Karlsruhe Institute of Technology

ITAS
YEARBOOK 2018

PREFACE

Dear readers and colleagues,

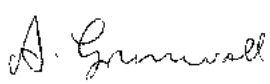
Technology assessment (TA) is an international endeavor. Over the last years, the Institute for Technology Assessment and Systems Analysis (ITAS) has participated in numerous European projects, has expanded its international cooperation from the US to Russia to China, India, and Australia, and has also oriented its research agenda more closely to the global challenges of our time. ITAS has established strong and productive international ties, is involved in several networks, and welcomes a variety of international scholars and (postgraduate) students every year. This is reason enough to present ITAS in this Yearbook 2018 to a global audience.

In this yearbook, you will find a selection of topics related to major societal issues:

- scarcity of resources,
- converging infrastructures,
- allocation of data, information, and knowledge, and
- long-term governance.

In view of these societal issues, TA is continuously challenged to develop new creative methods and research approaches. Striving to provide sound orientation, we interact with various communities in science and industry as well as with politics and public forums. This yearbook will highlight some topics, approaches, and projects that are at the core of our current research agenda. The mind map in the middle of the yearbook tries to illustrate the intricacy of the challenges and questions. We invite you to zoom in and explore our research.

Our intention is to intensify international cooperations in the future. This idea is supported by our colleagues at ITAS, who delve into new and emerging topics with great courage, passionately bring interdisciplinarity to life, and advance TA both methodically and in numerous fields of application. After all, we are nothing without our community at home and abroad, colleagues with whom we work together in confidence and who inspire us to think outside the box. Our special thanks go to you.



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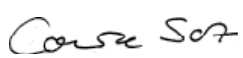


Constanze Scherz

CONTENT

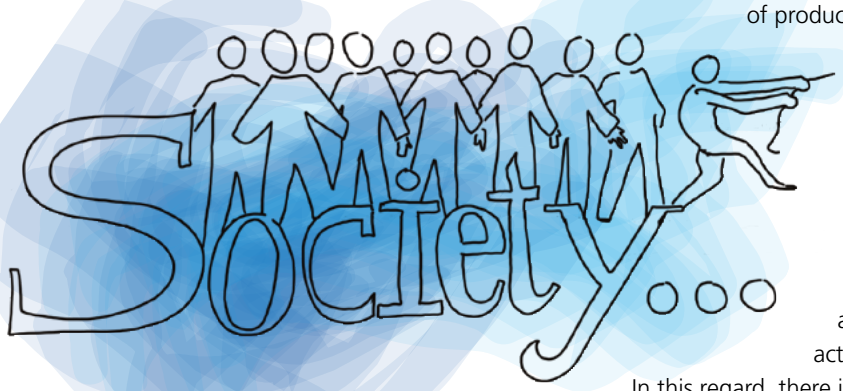
SCIENCE IN AND FOR SOCIETY
The Institute for Technology Assessment and Systems Analysis

Thinking in problems is at the core of the work at the Institute for Technology Assessment and Systems Analysis (ITAS). The Yearbook 2018 reflects this premise and concentrates on recent challenges for modern society. The yearbook also highlights the institute's continuous efforts in developing the capacity to operate in this challenging environment.

1. "Grand challenges" for society and technology assessment (TA)

Earth's resources are limited, plastic garbage floats in the oceans, digitalization weaves hardly controllable networks across national borders, the line between man and machine is blurred – many of the issues society faces today have one thing in common: they are neither limited in spatial or temporal nor in social terms. The original idea of "providing legislators with a capability for understanding and governing emerging science and technologies before they had detrimental environmental, economic, or social impacts"[1] has become a major challenge for technology assessment (TA) at large. Technological development cannot be analyzed in isolation – like in a laboratory situation –, it rather has to be embedded in global developments such as

- the problem of limited resources combined with climate change, which raises questions of sustainable ways of life, i.e., sufficiency, substitution, efficiency, and of finding a balance between ecology, economics, and human needs;
- the ongoing process of digitalization and digital transformation, promising more efficiency and productivity as well as new business cases and applications, which poses problems of the allocation of data, information, and knowledge;
- the emergence of large systems, networks of systems, and networks of networks (webs), which push forward the convergence of vital infrastructures such as energy, transportation, mobility, the world wide web, industrial production, etc.;
- the long-term governance required to tackle these issues which itself is confronted with short cycles of annual balance sheets in economy and election periods in politics. Very often, decisions in the present are decoupled from long-lasting consequences in the future, increasing the degree of uncertainty and ignorance.



The German Council of Science and Humanities (Wissenschaftsrat) summarizes accordingly: "[…] many of the Grand Societal Challenges […] are characterised by high levels of complexity, interdependency and polytely [the presence of multiple simultaneous goals], and also by difficulty in defining them precisely."[2] The respective high degree of uncertainty and lack of knowledge has consequences, especially for the task of providing scientific advice to society and politics in particular.

In the face of these challenges, there are calls for a transformation of society on a grand scale. Many call for a transition of the current unsustainable society to another, completely new and sustainable one. Prominent issues in this debate are the widespread use of renewable energy sources or sustainable production and consumption of goods and services, accompanied by processes of digitalization in industry, transportation, and health care. In addition, political agendas such as the European program on "Responsible Research and Innovation" (RRI) spark debates about the democratization of innovation processes.

Transition processes are complicated and complex, with many uncertainties attached to them. There is also plenty of resistance to change. The proponents of change must justify the inconveniences and risks accompanying new ways of production and trading and new lifestyles – that it is worth to shoulder the burdens of change for the greater good and for a beneficial outcome for many. Assessing the consequences of those transitions and thinking about different courses of action is an important task. In this regard, there is significant demand for scientific expertise. Technology assessment is challenged to contribute creative thinking, elaborate methods, and sound advice.

2. TA in theory and practice: "Translation" into scientific problems

One of the first efforts of every TA activity is to translate societal problems into scientifically workable problems. Accordingly, and vice versa, TA has to find ways to translate scientific outcomes to society and its decision makers – also taking into account cultural differences (e.g., in the case of "global TA"). When it comes to the "unboundedness" of many societal problems, there is certainly also the need to reduce these problems to bounded scientific research questions, i.e., to consider the reality of complicated and complex technical and social systems in the research design. Furthermore, TA often does not concentrate on single technologies, but rather considers technologies as part of society and integral within evolving processes, for example, the transition of society toward sustainability.

ITAS, as part of the modern, technology-driven society, conducts research in science and the humanities and offers support in complicated decision-making processes. This premise implies two basic points of reference that we share with other research organizations working on this task. On the one hand, we have to recognize societal problems of sustaining life, security, wealth, wellbeing, capabilities, etc., which in most cases have normative implications. With the drive to meet these requirements, an endless cycle of solutions to problems that raise new problems has emerged. Technology, its implementation, use, and decommissioning, is one of the decisive factors bringing about improvement and deterioration at the same time.

On the other hand, assessment tasks inevitably come along with strict expectations regarding scientifically correct observation. The fact that we cannot know for sure in advance which consequence of the technology will prevail is the limiting factor of our cognitive abilities. Jean-Pierre Dupuy expresses his discomfort: "Sometimes, to learn more is to discover hidden complexities that make us realize that the mastery we thought we had over phenomena was in part illusory."[3]

TA methods
ITAS's success largely results from the development of concepts and methods for technology and system evaluation, prospective impact research, and the involvement of stakeholders in these processes.

Systems analysis and sustainability assessment: ITAS focuses on an integrative sustainability concept as an evaluation framework. Using methods of multi-criteria evaluation, links between technology assessment and system questions (e.g., related to energy transitions) are investigated. The methods we use include analytical and empirical assessment tools, conceptual analysis, and various procedures such as systems modeling and analysis, techno-economic analysis and life cycle assessment, scenario analysis, surveys, and stakeholder involvement methods such as focus groups.

Like all science and humanities research, TA itself encounters inherent problems related to the status of the knowledge it generates, the orientation TA offers to others, and its possible contribution to forms and procedures of democratically legitimized decision making.

3. Approaching solutions: Capacity building and outreach at ITAS

The Helmholtz Association, the largest research organization in Germany, funded by the Federal Ministry of Education and Research (BMBF), provides a steady financial and organizational backbone for fulfilling our societal tasks as part of the Karlsruhe Institute of Technology (KIT). We expand on this by various activities of capacity building and outreach.

The Yearbook 2018 reflects on the context of our work and describes current research activities and project constellations. Since problems of great magnitude must be tackled from a broad range of knowledge bases, TA relies on applying, inventing, or incorporating a multiplicity of methods and concepts. Usually, research projects include various disciplinary competences, with the staff being trained to cooperate with other disciplines (interdisciplinarity) and with partners external to science and the humanities (transdisciplinarity). In recent decades, many projects have extended their reach through cooperation with national and international partners, as we will show in the following.

Institutionalized transdisciplinary relations

A key activity at the national level is the Office of Technology Assessment at the German Bundestag (TAB). The German Parliament awarded the first contract for operation of this unit to ITAS's predecessor AFAS in 1990, and the institute was successful in winning subsequent contracts. The aim of TAB's work is to provide the bodies and members of the German Bundestag with scientifically sound information for opinion forming and decision making. Recently, ITAS – in collaboration with its partners – received the mandate to coordinate the TAB activities for another five-year period until 2023.

Since October 2005, a group of European scientific institutes named European Technology Assessment Group (ETAG) – with ITAS as its coordinator – has been providing scientific services for the European Parliament related to social, environmental, and economic aspects of new technological and scientific developments. ITAS is also a member of the European Parliamentary Technology Assessment Network (EPTA), which supports exchange and mutual learning among the member states.

Research at ITAS is embedded in various communities. We are operating the "District Future – Urban Lab", a unique award-winning transdisciplinary infrastructure which is collaboratively supported by KIT, the city government of Karlsruhe, and citizens of Karlsruhe (**www.quartierzukunft.de/en**). The project raises questions of how to design and implement effective and socially acceptable participation processes, or how to appropriately design, apply, and communicate the conceptual basis of the sustainable development vision.

An important part of the European research and transfer environment is the Network Technology Assessment (NTA). NTA is an international association of German-speaking scientists, experts, and practitioners in the field broadly understood as technology assessment. The major strategic aims are to improve communication and the exchange of information within the TA community and to support the formation of a visible TA community able to strengthen the position and impact of TA in science and society. ITAS and FIZ Karlsruhe – Leibniz Institute for Information Infrastructure, backed by NTA, are designing and implementing a specialized portal for technology assessment labeled "openTA". Making use of state-of-the-art service-oriented technologies and Web 2.0 applications, the portal services and functionalities provided can be modified by the individual TA institutions and integrated into their own websites according to their needs (**www.openta.net**; funded by the German Research Foundation DFG).

TA methods
Future orientation: TA faces the challenges of creating future-oriented, anticipatory knowledge as well as reflecting on its production, dissemination, use, and quality. Anticipatory knowledge can be produced, presented, and used in numerous forms: computer models, scenarios, forecasts, foresight exercises with various participant groups, "Leitbilder" and narratives about possible socio-technical futures created in different cultural environments. Concepts such as hermeneutic TA, vision assessment, or socio-technical scenarios are used to assess and evaluate future knowledge. The role of TA in the formation of such knowledge needs to be reflected upon as well.

Participation: A recurring challenge is the development of and experimentation with participatory exercises. For example, in the field of synthetic biology (SynBio), ITAS attempts to establish an open dialogue between stakeholders on SynBio's potential benefits and risks and explores possibilities for its collaborative shaping on the basis of public participation. In addition, neighborhood and real-world lab research approaches play an increasingly important role in the field of urban sustainability transition processes, emphasizing the idea of a scientific/societal co-design of knowledge and strategies.

As a service to the scientific TA community, primarily in German-speaking countries, ITAS has been publishing the journal "TATuP – Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis" since 1992 in print and online (**www.tatup.de**). Each of the three issues per year has a thematic focus on an up-to-date research topic.

Philosophical and ethical principles of TA
In 2015, the research group WTP – Philosophy of Science, Engineering, and Technology was established at ITAS. Its research on the philosophy of science, engineering, and technology covers both epistemological and ethical aspects. Head of the group Rafaela Hillerbrand (previously TU Delft), professor for ethics of technology and the philosophy of science, got appointed via the Helmholtz Association's initiative for the appointment of excellent scientists from abroad. The research group broadens the range of topics within ITAS's core areas of expertise and allows the institute to provide the scientific foundations of technology assessment particularly related to sustainability analysis with a broader ethical and philosophical basis.

