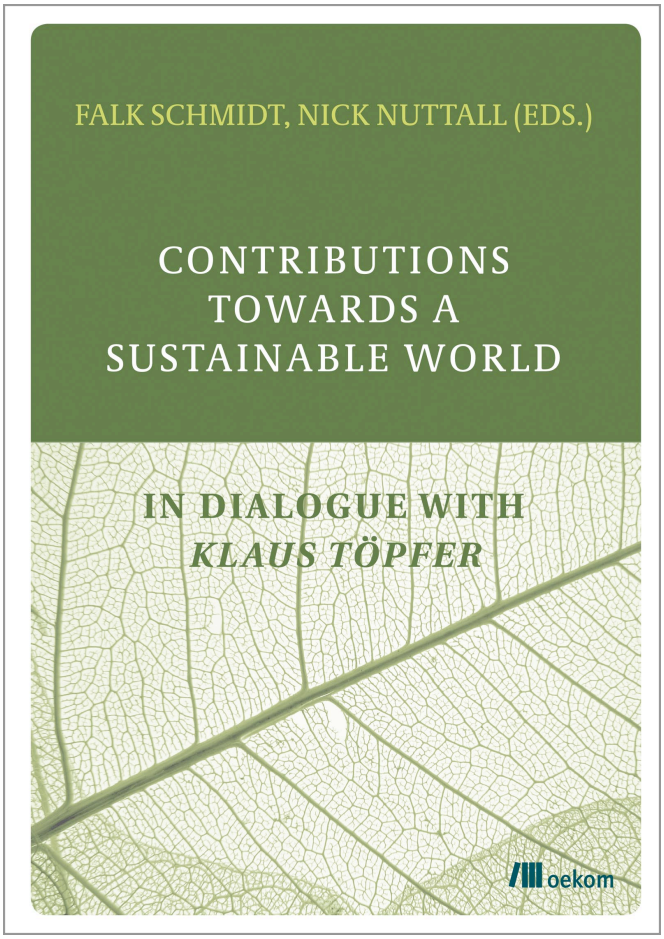

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Ernst Ulrich von Weizsäcker

Klaus Töpfer at 75

In 1985, my British friend and colleague Nigel Haigh advised me to meet the Parliamentary State Secretary at the Ministry of the Environment in Rhineland-Palatinate. Returning from America, I had recently become Head of the Institute for European Environmental Policy (IEEP/IEUP: Institut für Europäische Umweltpolitik), and Nigel Haigh was Director of its London branch. So I set off to Mainz in order to meet the much-vaunted advisor. His name was Klaus Töpfer. After just a few minutes I was sure of one thing: I wanted to recruit him for my institute's International Advisory Committee. Although our institute was highly political, it was party-neutral. And I was a Social Democrat, so I definitely wanted to enlist a Christian Democrat to the board. But he would have to be open-minded, undogmatic, and think internationally. Is there anybody who could be more fitting than Professor Klaus Töpfer? Hardly!

Klaus Töpfer said yes. But soon afterwards he became a minister in his own federal state. And two years later he even became a federal minister in Chancellor Kohl's cabinet. He was therefore no longer able to devote so much time to the IEUP. He was usually represented by his highly competent assistant Cornelia Quennet-Thielen, and that was fine. She later made an illustrious career in the Environment Ministry, Office of the Federal President, and in the Ministry of Education and Science.

As the Federal Environment Minister, Klaus Töpfer probably reached the peak of his popularity with his announcement of the Packaging Ordinance. The public were inspired by the idea that you could simply leave behind unwanted packaging in the shops. This was not even a central aspect of the ordinance, but merely a threat to those companies who refused to pay for the disposal costs. The initially government-controlled Green Dot scheme, known as the German Dual System, was responsible for the actual disposal. The Green Dot on the packaging meant that the manufacturer had paid their dues for the disposal costs. And the collection system using yellow bins and bags ensured that the material was recycled as much as possible. Rather ingenious — if it wasn't for the fact that

many households used the yellow bins as convenient overflow containers for residual waste, and some people simply refused to grasp the concept of waste separation. However, none of this diminished the popularity of the minister.

