and considerable pressure from the civilian population are required.

Energy prices and the prices for many raw materials are dropping. Does this fact make political, commercial as well as private energy and resource efficiency improvements regarding products and processes obsolete?

Hennicke: It doesn't make the improvements obsolete, but it complicates the process of raising energy and resource efficiency. In any event, the increase in efficiency will be inevitable in the long run, regardless of periods of price fluctuation or even a temporary decline in commodity prices. Therefore, forward-looking corporate and energy policies will always use non-market-based instruments in order to prevent supply risks and the risks of price fluctuation over the long term. If we still had decades to change our ways, we could wait for further signs of shortage and fluctuating commodity prices, which are very likely to appear anyway. However, when it comes to climate change, it is imperative we do something. We've already crossed the 'planetary boundaries'; the same applies to the loss of biodiversity. Time is maybe even the most important reason why we have to increasingly promote energy and resource efficiency – which has the greatest, fastest and the most economic potential to control climate change – in connection with sufficiency policies.

Prof. Dr Peter Hennicke is an economist. Up until 2008, he was the President of the Wuppertal Institute of Climate, Environment and Energy, where he is still acting as a senior advisor responsible for a number of different projects. He recently received the German Environmental Award.

Dr Stefan Thomas is a physicist and political scientist. He is the head of the research group 2: Energy, Transport and Climate Policy at the Wuppertal Institute.

The interview was conducted by Ralf Bindel.

Translated from the German by: Annika Wagener

»From a micro-social perspective – the technical acceleration of target-orientated processes seems like the answer to the problem of time shortage. However, that – on the macro-social level – acceleration proves to be an essential element of the root of this problem.«

Hartmut Rosa, Beschleunigung. Die Veränderung der Zeitstrukturen in der Moderne, (the change in temporal structures in the modern era) Frankfurt a. M.: Suhrkamp, 2012: see p.251

factor^{y} – the Magazine for Sustainable Economy

Although the word 'factory' is mostly associated with the manufacturing industry and industrial production, it can also refer to 'factor Y', the factor by which energy consumption needs to change so that future generations will find themselves living in similar conditions. Such an understanding of sustainability implies that all aspects of economic activity need to be addressed with sustainability in mind, including consumer practices as well as the manufacturing and services sectors.

factor^{y} highlights the role of businesses in sustainable development and aims to draw the drivers of the economy into the public debate. Such development entails resource efficient economic practices for both producers and consumers as well as educating and informing them about sustainability issues.

factor^{y} is a free magazine that is published four times a year in PDF format as well as on the magazine's website www.factory-magazin.de.

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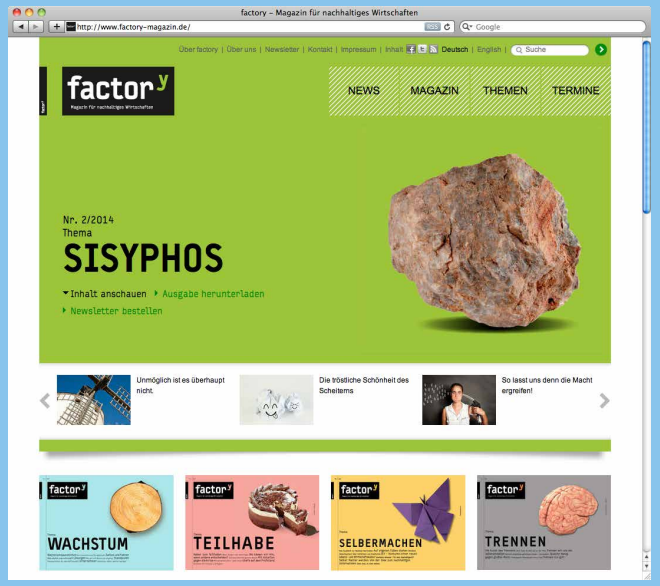

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