» www.itas.kit.edu/english/wtp

The journal was relaunched in August 2017 as a peer-reviewed, open access journal in cooperation with the oekom publishing house Munich.

In recent years, ITAS has been involved in establishing a network of researchers from Russia engaged in TA and RRI, which includes Lomonosov Moscow State University, Perm National Research Polytechnic University, and Tomsk Polytechnic University. The goal is to support the formation of a TA community in Russia and to set up international projects. In addition, there has been a lively cooperation in the field of "Human, Medicine, and Society" with the Orient-Institut Istanbul, a turkological and regional academic research institute affiliated with the Max Weber Foundation (**www.oiist.org/en/mensch-medizin-und-gesellschaft**).

ITAS is also involved in several international TA networks, such as the Society for the Studies of New and Emerging Technologies (S.Net; **www.thesnet.net**) and the Virtual Institute for Responsible Innovation (VIRI; **cns.asu.edu/viri**), led by the Consortium for Science, Policy & Outcomes (CSPO; cspo.org) at Arizona State University (ASU). Furthermore, ITAS is a member of the Global Consortium for Sustainability Outcomes, a global network to advance solutions to sustainability problems through research, development, and capacity building (**sustainabilityoutcomes.org**). In addition, ITAS is active in various constellations of the European Energy Research Alliance (EERA) to promote energy technology systems analysis (costs and environmental impact assessment) (**www.eera-set.eu**).

Education

With the foundation of KIT nine years ago, ITAS was able to increase engagement in university education and scientific qualification. Many ITAS researchers are involved in courses at various KIT

faculties. ITAS's probably largest contribution to scientific qualification is the supervision of PhD students and their dissertations. The Helmholtz Research School on Energy Scenarios and the ENRES PhD program Energiesysteme und Ressourceneffizienz (ENRES) are examples of coordinated graduation activities. A total of about 30 dissertations are currently being conducted at ITAS, covering a wide range of disciplines. Candidates are offered an accompanying PhD program developed by ITAS to distribute and further develop basic knowledge on TA and systems analysis.

4. Outlook

The capacities developed and applied at ITAS offer support to social actors, policy makers, stakeholders, and civil society in coping with the constantly changing "grand challenges" mentioned in the beginning. Making use of these capacities in several projects means not only applying them. Instead, each project brings about its own and specific challenges and contextual requirements, implying the necessity to further develop the capacities and methods. The the portfolio of capacities at ITAS is therefore constantly amended.

By Christian Büscher, Constanze Scherz, Daniel Frank, Sophie Kuppler, Jonas Moosmüller, Armin Grunwald

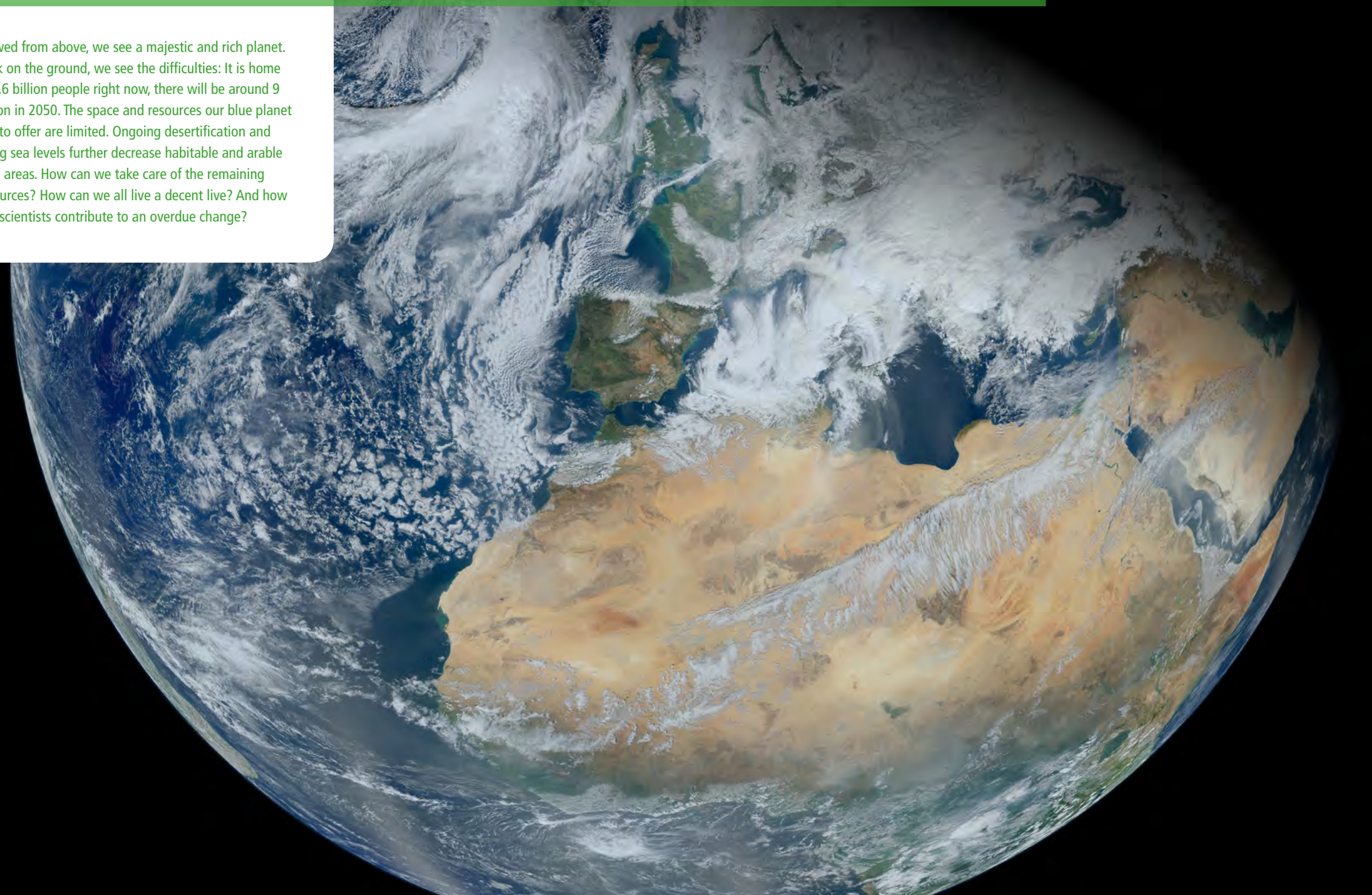
[1] Jathan Sadowski (2015): Office of Technology Assessment: History, Implementation, and Participatory Critique. Technology in Society 42: 9. **https://doi.org/10.1016/j.techsoc.2015.01.002**

[2] Wissenschaftsrat (2015): Grand Societal Challenges as a Topic for Science Policy. Position Paper. Stuttgart: Wissenschaftsrat **http://www.wissenschaftsrat.de/download/archiv/4594-15_engl.pdf** [Accessed 26 April 2018]

[3] Jean-Pierre Dupuy (2007): Rational Choice before the Apocalypse. Anthropoetics 13(3): 8

Limited resources & climate change – How to live within a finite nature

Viewed from above, we see a majestic and rich planet. Back on the ground, we see the difficulties: It is home to 7.6 billion people right now, there will be around 9 billion in 2050. The space and resources our blue planet has to offer are limited. Ongoing desertification and rising sea levels further decrease habitable and arable land areas. How can we take care of the remaining resources? How can we all live a decent live? And how can scientists contribute to an overdue change?



LIMITED RESOURCES & CLIMATE CHANGE
How to live within a finite nature

Every day, humankind gets more ingenious in using the resources planet Earth has to offer. We invent new resource-efficient technologies, replace, reuse, and recycle. Every day, soils are irreversibly depleted, oceans are polluted with tons of plastic. We consume and discard at a pace that could not be matched by any counterefforts so far.

Space travel for the first time made it clearly visible to everyone that Earth is a limited space. The message got through when the Club of Rome published its study "The Limits to Growth" in 1972, arguing that we would soon reach the peak in resource availability and that economic growth would need to be decoupled from resource use. By now, such a decoupling has been realized in many aspects. But since we also consume more than ever, our total resource consumption has not declined.

Economic growth does not only use resources, it also produces waste and by-products that are emitted into the environment. It is commonly agreed that climate change is directly caused by the way we produce and consume. At the same time, it affects our possibilities to do so, e.g. to grow food.

Challenges for society

Against this background, we have to ask: How can we ensure well-being for everyone? How can we reach a state in which everybody's basic needs are fulfilled and people can develop and thrive? Several persistent structural inequalities make it difficult to solve such issues. First, cheap prices for consumer goods such as clothes and food in developed countries cause environmental problems in the producing, i.e., mainly developing, countries. This leads to a further depletion of resources such as clean water in the affected areas. Second, many goods that could still be used are classified as waste and discarded, sometimes shipped off to less wealthy nations that have to deal with the toxic remnants. Third, current consumption and mobility patterns in developed countries cannot be reproduced in the rest of the world due to scarce resources and waste problems. For example, if every household in the world owned several cars, CO_2 emissions would rise immensely.

All this affects the possibilities of fulfilling the basic need of not suffering from hunger. As production conditions are changing and the world population is growing, the urgent question is how to feed the world. Desertification reduces the land area available for crop production, climate change leads to a rise in extreme weather events and thus to more crop failures, and land grabbing affects the possibility for locals to sustain themselves, to name but a few of the challenges agricultural food production faces.

The emergence of those problems called for ideas how to face them. Sustainability refers to the idea that we should use the planet's resources in a way that future generations will still be able to fulfill their needs. It aims at finding a balance between ecology, economics, and social needs. Using less resources and polluting less is at the core of most endeavors to tackle those problems. The approaches aim at substituting current non-sustainable resource uses by more sustainable ones.

Research at ITAS

Some of the answers to the problems researchers have identified are efficiency, substitution, and frugality. This means to use resources more efficiently, to substitute current unsustainable practices, and to live more frugally by using fewer resources. One example for substitution is identifying new sources of food. Cultured meat and microalgae are two quite different food sources that are produced in technical installations. In the following interview, Silvia Woll and Christine Rösch show the visions that drive research on these technologies and the status quo of their implementation. Under what circumstances would it be beneficial to widely introduce such kinds of food?

Attaching meaning to the abstract concept of sustainability for our daily lives and its practical application in a community, in particular by decelerating and doing things together, is at the heart of the "Real-world lab Karlsruhe". In this project, which was initiated by researchers at ITAS, valuable experience was gained in building capacities to co-create a sustainable city quarter together with its residents. The project also looks into a challenging future, aiming to make the knowledge gained available for similar projects elsewhere.