There was one political snag with the Green Dot scheme. Outside of Europe, the system was viewed as protectionist: a Chilean fruit producer felt that he was now forced to buy packaging with the Green Dot in order to comply with the German market. This was although only a fifth of his goods were actually sent to Germany. For the Chileans, the costs did not really provide any benefits. German manufacturers and packing companies, on the other hand, at least had the advantage of a precise target audience. The international Green Dot dispute was one of the first in which a broad segment of legal practitioners realized that there can be structural contradictions between the environment and free trade. This was, of course, a source of considerable irritation for the proponents of free trade, since they believed — and still do believe — that any liberalization of trade is, by its very nature, good for all. And so, during the Uruguay Round of the GATT (1996–2004), they invented the myth that free trade also served the environment. This myth, which has become a mantra in the World Trade Organization (WTO), was based on two claims: firstly, that environmental technologies would now easily and freely cross borders and, secondly, that free trade would accelerate the development of prosperity and only affluent countries and social strata could afford to worry about the 'luxury' issue of the environment.

The latter claim is, of course, highly problematic at a time when climate, biodiversity, and natural resources are at the forefront of the environmental debate. In these cases, it is clear that affluent societies are mainly responsible for the harm. So if free trade serves prosperity, it would also heighten worries about climate, biodiversity, and resources.

Politically, Klaus Töpfer was also a very important pioneer regarding climate issues. As Federal Environment Minister, he was a congenial supporter of the courageous Bundestag Enquete Commission on Preventive Measures to Protect the Earth's Atmosphere. This confronted the politically active public in Germany and beyond with the new challenges. There was a need for long-term, global ideas and actions that changed structures. Traditional pollution policy, however, was short term, national, and preserved structures. The initiative at the UN for a Convention on Climate Change emerged during Töpfer's tenure as the head of the German Environment Ministry (BMU) and at the time of the Enquete Commission. With the approach of the Earth Summit in Rio de Janeiro (1992), the BMU became a central partner of the German Foreign Office for the first time in its history. Chancellor Helmut Kohl recognized this new challenge and put the climate issue onto the agenda of the G7. In Rio de Janeiro, he also invited the parties to the Framework Convention on Climate Change to Berlin for their first Conference of the Parties.

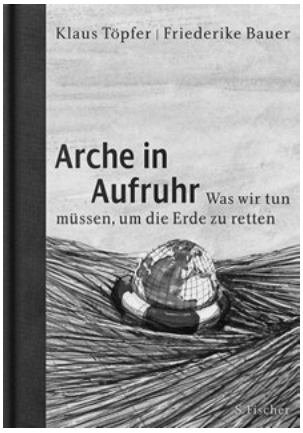
After an intermezzo as the Federal Minister for Regional Planning, Civil Engineering, and Urban Development (with responsibility for moving the Bundestag and federal institutions from Bonn to Berlin), Klaus Töpfer received probably the most important opportunity of his life: as Executive Director of the United Nations Environment Programme (UNEP) in Nairobi. He became Under-Secretary-General of the United Nations and head of a UN organization with a global remit.

However, conflicts were the rule, not the exception at international environmental conferences, almost always in the form of a North–South dispute. This is particularly evident with the Convention on Biological Diversity (CBD), but — mutatis mutandis — also with climate protection. The North typically wants to implement nature conservation outside of its own territory so as to protect nature from people and their demand for settlements, food, transport, and raw materials. Conversely, the South first of all wants to satisfy exactly that demand and wants the North to limit its own space requirements and to help finance biodiversity protection in the South. The latter refers to the CBD principle of a fair and equitable share of the benefits arising from the utilization of biodiversity for producing, for example, new medicines. Negotiations about that principle have been constantly delayed, ignored, and sabotaged by the North, in particular by the USA, which is not even party to the Convention. US scientists and commercial companies systematically collected biodiversity and then declared the loot to be the property of the US biotechnology companies or botanical gardens. During this time, Klaus Töpfer became one of the leading protagonists for the creation of a CBD anti-biopiracy protocol. It finally came into being in 2010 as the Nagoya Protocol (on access to genetic resources and equitable sharing of benefits), after Töpfer had already left the UNEP. The protocol came very watered-down and very late, pleasing the pharmaceutical and seed giants in the North.

In parallel, a transatlantic dispute has raged between Europe and the USA for decades over the use of precautionary or 'scientific' principles as the legal bases. At first sight, this does not seem to be a contradiction, but it is — particularly for the Americans. They accept ecological constraints only after scientific evidence is established of the alleged damage. We Europeans, on the other hand, have for the last forty years made the precautionary principle a core component of environmental policy: allowing legal constraints upon suspicion of severe damage, meaning to act before it is too late. Precaution marks the trans-Atlantic divide in particular on genetic engineering in agriculture. Relying on scientific evidence can be seen as problematic at a time when the relevant scientific community draws most of its funding from the genetic engineering industry.