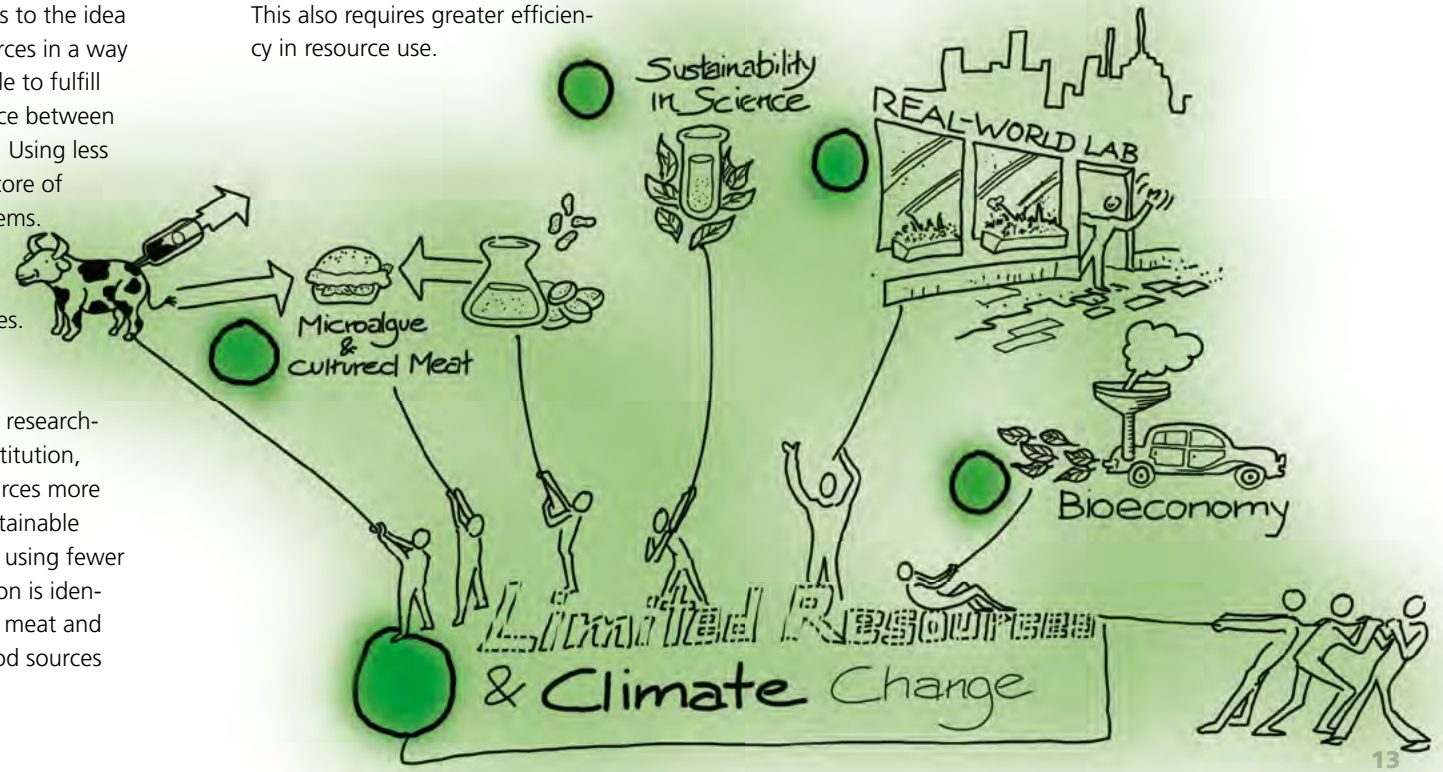
The vision of a bioeconomy entails several of the approaches mentioned: our fossil-based economy should be substituted by a bio-based one. This also requires greater efficiency in resource use.

But how exactly should such a far-reaching transformation take place?

In his research, Rolf Meyer has investigated different competing visions and formulated recommendations on how to deal with the complexity of such a far-reaching transformation.

Sustainability cannot only be achieved by replacing existing practices with new ones, but also by ensuring that research follows the principles of sustainability. Together with colleagues from other research institutions, Jürgen Kopfmüller and Markus Winkelmann suggested a set of criteria for ensuring that research is oriented toward the public good. But how can we put such criteria into practice? Guidelines for researchers on how to reflect such criteria and how to implement them are part of the answer developed in their research project LeNa – Sustainability Management Guidelines

By Sophie Kuppler



FOOD RESEARCH
Would you eat it if it were more sustainable?

Christine Rösch and Silvia Woll are researching the possibilities and challenges of new forms of food supply for a growing global population – producing proteins from microalgae and growing meat in the lab. Here they explain why we cannot know yet whether these technologies will solve the world's food problems.

Could you briefly outline the global problems of nutrition?

Rösch: One of the most pressing challenges is to combat hunger and malnutrition worldwide. In Germany, we use almost one fifth of the arable land for non-food production, e.g., for growing energy crops. Even though we are not facing hunger in Germany, we have a responsibility to feed the world.

Woll: Current meat production causes many global problems: ethical problems related to animal farming, environmental problems, such as the methane emissions of cows, and also health problems for human beings. We know that the consumption of meat can lead to type 2 diabetes, for example, and to cancer.

What is the idea behind producing food from microalgae and cultured meat?

Woll: People doing research on cultured meat – also called in vitro meat – want to bring it to market. Instead of stopping people from eating meat, their solution is to grow it in laboratories. They paint a very visionary picture in which one single farm animal is enough to provide the whole world with meat. We don't know yet if this will work.

Rösch: The idea behind food from microalgae is directly related to the challenge of an increasing population and the decreasing availability of arable land. Algae are produced in so-called photobioreactors. They only need sunlight, water, and nutrients and can be placed on sealed urban areas or even in the desert, if saltwater is available. In addition, they have a very high yield per area. If you compare them with palm oil, for example, you can produce several times the amount of oil from algae without cutting down rain forests.

What are your main findings?

Woll: Currently, there are many different visions. Participants of our focus groups and a citizens' jury imagined that cultured meat could lead to social tensions because conventional meat could become some sort of luxury. They also fear that if only a few companies hold the patent to produce cultured meat, they could misuse this monopoly. But the participants also came up with positive visions: Every little town could have, let's say, 25 or 50 farm animals that coexist peacefully with the inhabitants. Only once a week someone takes a biopsy for the cultivation of meat in the lab. However, for the moment it is important to state that even though we have the proof of concept that culturing meat is possible, we don't know its impacts on a large scale yet.

Rösch: We assess the sustainability of different algae-based value chains for food and energy. This means that we look into the potential on non-arable land and perform economic and lifecycle assessments as well as surveys on public perception and acceptability. Our results show that the potential in Europe is restricted. In desert regions, however, there are huge potentials. The problem is that we still have to put in more energy than, for example, for the cultivation of soybean. Also the costs for the production of proteins from microalgae are significantly higher than for soybean proteins. But this is not surprising. Algae-based value chains are still a nascent field of research compared to traditional production chains. That's why I have great hope that if we continue research and development, we will see more algae-based food in the future.

Do you think people are ready to eat such unusual food?

Rösch: I have noticed that people are interested in microalgae and already buy products enriched with algae. If we can realize algae production at low cost and with less energy demand to make it overall more sustainable than field-based food production, consumers will be even more willing to accept food from microalgae.

Woll: I agree with that. In the beginning, most people said no, they wouldn't eat cultured meat. At the end of our events, many people said: "Well, if it really had a clear positive impact on the treatment of animals or the environment, I would give it a try".

What are your suggestions for a future research strategy?

Rösch: We analyze systems approaches to fully grasp the benefits of microalgae and integrate them into the circular bioeconomy. For example, we investigate how algae can use the nutrient surpluses from biogas plants. In this way, algae can help to reduce water pollution caused by nitrates from agricultural sources.

Woll: The process of getting cultured meat ready for market isn't finished, so of course TA research has to go with it. I think cultured meat has the potential to really change the way we eat and how we see food. If something has so much impact on our daily lives, TA should consider it as well.

Algae and in vitro meat promise to solve the world's food problems, but are still far away from mass production.

ON THE NEED TO SLOW DOWN TO MOVE FORWARD

Experiences from the real-world lab Karlsruhe

What do bees, a second-hand label, singing, and a meeting place for citizens have in common? The basis for this unusual combination was laid in the year 2013 when a team of ITAS researchers set off to find out how to transform a city district with old buildings and a mixed population into a sustainable quarter – the District Future. Over the five years that have passed since, the "Oststadt" district in Karlsruhe has been the setting for a multitude of initiatives and events, bringing together citizens and researchers with one common goal: establishing a real-world lab to find out what drives sustainable development, both regarding technological as well as social innovations.

A milestone in this adventure was a citizens' forum held in the Oststadt in 2014 to identify the most relevant topics for the transition of the district. Translating these topics into action was then the task of the KIT researchers. However, they did not want to search for solutions in their labs only. No, their aim was to involve the public in the research process. And so they did. For example, they initiated a KonsumCafé (Consumption Café), based on the idea that re-using things is an essential part of a sustainable lifestyle. In addition to swapping clothes, plants, and seeds, people can inform themselves and discuss, for example, the benefits of seed sovereignty to be able to make their own informed choices.

What can we learn from those activities that could be applied to similar transformation processes in other districts or cities? "A mix of low-key participation formats such as the KonsumCafé, lectures, and workshops supports the bottom-up process," says project head Oliver Parodi. He highlights the success achieved by adding: "Some of the projects continue to exist, even after the official project terms have ended." Taking the idea of a mix of formats seriously, the real-world lab and the Community Foundation Karlsruhe initiated "Your SustainabilityExperiment" in 2016, where they asked citizens to come up with their own ideas on how to make the Oststadt more sustainable. "We realized that becoming sustainable means slowing down and placing a stronger focus on the community," explains Helena Trenks from the scientific team, referring to the cornerstones that each of these SustainabilityExperiments needed to fulfill.

This brings us back to the bees, the second-hand label, the singing, and the weekly citizens' meetings. They represent the projects implemented. In the future, people in the Oststadt might, for example, grow food together in self-made beds which are pollinated by bees living in nests made from tree trunks, visit their self-organized weekly get-together, the "Oststadt-Treff", decelerate through creative activities, or show the world that they re-use by attaching a "Second Future" label to their second-hand clothing. For the implementation of those projects, the citizens use the existing infrastructure: the Future Space for Sustainability and Science – a meeting room open for citizens and scientists and the heart of the living real-world lab!

Various joint projects of citizens and scientists make the neighborhood more sustainable and worth living in.

Slowing down also means to realize and embrace that transformation processes take time. "Even if you know that your lifestyle is not sustainable, it is very difficult to change your behavior patterns," says Helena Trenks. For this reason, the Baden-Württemberg Ministry of Science, Research, and the Arts has decided that the real-world lab does not only have to continue and expand its work in Karlsruhe, but also make its experiences available to projects elsewhere and build a network of different actors for implementing sustainable development. To support these goals, the Karlsruhe Transformation Center for Sustainable Futures and Cultural Change (KAT) will be developed over the next years. The center will provide opportunities for research, innovation, knowledge exchange, and learning – but also for contemplation and the slow movement culture. It will address questions such as what role technologies can play in a sustainable transformation of the use of energy. Oliver Parodi has a vision: "Over the next years, the KAT will develop into a motor for sustainable development, not only locally, but also at a national and international level." (sk)

» www.quartierzukunft.de/en

District Future going global

The Global Consortium for Sustainability Outcomes (GCSO) is a network of eleven international research institutions with the aim of developing solutions for sustainability problems locally and applying them globally. ITAS takes part in two GCSO initiatives: One concentrates on capacity building for municipal employees, enabling them to take more sustainable decisions. The other focuses on developing a toolkit to identify tasks for saving energy, water, or preventing waste in public buildings in different geographical and cultural contexts.

» sustainabilityoutcomes.org

TOWARD SOCIALLY RESPONSIBLE RESEARCH
A challenge for individuals and institutions

Sustainability – a goal not easy to achieve in our complex world. The United Nations' sustainability goals address great societal challenges. Adequate solutions are always associated with social transformation processes. Research has to face the task of co-designing these processes. However, so far it has not been systematically or even generally defined what this means in detail.

The "LeNa – Sustainability Management Guidelines" project defined the criteria for research in social responsibility and developed approaches for their application in everyday research activities. The eight criteria can be subsumed under two questions: "How is research conducted?" and "With/for whom is research conducted?" For example, research on important societal questions should not only include all the relevant scientific disciplines in the respective topics, but also the public. Research into new technologies should, e.g., also consider the needs of future users and the possible impacts on society and the environment. This must be kept in mind during all phases of the research process – from finding a research topic to developing the research design and methods, carrying out the research, and communicating and evaluating the results. In their daily research, several disciplines often apply only some of these criteria. However, only the combination of all of them can guarantee socially responsible research.

A framework for reflection developed in the LeNa project helps the researchers to better integrate the criteria into their daily research routine. It consists of fact sheets for all eight criteria, which state, among others, their importance and include the significant steps and methods for their implementation as well as positive examples. "Quick check" questions should also enable the researchers to assess how relevant a criterion is to them and how they could implement it, for example, by considering the goals of freedom and efficiency of research. The aim is to start a profound debate on the applicability of this framework of reflection, at first in the institutions involved, but later also beyond.

Such a reflection framework makes it possible to integrate new knowledge and improve the legitimacy and trustworthiness of research and its results, thus enhancing the overall quality of research. However, its systematic implementation is resource-intensive and requires substantial changes in the entire scientific system. Such changes do not only affect the researchers' own willingness and skills, but also the research institutions' policies regarding staff, promotion, and further training as well as the institutional framework conditions, which are defined by, e.g., the funding bodies or university curricula.

» www.lena-projekt.de

Essay by Jürgen Kopfmüller and Markus Winkelmann
The two ITAS researchers were members of the "LeNa – Sustainability Management Guidelines" project, which was conducted by institutes of the Fraunhofer-Gesellschaft, the Leibniz Association, and the Helmholtz Association and funded by the Federal Ministry of Education and Research.

BIOECONOMY
Contested pathways to more resource efficiency

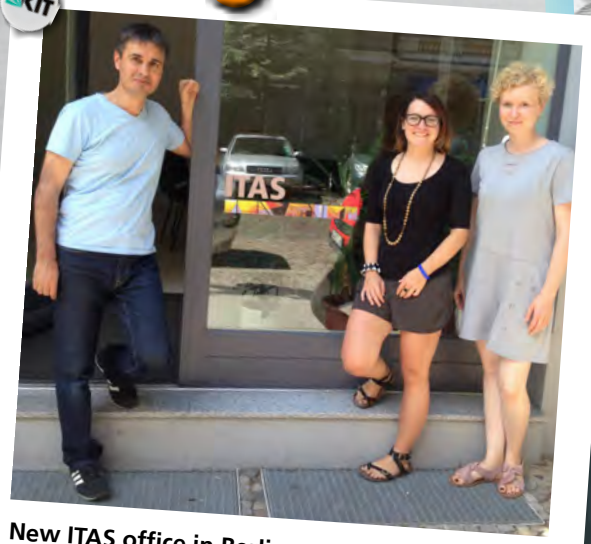
The transformation from a fossil-based to a bio-based economy is seen as a possible answer to global challenges such as climate change, food security, and the finite nature of and our dependence on fossil fuels. That is what promoters have in mind when they speak about bioeconomy.

But what exactly should such a far-reaching transformation entail and how is it supposed to take place? Officially, bioeconomy has become an important issue in research and innovation policy making, for example, with the 2012 EU bioeconomy strategy and the 2014 German bioeconomy policy strategy. They focus on innovation through research and technology development with a strong emphasis on new value chains for innovative bio-based industrial products and bioenergy.

"However, this official bioeconomy approach is contested in scientific and societal debates", says ITAS member Rolf Meyer, who has been investigating bioeconomy concepts for years and conducts regional projects in this field. As an alternative, an ecology-centered vision of the bioeconomy is put forward. Its focus is on agroecological techniques and methods such as increasing plant genetic diversity, improving nutrient recycling, enriching biodiversity, and enhancing the health of soils, crops, and livestock. This alternative approach concentrates on regional rather than global value chains. Also the main focus of the transformation diverges: The alternative vision places far-reaching changes in agriculture and food production at its heart, whereas the official visions imply a continuation of the current trajectory for these sectors.

It is undisputed that sustainability gains are an important prerequisite for a successful transformation from a fossil- to a bio-based economy. A systemic research approach – such as thinking in terms of value chains and systematic analysis of changes and impacts – is proposed to understand sustainability issues and to solve conflicts of objectives. "Nevertheless, in the context of bioeconomy, a systemic approach is difficult to achieve due to fragmented realities," explains Rolf Meyer by highlighting one central finding of his research. For example, many new conversion pathways with today often unclear end-products compete for multiple limited biomass resources. Furthermore, many different actors – governmental and others – with diverging interests are involved at many different levels and in many sectors. Finally, it is very difficult to foresee impacts of changes for the whole system due to an interplay and feedback of impacts.

Taking all these complexities and diverging visions into account, what should a government do to further a bioeconomy transformation? ITAS researchers recommend: The ability to learn and adjust should be enhanced in the governance of the bioeconomy. (sk)



New ITAS office in Berlin
The Helmholtz office, various embassies and foundations just a stone's throw away: In the summer of 2017, ITAS opened an office in the German capital to network more closely with political and international players. The office forms a second pillar next to the Office of Technology Assessment at the German Bundestag (TAB). Colleagues on site work with partners from all over the world (read more on page 50). Their aim is to expand the idea of global TA and make ITAS a driving force behind it.

Parliamentary advice
The German Bundestag can rely on the advice of the ITAS-operated Office of Technology Assessment at the German Bundestag (TAB) for another five years. The Committee on Education, Research, and Technology Assessment took the decision in June 2018. "All parliamentary groups agree that the TAB should continue its highly valued and successful independent advisory work," said committee chairman Ernst Dieter Rossmann. The TAB has been advising the German parliament on questions of scientific and technological change since 1990.
» www.tab-beim-bundestag.de/en

Double harvest with agrophotovoltaics
By combining food and photovoltaic (PV) production, agrophotovoltaics (APV) may help solve the food vs. power dilemma. But, what is society's opinion on this technology? To shed light on this question, ITAS conducted two citizens' workshops near a pilot plant in the Lake Constance area. One result: Only if both roof and area potentials were fully exploited, the participants would prefer APV over ground-mounted PV and biogas. Further, the design of the technology can only be socially and environmentally compatible if accompanied by a restrictive framework that, for example, defines specific site criteria and stipulates the cultivation of agricultural crops. » agrophotovoltaik.de

Real-world lab symposium in Karlsruhe
In April 2018, Baden-Württemberg Minister of Science Theresia Bauer (center) was pleased to receive recommendations for the future establishment and promotion of real-world labs. They were handed over by Astrid Ley from the University of Stuttgart and Oliver Parodi, head of ITAS's real-world labs District Future – Urban Lab and Urban Transition Lab 131, and co-organizer of the symposium in Karlsruhe. On the occasion, representatives of all 14 so-called BaWü Labs summed up three years of real-world laboratory research in Baden-Württemberg and discussed the future of their transdisciplinary approach.

Community development through energy access
Research teams from ITAS and the Arizona State University have started cooperations with local NGOs and enterprises in Nepal, Philippines, Uganda, and Bolivia. Their research on off-grid and renewable energy access in remote and rural communities is intended to contribute to reducing poverty and advancing other Sustainable Development Goals (SDGs) such as quality education, gender equality, and clean water. The one-year project, funded by the Global Consortium for Sustainability Outcomes, started in July 2018. In a next step, it is planned to be extended to hundreds or more off-grid energy projects worldwide.
» sustainabilityoutcomes.org

The working environment of the future
Visions of the world are timeless. While currently artificial intelligence and self-driving cars dominate the debate, half a century ago it was about assembly line production, robots, and the social consequences of automation. Addressing past visions can help to cope with new technologies, says Bettina-Johanna Krings, head of the ITAS research area Knowledge society and knowledge policy. Among other activities in the Science Year 2018, she participated in a multi-generational dialogue on the future of work in Karlsruhe funded by the Federal Ministry of Education and Research.
» www.arbeitszukunft.de

Allocation of data, information, knowledge – How to share the benefits of a digital world

We dream of a world of free-flowing data and open access to information and knowledge. In reality, data are carefully guarded resources which can provide valuable information. Those who have access to and know how to exploit (big) data have a competitive advantage on the market or in power relations. How society will be affected by the unequal access to data, information, and knowledge is one of the most pressing questions of our time.

ALLOCATION OF DATA, INFORMATION, KNOWLEDGE
How to share the benefits of a digital world

In the early years of computerization and digitalization, the optimism of a linear increase in the use of information and communication technologies (ICTs) prevailed. For example, scientist George P. Huber expected in 1990 "improvements in effectiveness of intelligence development and decision making."[1] ICT has become a major factor as planning and coordination tool to foster control over complicated systems and increase transparency in organizational processes. On the flip side, the degree of complexity has grown as well, mostly due to the architecture of ICT itself.

Nowadays, we usually encounter socio-technical structures – like cyberinfrastructures or energy systems – where complicated technical operations run in the background, while for most of us access is limited to the simple interfaces at the front end. When using digital devices, such as computers or modern vehicles as well as Internet banking or social networks, we usually have no insight into how these "machines" actually work.

Nonetheless, ICT is a major productivity factor since it promises more efficiency in industrial production, administration, and the management of scarce resources, e.g., through "smart" energy systems. However, these developments represent a rather non-linear and problem-laden progress. ICT as productivity factor always interferes with existing organizational structures, which causes problems of aligning habits, skills, and knowledge of people as well as cultures and the characteristics of the work environment to the technical means at hand. The ensuing friction hampers productivity. In cases of a more efficient use of scarce resources, "rebound effects" negate an overall desired positive effect because of an excessive consumption of the freed-up resources.

Challenges for society

In the last decades, electronic data processing has continuously improved the means to gather, compute, store, and distribute large amounts of data. Nonetheless, some premises of information-processing techniques have never changed. Any user of data-generating machines has to select and interpret the data at hand in order to determine its usefulness. Only the interpretation of data in relation to expectations generates information. Subsequently, if we use information for action and decision making, it can be considered as knowledge claim. However, by using electronic data processing, the uncertainties and risks of decision making are not eliminated, just as social issues of responsibility and liability do not disappear "automatically".

One common misunderstanding about algorithms is the determinism that is attributed to computerized technologies. This fatalistic position culminates in the phrase: "The machine or the software, respectively, decides."
Any algorithm is a product of human ingenuity. Therefore, we have to take a closer look at the specifications that precede the algorithm in operation, which are the result of decisions of designers and engineers. Nowadays, many actors collect data wherever they are generated. Data exploitation creates a social breach between those with access, i.e., the decision makers who invent and implement algorithms, and those who do not have access, i.e., the masses of affected citizens. In social networks, in online businesses, for political intelligence services, data is gathered for yet to be determined purposes. Private enterprises hope to exploit knowledge of user preferences. Political entities expect to increase the effectiveness of surveillance or even to implement a social scoring system.

The Chinese "social credit system" experiment, which determines the "trustworthiness" of its citizens, has attracted a lot of attention. The question is how far state agencies might proceed with the data collected on the behavior of individuals, the information drawn in terms of a negative or positive evaluation, and the distribution of the knowledge generated about the social status and reputation of persons.

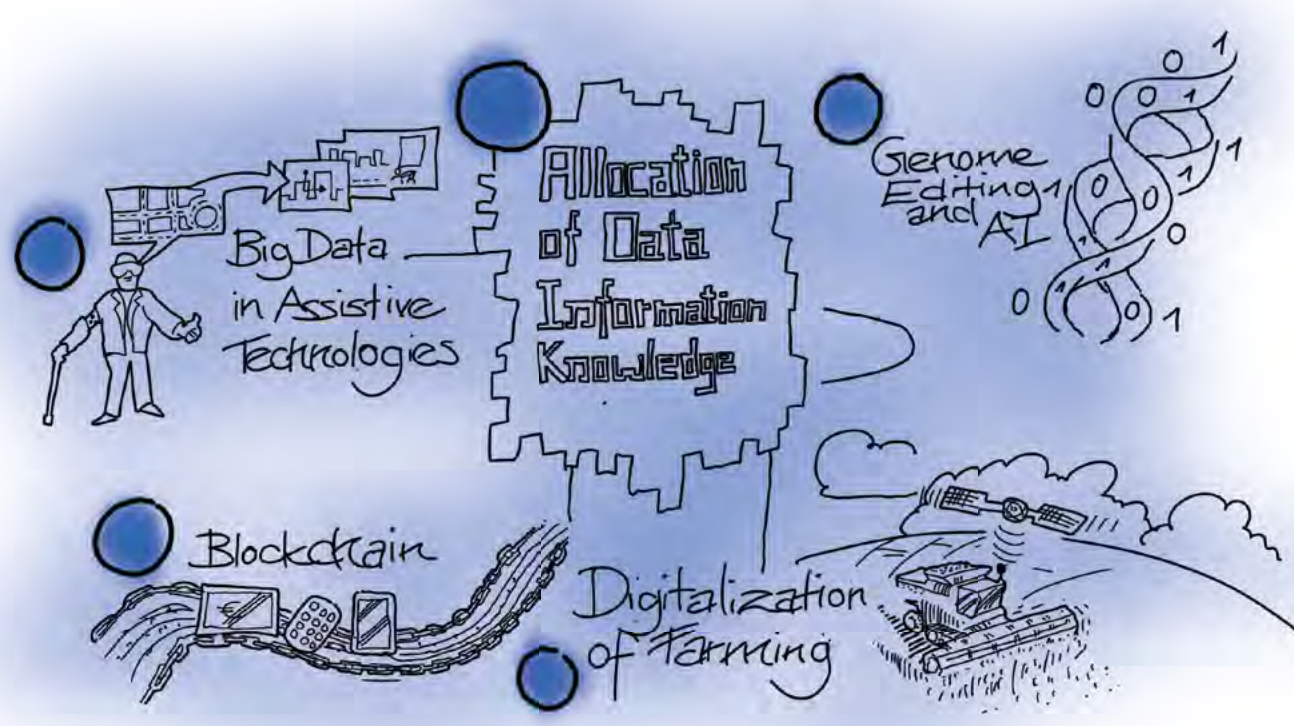
Research at ITAS

How far the digital transformation reaches into our technical "Lebenswelt" is reflected in various projects at ITAS. Visions about big data, artificial intelligence, the manipulation of the human genome, human assistance systems, and many more topics of digitalization and digital transformation are discussed regarding their risks and opportunities. A selection is presented on the following pages.