Even before assuming office at UNEP, Klaus Töpfer closely familiarized himself with these lines of conflict and, particularly among developing countries, has earned considerable respect as somebody from the North who is absolutely fair when tak-

ing into consideration (and, where appropriate, representing) the concerns of the South. In addition, we Europeans were always able to rely on his perspicacity regarding the precautionary principle. Fully in line with the UNEP's mandate, Töpfer would always base his fight for the precautionary principle on the 'Rio Principles' from 1992, which have been signed by all UN member states, including, perhaps inadvertently, by the USA. (Regretting this 'mistake,' the USA tried very hard during the Rio+20 Conference in 2012, to make the Rio Principles obsolete by not reiterating them, but fortunately the guardians from the other side, notably from developing countries, outwitted that attempt.).



UNEP's main task has never been the legislation — that is discussed and fought over by the member states during the international negotiations. Rather, UNEP is mainly concerned with projects that show the South how the environment can be conserved or regenerated while simultaneously improving the economic living conditions of local people.

Töpfer has recorded his insights into the global environmental situation, and in particular into what we Europeans need to do, in a wonderful book entitled 'Arche in Aufruhr' (Ark in Turmoil: Töpfer & Bauer 2007).

He has been back in Germany for some time now, and the German Government has very wisely enabled him to take up a new leading role — at the IASS, the Institute for Advanced Sustainability Studies in Potsdam. Sustainability is the most important issue worldwide. At the aforementioned Rio+20 Conference in 2012, the most important issue was the development of Sustainable Development Goals built upon the Millennium Development Goals that expire in 2015. And, once again, we see the same old familiar themes: climate, biodiversity, resources, and the developing countries' constant desire to catch up with the North in terms of prosperity. Within a short time the IASS has therefore developed into a highly sought-after international partner.

Perhaps it would be expedient for the IASS if the sustainability challenge was formulated constructively: all people want a reasonable level of prosperity. An ecological dictatorship that, based on presumed or proven limits, restricts the lifestyles of people is politically insane. As a consequence, the international competition between nations and companies is essentially geared towards producing as much prosperity as possible. However, it is precisely this competition-driven, blind economic expansion that is leading us headlong into the ecological abyss. We have a chance if we can demonstrate how to increase prosperity while at the same time preventing the exploitation of nature. That is the objective and basic concept behind Factor Five

(see von Weizsäcker et al. 2009): reducing the energy requirement of buildings by 80 or 90 percent, reducing the water consumed in agriculture by a factor of five for each kilo of cereal produced, increasing five-fold the recycling rates for hi-tech metals, or drastically reducing the distances involved in the production chain of raincoats or strawberry yogurt—these are all technically achievable goals.

So why is this not done, or only in small measures? Because under the prevailing conditions more profits are made by continuing to waste resources than by stopping this. This is where sustainability policies need to be applied. I am thinking of a policy that makes the consumption of energy, water, and minerals more expensive each year in proportion with the increase in energy or resource efficiency. The cost of resource use then remains stable on average, but from year to year it becomes increasingly lucrative to further improve efficiency and/or reduce waste. The historical model for this proposal has been the Industrial Revolution with its dramatic increase in labor productivity. Whenever productivity increased, the workers were able to command higher wages. And the ping-pong effect continued: the higher wages forced industry to enhance labor rationalization. Following one hundred years of this ping-pong effect, labor productivity increased by a factor of 20!

That is, of course, an oversimplified depiction of the idea. In reality it will be contentious to implement such policies—perhaps a lovely new challenge for people of Klaus Töpfer's stature.

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Mario Tobias

Translating Knowledge into Action: How Do Innovative Technologies Enable Sustainability?

Introduction

We live in a globalized world that faces unprecedented challenges. Global phenomena of our time such as rapid climate change, ecosystem imbalances, population growth, demographic change, urbanization, globalized markets, and scarcity of energy and resources pose a major threat to the sustainable development of our planet.

Consequently, we need to find global solutions to all major issues that may jeopardize sustainable development. Advanced research on sustainability matters must be undertaken to identify, evaluate, and implement new perspectives and pathways towards a more sustainable future. Since the influence of national governments in tackling such global issues is limited, the most appropriate approaches need to be found in cooperation with science, industry, and politics. Furthermore, these efforts must involve society at an early stage of knowledge creation in order to ensure public acceptance.

In line with this ambition, the Institute for Advanced Sustainability Studies (IASS) was founded in Potsdam in 2009 to provide research on important sustainability challenges and to stimulate the transfer of sustainability knowledge from scientists to society — under the objective of *translating knowledge into action*. Since then the IASS has been working on fundamental questions of a transformation towards sustainability: What are options for sustainable environmental and resource governance? What are suitable pathways for the transition of energy systems? How can technologies contribute to a circular economy?

A Path to a Circular Economy

In a world approaching 8 billion people, we can no longer afford the overexploitation of resources, or a throw-away society based on oversimplified business models that neglect the relationship between production and the natural environment. Instead, the role model for a sustainable future must be Mother Nature. Nature does not know waste in terms of loss of material or energy; everything is connected and interacts as a system, and resources are thus used in a circular manner. In fact, nature itself invented the principle of recycling. The important question of the 21st century is thus how to properly apply nature's own model of a circular interconnected economy in the organization of our economic processes and the handling of products along the supply chain. The goal must be to deeply embed the circular use of resources within economic reasoning.

Already, some twenty years ago, a sustainable transformation process was initiated in Germany through the establishment of a circular economy replacing the one-way waste treatment of landfilling. During his term as the federal minister of environment, Prof. Klaus Töpfer took a leading role in this implementation of the circular economy concept in the German waste legislation of the 1990s. Although it was initially considered a "crazy German idea," the legislation has proven to be one of the most important achievements of environmental policy in Germany, and an export star. While the introduction of extended producer-responsibility and internalization of costs through the 'polluter pays' principle found little sympathy on the producers' side at first, the perspective on waste has begun to change: In many ways waste has become a valuable resource. The so-called 'lifecycle' or 'cradle to cradle' principle has emerged due to increasing resource scarcity and the resulting need for process innovations, as well as public pressure from environmental stakeholders and general society. Today, the lifecycle approach lays an important foundation for the further implementation of a circular economy.

In this tradition the IASS and its research platform *Enabling Technologies for Sustainability* (ETS) are involved in numerous projects on designing and implementing technological, political, and economic solutions to optimize different circular economies: Existing recycling structures need to be improved to reduce the depletion of resources, while new circles have to be identified to further transmit the ideal of a zero-waste economy.

A Path to Sustainable Technologies

In order to find innovative solutions for urgent problems such as climate change, the destructive exploitation of natural resources, and the scarcity of strategic metals, cutting-edge research is needed to promote transdisciplinary approaches and to develop multidisciplinary networks of scientists from various backgrounds such as civil society, politics, and business. The IASS has already taken important steps in this direction. The ETS platform explores how innovative technologies can support sustainable development of the environment, the economy, and society at large. However, technological innovation by itself does not ensure this development. Innovative products and technological solutions need to be accompanied by a systemic approach that identifies 'sustainable business cases.' Therefore, in accordance with the IASS' mission, the ETS platform collaborates with partners from research institutions, industry, and civil society to determine the potentials of promising technology developments and to evaluate these from a scientific as well as the political and economic perspectives. In its alliances and collaborations, ETS serves as a communicator and partner for knowledge transfer.

Sustainable ICT Solutions: Transforming e-waste into Valuable Resources

Information and Communication Technology (ICT) has played an important role in fostering the economic growth of all advanced economies. Modern technologies such as computers and mobile devices have rapidly permeated people's lives. Computers, the Internet, mobile phones, data banks, and 'smart networks' all play a vital role in everyday life and will be essential in its future development. ICT products and applications have become inseparable from our daily routine, both in the public domain and in our professional and private lives.

However, these fast-paced technological improvements of information and communications technology have also contributed to the general (over)exploitation of resources. Although our modern everyday lives are unthinkable without these products and appliances, it is not clear whether they are 'part of the problem' or a significant 'part of the solution.' Moore's Law describes the doubling of computing performance approximately every two years, and the resulting consequences such as the shortening of lifecycles. Such increases in performance can be attributed to utilization of new materials and the repeated miniaturization of products. Half a century ago, only a dozen elements were required to satisfy industrial production; today, almost all the elements of the periodic system are required. Contrary to expectations, the reduction in size and weight of electronic goods has not slowed the extraction of natural

resources. Production processes might have become less resource-intensive; however, rising sales and increasing affordability have offset the advantages of miniaturization and increased eco-efficiency. Currently, the use of ICT technology causes approximately 2 % of the planet's carbon dioxide emissions — which roughly corresponds to the emissions of the global airline industry.