First, in an interview with biologist Harald König, the convergence of biotechnology and information technology is briefly discussed. The project team of Christoph Kehl, Carmen Priefer, and Saskia Steiger at the Office of Technology Assessment at the German Bundestag (TAB) in Berlin assesses the consequences of the digitalization of agriculture. Visiting scholar Karsten Wendland, professor of media computer science at Aalen University, analyzed blockchain technology in collaboration with ITAS staff and explains some of its main features. Finally, Nora Weinberger reports on digital systems for assisting disabled people.

By Christian Büscher

[1] George P. Huber (1990): "A Theory of the Effects of Advanced Information Technologies on Organizational Design, Intelligence and Decision Making", The Academy of Management Review 15(1): 66.



GENOME EDITING CHALLENGES OUR ETHICAL STANDARDS

Interview with Harald König on the bio-info nexus

The convergence of bio- and information technology – referred to as bio-info nexus – promises the design or redesign of biological systems and the creation of new biological functions. Harald König, biologist and expert in risk-benefit analysis and the governance of synthetic biology and emerging technologies at ITAS, offers insights and points to the possibility of a "slippery slope" toward genetic enhancement of future generations.

What is the technology behind the bio-info nexus?

There is an increasing interconnection between "bio" and "info" – both influence each other. On the one hand, information technology allows for enormous data processing, increased automation, and fast learning, and, therefore, drives the progress toward analyzing and understanding living systems. This is the basis for constructing new biological functions and systems in biotechnology or regenerative medicine, but also in human enhancement technologies. On the other hand, biological principles may inspire information processing systems such as learning algorithms for artificial intelligence. Thinking even further, biological principles may also be employed to improve the governance of complex systems.

How is the governance of complex systems feasible?

Biological systems linked to information processing have enormous capabilities to adapt to complex and changing environments. Thus, harnessing them may lead to a better governance of and decision making in complex systems or in "causally dense" settings like economics, financial markets, or politics at large. This may in particular involve principles linked to guided self-organization or evolutionary theory, including recent concepts such as the adaptive market hypothesis, rather than a focus on algorithms or mathematical modeling alone.

Are there some examples of what can be engineered?

One vision is to design or redesign biological systems and to create new biological functions, like "synthetic" metabolic pathways that have no blueprint in nature, e.g., to produce certain chemicals in bacteria. Computer-based modeling of such pathways is already possible for bacteria: Researchers define what product they want to create and, through these models, they obtain predictions of candidate "synthetic" pathways. For instance, 1,4-Butanediol, a chemical used to produce plastics or polymers, can now be synthesized in bacteria via such a new pathway on an industrial scale. Right now, the industry concentrates on high-value chemicals such as fragrances and flavors.

What are the boldest visions?

The ability to interpret the human genome. Using big data, artificial intelligence, and machine learning, engineers might be able to predict which genome sequences they need to rewrite in order to manipulate even complex phenotypes. Such phenotypes may be common diseases, but also sensitive human traits such as intelligence. This idea raises some fears.

What are the possible consequences?

On the one hand, there is the prospect of gene therapy or the preventive "correction" of genetic variants linked to disease risks. On the other hand, it may be difficult to draw a clear line between therapy or preventive interventions and enhancement. In addition, genome-editing techniques are not 100% precise so far and can unintentionally change other genes. This might lead to health issues or disabilities in offspring later in life. Such a result can hardly be tested in vitro in advance. Long-term surveys are necessary.

What is the role of TA in this context?

Besides the assessment of safety questions, we as TA experts see it as our mission to foster a broad societal discussion on possible consequences and ethical questions. This topic opens up possibilities to operationalize ethical deliberations and moral stances and to contribute to governance. One example is a recent report of the US National Academies of Sciences, Engineering, and Medicine. The colleagues outlined criteria for conditions in which germline editing for the therapy of diseases might be permitted. These include the prevention of a serious disease with no alternative treatment and multigenerational follow-up. Even though genetic enhancement applications are rejected in the report, the issue of blurring boundaries between curing and enhancing remains.

Are there other conflicting issues you would like to highlight?

The stakeholders' different perceptions of risks and benefits results in sharp divides over the use of these technologies to realize even common goals, such as fighting genetic diseases or addressing sustainability issues. For instance, a new bioeconomy based on synthetic biology promises to use biomass more efficiently and is therefore supposed to be part of a solution toward sustainable development. However, critics claim this will only lead to increased more consumption of biomass.

Advancing information technology drives the progress toward analyzing and understanding living systems.

BIG DATA IN THE COWSHED

Opportunities and risks of digitalization in agriculture

Agriculture in industrialized countries is characterized by a high degree of mechanization and automation. Innovative agricultural technologies and digital data processing are currently pushing the world of food production into new directions. The ongoing project "Digitisation of agriculture" conducted by the Office of Technology Assessment at the German Bundestag (TAB) in Berlin is drawing a comprehensive picture of major developments.

Linking digital applications at farm level to overarching production systems (Farm 4.0) in order to increase economic and ecological efficiency is the main vision of digitalizing agriculture. Among the new technologies already in use in the field of crop production are GPS-driven machines, sensors, and techniques that enable variable application of fertilizers and pesticides and automatic yield mapping by drones. In livestock farming, this includes robots for milking, feeding, and the removal of manure, but also sensors for checking vital data and herd management. The data collected can be linked to external information such as weather data and further processed by analytics tools. This allows farmers to identify production steps that could be optimized.

Another vision is to connect digital technologies along the entire value chain, from feed and seed production to cultivation, food processing, and retail. The aim is to improve production steps in terms of flexibility and to increase transparency for consumers. Even in its infancy, it can be assumed that digitalization leads to fundamental changes in structures, processes, and responsibilities. The project explores the opportunities and risks of this development.

The responsible team of Christoph Kehl, Carmen Priefer, and Saskia Steiger has recognized that a number of problems in the field of data generation and usage have not been addressed appropriately, and that therefore no solutions are in sight yet. First, data-based networking relies on different practical prerequisites. This encompasses the existence of a high-performance broadband infrastructure, which is lacking in many rural areas in Germany, supply with geographical data by public authorities (e.g., cadastral information, soil maps, road networks), and the use of standardized data formats to connect information from different sources.

Second, it is expected that farmers will become increasingly dependent on service providers, especially for the purpose of data interpretation. This potentially leads to new dependencies, particularly since the protection of data and their use and processing by third parties, such as machine or software manufacturers, are not legally regulated so far. In surveys of farmers, concerns about data security are mentioned as main barrier to the use of digital technologies. The project heads Carmen Priefer and Christoph Kehl observe: "There are worries about the loss of data sovereignty, with the consequence of decreasing entrepreneurial autonomy, and the formation of new power constellations and market monopolies. The desire to treat operational data confidentially is in conflict with attempts to exchange information along the value chain in order to increase transparency."

Third, automated data collection and interpretation by expert systems have an impact on the agricultural knowledge basis. For example, there is a risk that the tacit know-how of farmers (e.g., about site-specific management, ecological interrelations) will decrease or even vanish with an increasing digitization.

Fourth, the robustness and design of production processes based on digital systems play an important role. Since safeguarding food security is a crucial societal task, supply must be ensured, even in the case of technical failures or manipulation. Consequently, data loss must be prevented by decentralized, redundant system structures.

For the analysis of these issues, a mixture of methods is used. Literature research is accompanied by commissioned expert reports in order to gain insight into current research and development projects or discussions in the research community. Moreover, the team carries out expert workshops in order to discuss different viewpoints and clarify open questions. The project will compile an in-depth overview of the state of development and use of satellite-based navigation, robotics, sensors, drones, and data-based business models, the potential opportunities and risks for agriculture, environment, and society as well as options for shaping the development at various levels of legislation, business, or research. (cb)

Using digital applications makes farmers potentially dependent on third parties such as software manufacturers.

VISIONS ON THE TEST BENCH
Assessing blockchain concepts and cryptocurrencies

Bitcoin and related currencies have brought the blockchain technology to a wider audience. Since mid-2017, the volatility of cryptocurrencies has pushed regulators from almost all countries to deal with the new situation that digital assets are available worldwide (and thus across borders) and cannot be directly attributed to a specific location. Besides cryptocurrencies, this also applies to "tokens", i.e., digital coupons, which allow anyone to participate in projects in the blockchain world.

In this field, often libertarian forces are at work, which rely on independence from the state's financial systems and hope for high degrees of freedom through means of payment and value carriers that are not controlled by central banks. As a result, the first countries (China, South Korea) are now massively regulating the cryptocurrency markets and are deliberately blocking Initial Coin Offerings (ICOs), a means of crowdfunding centered around cryptocurrency.

Less discussed in public are the structures of the blockchain technology itself, which aims to create trust and counterfeit security through decentralized, highly distributed data management. Many blockchain platforms provide "smart contract" mechanisms that automate, chain, and condition transactions within the blockchain.

In certain cases, it becomes possible to eliminate the middleman or trustee by digitally implementing their previous tasks within the blockchain. Financial services providers, notaries, and other intermediaries are alarmed as their legitimacy is questioned and they start looking for new digital business models based on blockchain technology.

In the current discussion, blockchain and cryptocurrencies go hand in hand with great promises and visions of the future that are rather driven by the wishes of the creators than by real facts. The concepts are sometimes ideological, they find their clientele and feed narratives which give rise to expectations that may need to be corrected.

Fortunately, there are direct approaches to studying blockchain concepts, as most blockchain projects have presented and published their ideas and business models in plain language in white papers. These are a concrete starting point for the assessment of socio-technical visions. Our current joint research aims to identify and demystify notions of technological futures and their associated ideological imprints and to distinguish ways of dealing wisely with the new digital opportunities.

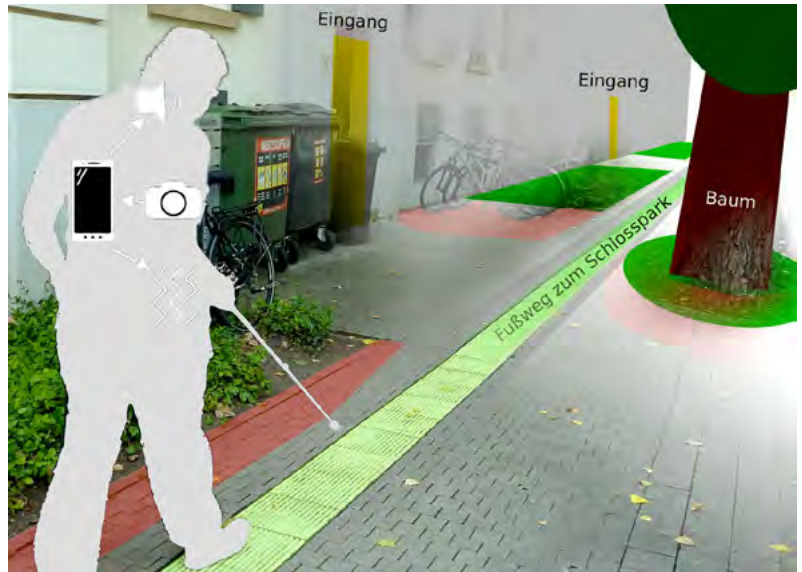
Essay by Karsten Wendland
The professor of media computer science at Aalen University was a visiting professor at ITAS in 2017/2018 and worked on cryptocurrencies, blockchain-based crowdfunding, and artificial consciousness.