Reducing raw material inputs and increasing resource efficiency are two important requirements for the green transformation of societies, because resource depletion — independent of availability — always has negative ecological and often negative social consequences. Such consequences need to be limited or avoided, e.g., through re-use of electronic e-waste circulating around the world. In general, the sustainable management of resources is an economic necessity for resource-dependent economies such as Germany, which largely depend on the availability of strategic resources in sufficient amounts and at affordable prices.

Hence, to enable information and communication technology for sustainability, a transformation leading to greater resource efficiency by means of a circular economy in the ICT industry is absolutely indispensable. This transformation can only be successful if implemented globally and if best practices are exchanged between countries. Therefore, cooperation is needed between countries with highly developed and efficient recycling infrastructures and those with less developed or unofficially organized systems for recycling.

Carbon Dioxide Utilization Technologies: Rethinking from Waste to Feedstock

Although carbon dioxide (CO_2) has always been part of our atmospheric lifecycle, it has only recently become an issue. As a result of industrialization, the concentration of the greenhouse gas CO_2 in the atmosphere has increased by almost 40 percent in the last 250 years. Overall, atmospheric CO_2 concentration has not reached today's levels for the past 650-thousand years (e.g., Lüthi et al. 2008). Furthermore, the man-made contribution to atmospheric CO_2 levels has accelerated within recent decades. In the most developed countries, including Germany, the largest proportion of CO_2 emissions originates from the energy sector. Nevertheless, a considerable share derives from other industrial processes, such as production in the chemical industry.

However, in certain industrial processes CO_2 has long been considered a resource. In addition to its use in the carbonation of beverages and the production of urea, CO_2 can be utilized as a carbon source in a number of chemical reactions. The element carbon in the form of carbo-hydrogens is one of humankind's major energy sources (e.g., coal, petroleum gas, crude oil, etc.) and also part of many materials that surround us in our everyday life, such as plastics and foams. Due to the volatile prices of fossil fuels, the idea of an alternative carbon source seems convincing. Thus, governments

have offered funding and the chemical industry, among others, has been researching so-called 'carbon capture and utilization technologies' (CCU). Major technological breakthroughs have been achieved, especially with regards to the chemical catalysis of CO_2.[1] As a result, in the near future the carbon needed for various chemical products or even renewable fuels could be generated from recycled CO_2 'waste' emissions from industrial plants.

The utilization of carbon dioxide as a feedstock for the chemical industry certainly has striking advantages. Fossil fuel consumption could be reduced, thus helping to preserve the Earth's natural resources and reducing production costs for the industry. By filtering CO_2 from industrial exhausts, emissions can be retarded or, depending on the specific utilization technology, even constantly offset. In particular, highly industrialized countries with limited natural resources (such as Germany) have a vital interest in alternative approaches to meeting the raw material needs of industry and in mitigating political dependencies, as well as positioning their economies within a promising field of emerging technologies with major export potential.

In a broader context, the technological use of CO_2 as a raw material implies not only a change in perspective for the chemical and processing industry but also a necessary change in the approach to waste and resources in general. A material that has been considered a pollutant and a main driver of anthropogenic climate change is currently subject to a process of rethinking, leading it to be rebranded as a valuable asset for our economy. Moreover, developing functions for CO_2 that would otherwise be emitted into the atmosphere is an important step towards closing material lifecycles and a zero-waste society.

The ETS project 'CO_2 as an Asset — Potentials and Challenges for Society' is undertaken by a transdisciplinary team to establish the challenges and potentials of such promising technologies. The project focuses on societal aspects of CCU technologies, and aims to evaluate the benefits and risks for society as well as their possible contribution to a circular economy. Therefore, an essential part of the project is the lifecycle analysis of CCU processes and products as well as comparison with conventional products in the chemical industry. This research will be undertaken in cooperation with the university RWTH Aachen. Furthermore, the project is supported by Bayer Material Science as an industry partner.

1 Several usage alternatives for CO_2 are being explored via research projects at scientific institutions and within industry. The German Ministry of Education and Research is supporting these efforts as part of the 'high-tech-strategy' of the Federal Government.

Change towards sustainable development and a circular economy requires not only decisive measures such as building appropriate infrastructures that incorporate efficient collecting and effective recycling systems, but also the implementation of a political, regulatory, and social framework that supports these technologies. Society at large needs to be involved in the change towards sustainability: producers, dealers, customers, and politicians who need to promote technological improvements and cope with the challenges of a steadily changing environment. Inter- and transdisciplinary approaches that bring together universities, ministries, and industry, and which combine insights from various disciplines such as politics, law, social sciences, economics, geosciences, and engineering science can initiate important new technological developments, stimulate the exchange of ideas, and produce synergies to the benefit of all. Such approaches have already been successfully implemented at the IASS.