FROM BIG DATA TO TECHNICAL ASSISTANCE
Developing a navigation system for blind and partially sighted people

Movable and immovable obstacles, landmarks, passable routes, places of interest, building entrances and passages, street crossings, crosswalks, traffic light pylons, parks, barriers, benches, signs, trees, and public transport stops – in the TERRAIN research project, real-time environmental information by image processing is combined with the huge amount of data from urban models and cadasters and the positioning of persons.

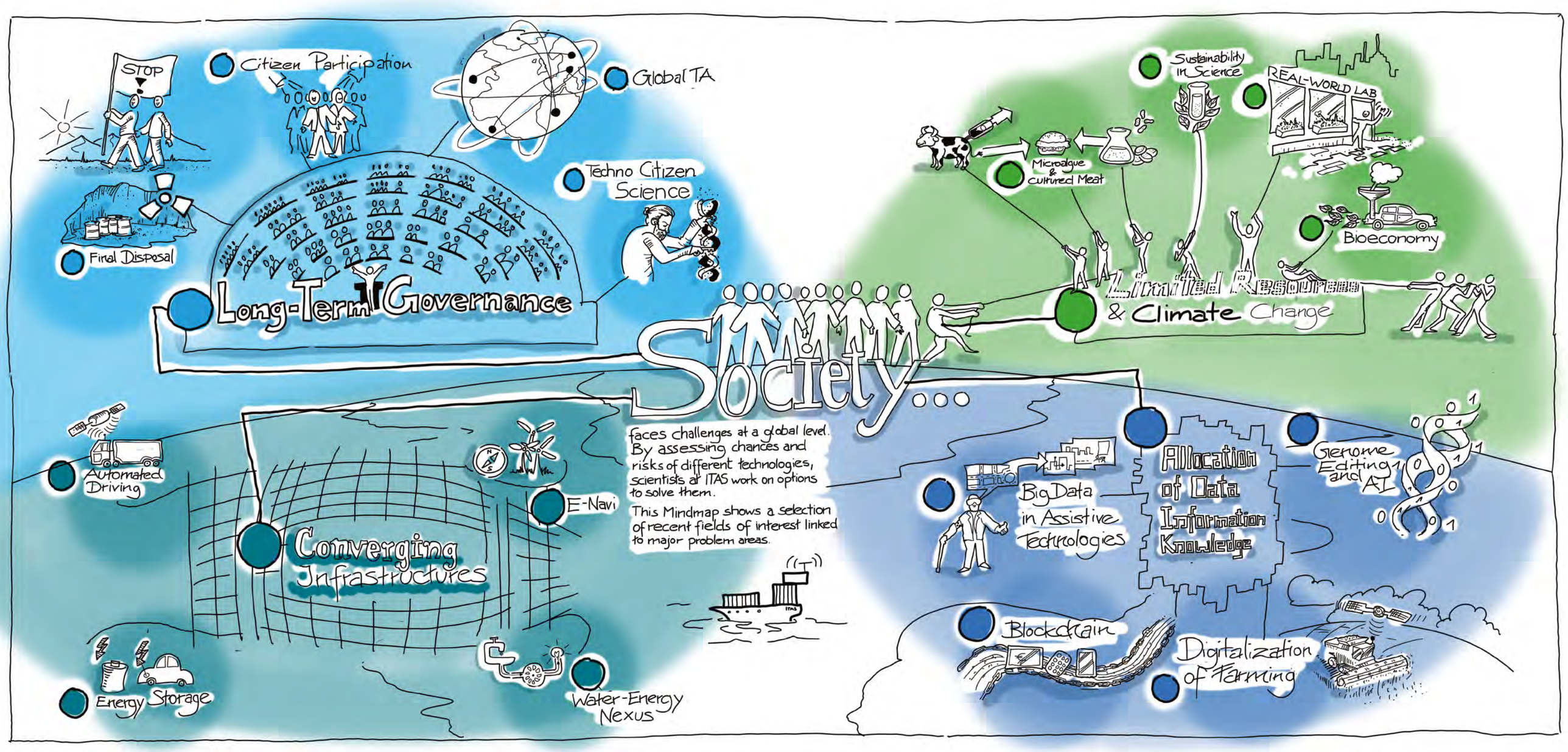
The aim of the project: developing an audio-tactile navigation system that enables blind and visually impaired people to move freely and autonomously in urban areas. A team at ITAS is in charge of accompanying the overall development of the technology, considering not only legal and economic, but also social and ethical aspects.

Up to now, blind and partially sighted people have to overcome two challenges in urban areas: They have to manage, on the one hand, the free movement through space and traffic (navigation), and, on the other hand, the knowledge of the spatial conditions and walkways (orientation). They face problems with the perception of obstacles and landmarks that are crucial to create a mental map as a picture of the surroundings and to determine one's own location. "This deficit often gives rise to the fear of accidents and collisions, often also of disorientation, resulting in a reduced area where people feel safe to move freely," Nora Weinberger, project leader at ITAS, describes the current situation. In the end, this could lead to social isolation – today around one third of the blind and visually impaired people leave the house only in sighted company.



This is where the technological system ties in by combining data-based navigation with camera-based image processing in order to create a cognitive image of the environment in real time. "In this way, big data will be used to allow blind and partially sighted people a participative access to society. In short, big data support assistance," resumes Nora Weinberger. But she also stresses the importance of actor-specific and societal framework conditions, since they can both inhibit and promote acceptance. Under certain circumstances, technical – but above all non-technical – factors could even lead to the complete rejection of the technology idea, resulting in a considerable forecast uncertainty regarding its success. To avoid this, the development-related technology assessment conducted by ITAS in the TERRAIN project takes into account these relevant factors and involves all those affected by the technology (for example, the target group itself and the public). At the same time, the assessment is not intended to hinder or inhibit the desired innovation. On the contrary, it should contribute to an "early warning" by raising sensitivities and recording essential perception parameters with regard to the technology. (cb)

» www.terrain-projekt.de


STOP
Citizen Participation
Global TA
Techno Citizen Science
Final Disposal
Long-Term Governance
Sustainability in Science
REAL-WORLD LAB
Microalgae & cultured Meat
Bioeconomy
Limited Resources & Climate Change
Society...
faces challenges at a global level. By assessing chances and risks of different technologies, scientists at ITAS work on options to solve them.
This Mindmap shows a selection of recent fields of interest linked to major problem areas.
Automated Driving
E-Navi
Converging Infrastructures
Energy Storage
Water-Energy Nexus
Big Data in Assistive Technologies
Allocation of Data Information Knowledge
Genome Editing and AI
Blockchain
Digitalization of Farming

Converging infrastructures – On our way to an all-encompassing service?

We rarely perceive them consciously and yet they surround us always and everywhere – infrastructures. They are hidden underground, working wirelessly, or are just taken for granted. Once built separately, different networks for energy, information, and mobility are becoming more and more interdependent. How these converging infrastructures affect society is a key question and the subject of very different research projects at ITAS.

CONVERGING INFRASTRUCTURES
On our way to an all-encompassing service?

Vast transport networks connect the places where we live, work, and spend our leisure time. Supply and disposal systems for electricity, heating, and water permeate the ground underneath our feet. Above our heads, information and telecommunication technologies exchange ever-rising amounts of data packets. In short: We are surrounded by and embedded in technical infrastructures. They do not have an end in themselves, but are the basis for the fulfillment of our diverse needs or requirements: We want to be mobile – physically as well as with our mind. We want to keep our homes warm in the winter and cool in the summer. And we want to have electricity and mobility – cheap, clean, and 24/7.

Just a few years ago, nobody would have expected goods ordered from a mail-order catalog to be delivered within a few hours. What is considered luxury today will be tomorrow's expected standard. Another example: higher transmission rates led to the possibility of streaming videos on the Internet, which paved the way for new business models such as streaming services. However, to make these commercially successful, a certain amount of customers was necessary, which in turn required the widespread availability of faster Internet connections. In this respect, the ever-increasing expansion of infrastructures and, in particular, their convergence are intended to meet the ever-increasing needs. Nevertheless, it remains to be seen to what extent consumers will be willing to restrict themselves if smart grid applications only allocate them certain time slots for using the dishwasher or recharging their car.

Challenge for society

The social implications of these developments are enormous. Even if it should turn out that, for society as a whole, the positive consequences outweigh the negative ones, this will not apply to everyone. Particularly in the case of such drastic socio-technical changes, the distribution of opportunities and risks must be analyzed in detail. For example, Internet-based networking increases the risk of sabotage and data misuse, as, e.g., simulated hacking attacks on local energy providers have shown. The provision and preservation of critical infrastructures have long been regarded as sovereign tasks of the state, which were partly fulfilled by quasi-monopolistic, state-owned companies. Today, the state gradually withdraws from these tasks and opens up spaces for private companies and competition. Examples are the expansion of the recharging infrastructure for e-mobility by car manufacturers and service station operators or the privatization of further parts of the road network in private-public partnerships.

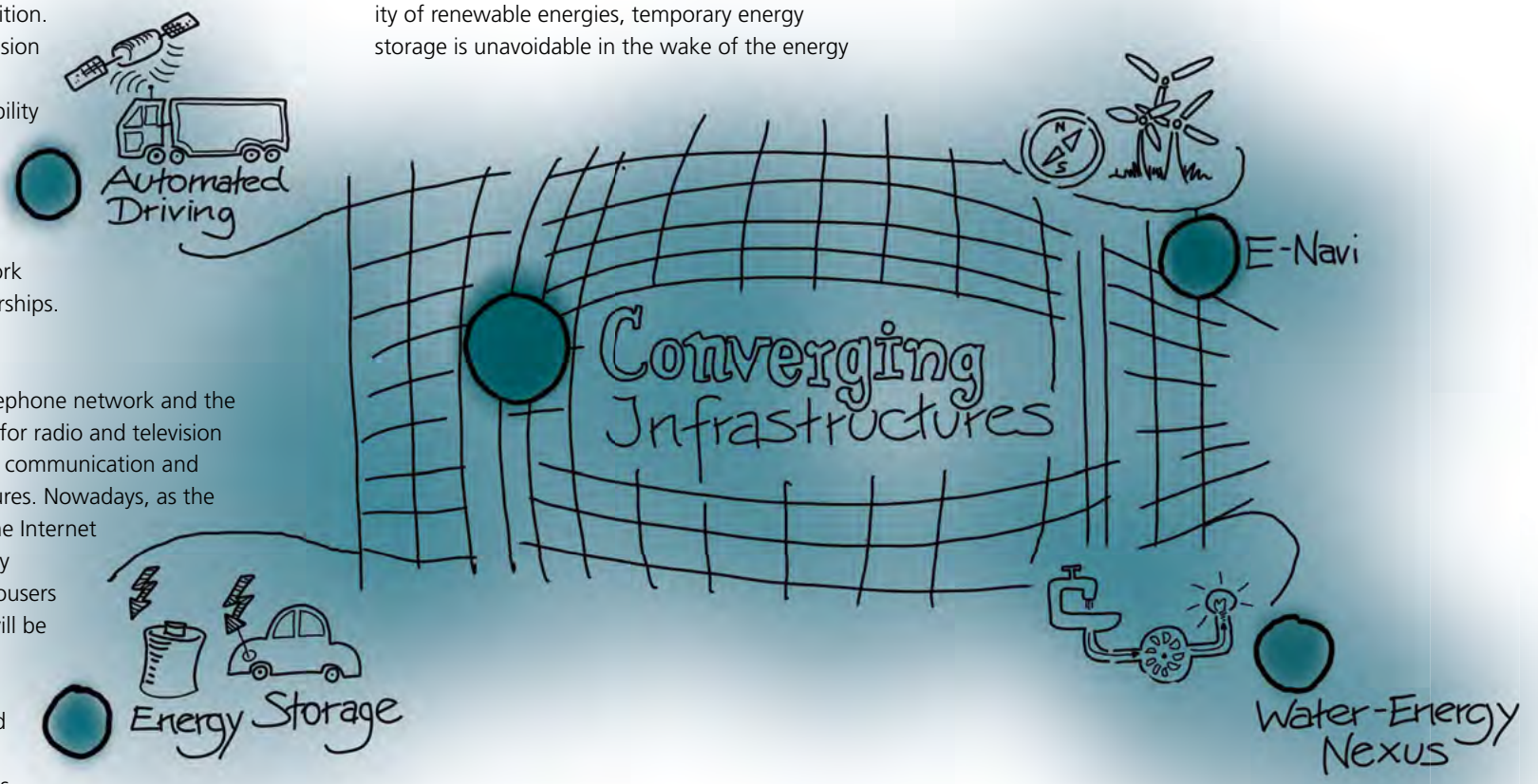
Research at ITAS

For a long time, the telephone network and the broadcasting networks for radio and television have been the essential communication and information infrastructures. Nowadays, as the gradual expansion of the Internet has reached nearly every household and every trousers pocket, the next step will be expanding the network further to include even the smallest devices and implement the idea of the Internet of Things.