Moreover, in accordance with the IASS objective to translate knowledge into action, young people need to be sensitized to the issue of sustainable consumption, for instance with regards to the lifecycle and ecological footprint of electronic devices. Employing young people's interest in mobile devices, the ETS team at the IASS uses an interactive 'Raw Materials Box' to demonstrate the resource intensity of a mobile phone. The box includes nine minerals and ores that are the basic inputs for mobile phone production. The project was part of the 'raw materials expedition' by the German Federal Ministry of Education and Research. It involved approximately 1600 schools all over Germany, and 2000 boxes were sent out to schools and education institutions. The project has received very positive feedback from students and teachers alike, and current demand for the boxes is unremitting. In addition to learning about resource recycling, urban mining, and the basic principles of circular economy, users are also introduced to issues relating to environmentally-friendly product use. Focusing on young people's participation in processes of sustainable development has proven to be a successful and rewarding approach to initiating sustainable development and environmentally-friendly use of resources.

Will carbon capture and utilization (CCU) technologies be considered as an enabling technology for sustainability? It is perhaps too soon to say, but once the promising research results of today are transformed into the business cases of tomorrow, the public and consumers will decide the true potential of these technologies. Politicians will decide about technology funding and tax benefits. Residents will have their say regarding the construction of industrial facilities, pipelines, and other relevant infrastructures. The processing industry will decide between continuing 'the way it used to be' or transforming their facilities and products in line with the require-

ments of a more sustainable future. And finally, the new products 'made with CO_2' must be brought to market—whether it be a mattress, a car seat from foam plastics containing CO_2, a new jogging shoe, a football with a special coating from CO_2, or an innovative synthetic fuel made with CO_2.

Unfortunately, the successful implementation of innovative technologies is often inhibited by a lack of information from the start of a project, and by the distribution of 'pseudo knowledge' or other emotional obstacles. Acting on the IASS' ambition to translate knowledge into action, research on CCU is therefore accompanied by a wide range of communication activities. While communication challenges within technology innovation is an object of research itself, the project team considers itself an active communicator with stakeholders in business, politics, media, and the general public, and works to establish adequate communication channels with each of these groups. The objective is to enhance knowledge about CCU technologies and their potential advantages and, as a consequence, to soften the path for the successful implementation of a new sustainable technology. Thus, the IASS projects serve as drivers for sustainable innovation and as advocates of sustainable thinking and re-thinking.

An Innovative Pathway of Transdisciplinary Research and Action

The 2007 Nobel Laureate Symposium 'Global Sustainability—A Nobel Cause' in Potsdam inspired the Alliance of German Science Organizations to found an interdisciplinary, interactive, and international institute for sustainability research: the Institute for Advanced Sustainability Studies (IASS). Due to a mostly specialized and mono-disciplinary research environment, there was a perceived need for new perspectives on the complex challenges of sustainability. Prof. Töpfer was chosen as the founding director of the IASS.

The IASS has since worked successfully on its mission to develop innovative, sophisticated approaches to highly relevant sustainability issues, to make outstanding contributions to scientific progress, and to shape opinions by functioning as a hub for strategic dialogue between researchers, policy makers, businesses, and society. On its way to becoming a high-profile research institute with more than 100 employees from 27 different nations, the IASS has benefited substantially from Prof. Töpfer's broad experiences and his new, innovative, and transdisciplinary approach to research and science. Prof. Töpfer never tires of convincing scientists, business people, policy makers, and civil society of his ideas on sustainability. Instead, he regularly demonstrates his conviction that the learning process must be initiated from civil society, and that creating knowledge is never a one-way road. Just like in a circular economy that preserves resources for future generations, we need to act according to the knowledge

we have gained for the sake of the future. Science, politics, and civil society have to interact in order to create a sustainable future for the world.

Translating knowledge into action consequently includes the concepts of creating 'change through knowledge' and gaining new 'knowledge by changing' traditional pathways to the future. Corresponding to the principles promoted by Klaus Töpfer throughout his impressive professional career, and in accordance with his well-known personal convictions, the IASS with Prof. Töpfer as Executive Director fulfills its purpose in its various projects by enabling sustainability and initiating innovative learning processes for new ideas.

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