However, this is only the starting point for integration: autonomous and automated vehicles will also depend on a highly connected communications infrastructure. The impacts of the automatization of mobility on urban infrastructures and the citizens' mobility behavior in the region of Karlsruhe are analyzed in the "Profilregion Mobilitätssysteme Karlsruhe". But even if vehicles will be connected to the communication network, one question remains: How can they be supplied with power? The answer gets even more complicated, if we assume that 100% of the traffic will be electrified in the future and we therefore have to expect a 25% increase in electricity consumption in Germany. Thus, the integration of the vehicles into the electricity infrastructure is inevitable. This also opens up new possibilities for using their batteries for the temporary storage of energy, too. Due to the fluctuating availability of renewable energies, temporary energy storage is unavoidable in the wake of the energy transition. However, the expansion of renewable energies is only one pillar of the energy transition, posing enormous challenges to society. These are analyzed in the ENavi project. Another pillar is the more efficient use of already existing energy sources. At ITAS, three dissertation projects on the water-energy nexus deal with the infrastructural prerequisites of efficient energy recovery from sewage.

It is significant that these developments can no longer be considered independently of each other. The infrastructures of information, mobility, electricity, and water are becoming more and more interconnected. The age of converging infrastructures has just begun ...

By Daniel Frank



ON COPERNICUS'S TRACKS
Navigating through the energy transition

The transition to renewable energies is an enormous challenge for the entire society. To master this, the ENavi project aims to develop a tool for navigating through the adversities. Dirk Scheer, project head of the ITAS part of ENavi, tells us what the project is about, the contribution of TA, and a worldwide view.

Can you tell us something about the overall goal of ENavi?

Our common aim is to support robust and prudent political decisions for the German energy transition. Therefore, we need to gain a better and deeper understanding of the interlinkages of what we call the "system of systems". The energy sector is linked to various corresponding areas such as industry, transport, or consumption. We want to demonstrate options for action and show how the different components of the future energy system can be systemically integrated.

Therefore, we try to assess as precisely as possible what impacts certain measures would have on the system of systems in the short, medium, and long term. And we aim to carry out a transdisciplinary discourse with stakeholders in order to balance pros and cons related to these measures and to find out ways and impacts of their realization.

This means you are developing a kind of navigation tool for the energy transition. How exactly does such a device look like?

Pushing the German energy transition is first and foremost based on political decisions. For example, without the Renewable Energies Act, the energy transition would not have taken off. No decision – no transition! This is the navigation tool's starting point: we gather and elaborate promising political measures and combine them into coherent policy packages. Next, an interdisciplinary impact assessment is done to analyze, among others, economic, environmental, social, or legal impacts. Using a multi-criteria sustainability approach, single results are then synthesized as an input for stakeholder discourse on pros and cons of the package. From that end, decision makers dispose of evidence- and value-based checked knowledge supporting forthcoming decisions.

"Robust and prudent political decisions" are necessary to make the German energy transition a success.

What does ITAS contribute to the project? What can TA do here?

We at ITAS are involved in several crucial ENavi tasks. We advance the fundamental design of the navigation tool within the working package "Roadsmap & Navigation". Interdisciplinary impact assessment is done both for rare earth elements relevant for high-performance car batteries and for behavioral transformation issues in the mobility sector. The latter investigates the transformative potentials of multi- and intermodal mobility concepts. Finally, colleagues are heavily involved in the multi-criteria assessment research necessary for policy package evaluation.

What does it mean for the TA work when infrastructures become increasingly intertwined?

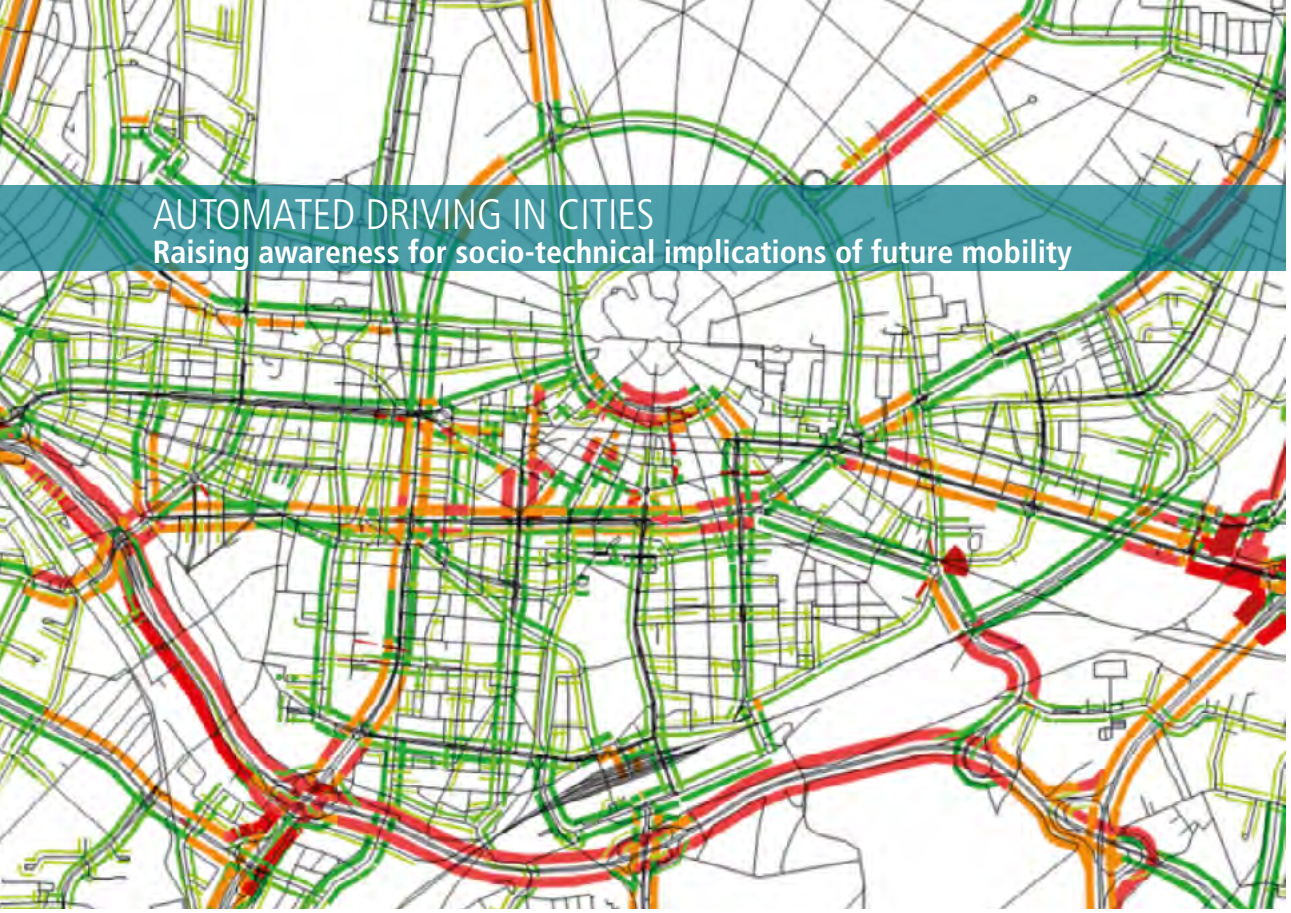
It simply means that TA becomes more interesting and more challenging at the same time. The energy system is a prime example for infrastructure coupling and integration. The power, heat, and mobility sectors seem to merge into an "all electricity world" based on renewables, which is one promising road toward climate friendliness. Smartness through digitalization adds a further infrastructure in all three sectors. Think of smart grid, heating, and mobility apps, or the power storage flexibility option in car batteries. Digitization cannot do without information – another infrastructure layer. All these issues are backed by social infrastructures in the energy system like institutions, agencies, regulators, etc. TA then meets the challenge to accurately analyze and provide robust impact knowledge of a fast changing and more complex object of investigation.

Is the project limited to Germany or could the results also help other countries to follow a similar path?

At first glance, it is indeed a project focused on Germany. At the second glance, however, transforming the energy system is a worldwide phenomenon. The transition of the energy system has become a key political issue in many countries. In essence, ENavi is about elaborating a long-term governance tool. It systematically synthesizes the state of scientific knowledge, identifies promising research areas, and provides decision makers with knowledge on highly probable impacts of technologies. In that sense, the approach is "without borders" and may support other countries on their unique pathways toward their energy future.

The Kopernikus initiative, launched by the Federal Ministry of Education and Research (BMBF), is the largest research initiative in the field of energy transition in Germany. 260 institutions from science, business, and civil society are working together in four subprojects for a successful technological and societal transformation of the energy system. ITAS is involved in all four subprojects, of which ENavi is one.

» www.kopernikus-projekte.de



AUTOMATED DRIVING IN CITIES

Raising awareness for socio-technical implications of future mobility

Recently, automated driving has received increased attention in the scientific as well as in the wider public debate. Developers are sketching bright futures where fully autonomous cars provide cheap, accessible, and safe transport options for everyone. However, this debate is currently dominated by a technical view on automated vehicles and the respective engineering challenges and some ethical reflections about choice making in real-world driving situations.

Scientists at ITAS look at future driving from an integrated socio-technical perspective. Together with their partners from the Institute for Transport Studies and the Institute of Economics at KIT they investigate the interrelations between potential automated driving scenarios and urban infrastructures as well as mobility behavior. The project is part of the research activities in the "Profilregion Mobilitätssysteme Karlsruhe" – a regional research cluster around mobility systems. "We focus on analyzing automated vehicles' interaction with other road users, and we are also interested in potential or missing benefits for different user groups such as commuters or elderly people," outlines Max Reichenbach from the project team. These questions are not only relevant in the case of fully autonomous driving (so-called "robo taxis"), but also in partial automation scenarios where vehicles become capable of operating autonomously within a given range in certain operational situations, for example, only on motorways, only at slow speeds, or only for automated parking.

The scientists emphasize that respective use cases in the real world depend on infrastructural prerequisites of one or another sort, implying a partial convergence of technological domains. In order to fully tap their potentials, certain vehicle automation technologies may require the communication not only with other automated vehicles but also with road infrastructure elements like traffic lights or traffic management centers. "If we look at automated parking," says Max Reichenbach, "city districts could be relieved from on-road parking, but at the same time would require management approaches in central parking facilities. This could also extend to coordinating electric vehicles' demand for electricity."

However, ITAS scientists are convinced that the application of autonomous driving technologies may in turn also lead to more and different phenomena of convergence. The potential "lean-back times" in an automated vehicle may be filled by using services based on information and communication technology, turning the vehicle into a multi-purpose interaction instrument with the Internet and other media. Again, the extent of these potentials is closely linked to the detailed technical specifications and the applicability of the vehicles' automation capabilities.

To illustrate the range of open questions, the project team considers different real-life situations, for example, one of a person living in a small town 20 km outside the city of Karlsruhe. For him or her, the route choice – whether made by him- or herself or by an app integrated into the vehicle – may crucially depend on where the vehicle can actually operate autonomously: only on motorways, also on other grade-separated roads, also on roads with at-grade intersections, or only at low speeds serving automated parking purposes. "In terms of lean-back times, these specifications determine whether the user gains some rather useless seconds or if he or she may utilize the whole journey time for other activities," explains Max Reichenbach. Furthermore, the different scenarios' implications must consider different socio-demographic groups. There are important differences whether we are talking about a commuter travelling to his workplace, a disabled person with currently limited access to transport options, people escorting children to leisure activities, or other user groups.

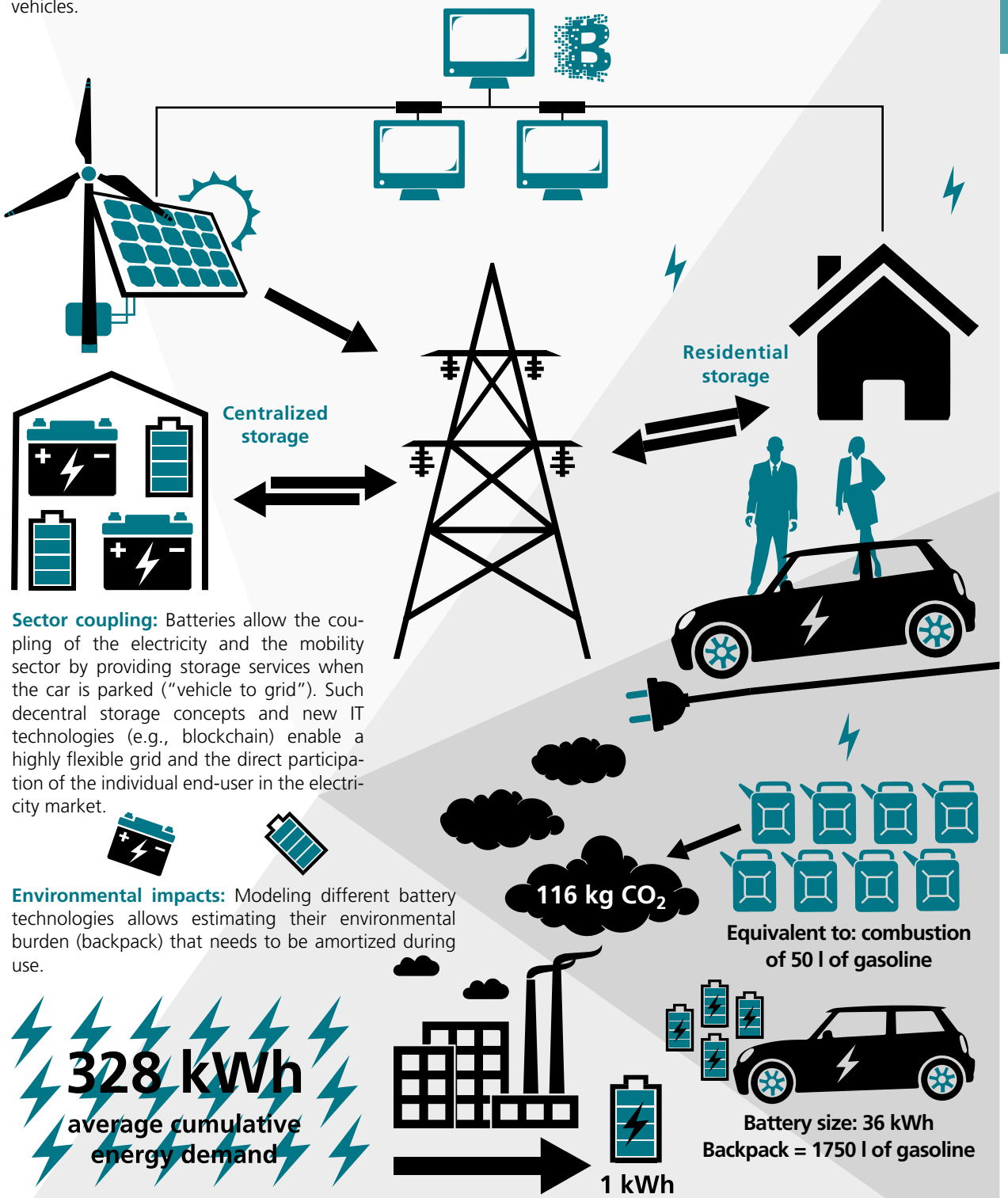
With their work in the "Profilregion Mobilitätssysteme Karlsruhe", ITAS and its partners try to raise awareness for the implications and challenges of different use cases of an automated driving technology. "Automated driving promises certain societal benefits, but at the same time, its wide-scale application will come with new challenges and problems," warns Max Reichenbach. Rebound effects could occur when autonomous vehicles make the use of cars more attractive (with people switching from more environmentally friendly transport modes like walking, cycling, and public transport), up to the point of having more congestion instead of less. Other challenges include conflicts in the actual interaction with cyclists and pedestrians (and conventional car drivers) in the streets, or a potential pressure on authorities and cities to adapt physical infrastructures. (df)

How can different user groups benefit from automated driving? ITAS researchers take a closer look at real-life situations.

» www.profilregion-ka.de

THE FUTURE OF ENERGY STORAGE

Energy storage is increasingly important for a successful energy transition. As wind and sun are highly fluctuating, the demand for grid-buffering services rises. Established technologies (such as pumped hydro storage) compete with new developments (such as hydrogen or advanced batteries). Especially batteries are suitable for decentralized systems and vehicles.



Sector coupling: Batteries allow the coupling of the electricity and the mobility sector by providing storage services when the car is parked ("vehicle to grid"). Such decentral storage concepts and new IT technologies (e.g., blockchain) enable a highly flexible grid and the direct participation of the individual end-user in the electricity market.

Environmental impacts: Modeling different battery technologies allows estimating their environmental burden (backpack) that needs to be amortized during use.

Further information on sustainability aspects of different energy storage technologies can be found in the published work of the SYSTEEM group at ITAS (**www.researchgate.net/lab/Marcel-Weil-Lab**)

Dedicated to research into new water infrastructure for growing urban agglomerations: Jasmin Friedrich, Franka Steiner and Dámare Araya (from left to right).

THE WATER-ENERGY NEXUS

PhD researchers work on crucial relations for urban sustainability

In contrast to the transformation of energy systems and closed loop systems in the solid waste sector, urban water supply and wastewater discharge still follow old traditions: cities import fresh water from their hinterlands and flush the sewage to areas located downstream. At the same time, evermore energy-demanding treatment steps are necessary for the conditioning of water. Three PhD projects at ITAS investigate the potential contributions of new water infrastructure systems to a more resource-efficient and livable urban environment. They are situated in different urban contexts in Germany and Chile in order to cope with different challenges related to the water-energy nexus (WEN).

Jasmin Friedrich focuses on the German urban building stock, which is often a priori excluded from transition strategies, being considered as "too complicated" or "too expensive". However, transforming the building stock could contribute to a noteworthy decline in resource demands and environmental impacts. Therefore, she creates a holistic sustainability assessment of different transformations of the water-energy infrastructure for an existing German urban neighborhood. This helps to identify specific challenges of the urban WEN and supports municipal decision makers in their city planning.

Franka Steiner works on newly built areas in Chile where rapid urbanization takes place. Despite the relatively uncontroversial potential of new water and sanitation systems for higher resource efficiency, more knowledge is needed on whether those systems can contribute to a more sustainable urban environment as a whole. She develops a comprehensive method to assess the sustainability performance and already existing sustainability indicators for the regional context in close communication with experts from local and regional authorities in southern-central Chile. Furthermore, the feasibility of different water systems is jointly assessed.

Dámare Araya from Arica, one of the most arid cities in Chile, concentrates on the development of a decision-support method to assess the impacts and adaptability of different technological options for water re-use and desalination in arid areas. With a growing population, overuse of water resources, and changing precipitation patterns due to climate change, arid areas urgently require new options for water supply. This work shall support the implementation of new technologies through the assessment of their performance in context-specific scenarios.

In Germany, the ITAS WEN group takes advantage of the dynamics of the energy transition in order to expand the idea to other pivotal resources like water and food. In developing and threshold countries, their work could contribute to leapfrogging the traditional infrastructures for water and wastewater in growing urban agglomerations. (df)

Pedaling to work
Motivated by ITAS's move to Karlsruhe city center in 2012, our colleague Reinhard Heil, philosopher with a focus on big data and and new and emerging sciences and technologies, evolved from a pedestrian to a cyclist. By summer 2017 – around five years later –, he had done a good 40,000 km, virtually a circumnavigation of the globe. To overcome this distance, it took 1 bicycle, 11 sprockets, 11 chains, 11 brake pad sets, 4 chainring sets, 4 tires, 3 lamps, 2 wheels, 1 crankset, 1 bottom bracket, and 1 accident as well as many calories.

Indo-German forest bioeconomy research
In summer 2018, Prem Prakash Singh (left) from North-Eastern Hill University (NEHU) in Shilong (India), came to ITAS as visiting scientist. Together with Somidh Saha (right), ITAS-based expert in the field of forest restoration and adaptation to global change, he worked on the restoration of degraded oak forests in the Himalayas. Singh´s stay, supported by the International Union of Forest Research Organizations, Vienna (Austria) and the European Forest Institute, Joensuu (Finland), marks the beginning of a cooperation between ITAS and NEHU in forest bioeconomy research.

Grunwald in ethics committee on automated driving
What should automated vehicles do if they are involved in an accident? To answer ethical questions of autonomous mobility, the Federal Ministry of Transport set up a committee. Armin Grunwald, head of ITAS, contributed his expertise in technology assessment and ethics of risk in the 14-member body. One of the key points of the final report published in June 2017: Automated and networked driving is ethical if the outcome of the risk assessment is positive, meaning that the systems cause fewer accidents than human drivers.

Successful PhD candidates
In his PhD thesis at the Institute of Philosophy at TU Darmstadt, Dirk Hommrich (left) analyzes the contemporary mise-en-scène of brain research in the media. A jury honored his dissertation as the best PhD thesis of the faculty in 2017 at a festive event in May 2018 in Darmstadt. Our congratulations also go to the other successful PhD students of ITAS since 2017: Carmen Priefer and Manuel Baumann (right), as well as Silke Feifel, Daniel Frank, Adeel Malik, Michael Poznic, Martin Sand, Christoph Schneider, Patrick Sumpf, and Saskia Ziemann.

Green Talents visit Future Room
How can we, together with the inhabitants of an entire city district, create a new quality of life characterized by sustainability and deceleration? In October 2017, 25 young scientists from 18 countries visited Karlsruhe's Future Room, the spatial and communicative "heart" of ITAS´ real-world lab, eager to learn more about the transdisciplinary work happening there. The Federal Ministry of Education and Research annually invites the so-called "Green Talents", high potentials in sustainable development from all over the world, to Germany.

Baden-Württemberg aims high
Can aerial ropeways help solve urban traffic problems? More and more cities in Baden-Württemberg consider them as an option for public transport. In the future, planning will be supported by a guideline with recommendations on the potentials and difficulties of this transport technology. Researchers from ITAS and the Institute for Transport Studies of the KIT developed the guide over two years and presented it at the Stuttgart City Hall in July 2018.

Parliamentary advice
The European Parliament will continue to rely on the European Technology Assessment Group (ETAG) coordinated by ITAS. The network of eight European TA institutions was launched in 2005, taking into account the growing importance of a joint European science and technology policy. ETAG's new activities on behalf of the European Parliament focus on studies in the fields of eco-efficient transport, modern energy solutions, and sustainable management of natural resources. Potentials and challenges of the information society, health and new technologies in the life sciences, science policy, communication, and global networking are further research subjects.

Long-term governance – How to democratize technical decisions for our future

Technological innovations set the course for the development of modern societies. How can people be subjects rather than objects of this development? How can they contribute their knowledge and share their concerns in scientific and innovation processes with long-term consequences? Decision makers in Germany, Europe, and abroad become more and more aware of the need to involve citizens. ITAS researchers want to provide them with the necessary tools by thinking outside the box and experimenting with new participation methods.

LONG-TERM GOVERNANCE
How to democratize technical decisions for our future

We do not know what the world will look like in 100 years. But we can observe technological developments, social conditions, and political trends and depict possible futures with the help of experiences we have gathered in the past. The pictures of the future often show that the expected consequences of technologies must be regulated here and now. But can we also regulate our society in a way that unanticipated consequences develop as socially and environmentally friendly as possible? Here, classic planning and regulation mechanisms reach their limit.

Challenges for society

The Internet, big data, and extremely fast transmission of huge amounts of data accelerate the delimitation: For the first time in history, humanity around the world can exchange in real time. This "globalization" touches very diverse areas of life: Food must be distributed so that no one starves in this boundless world. Also the boundaries between human and machine become blurred. Although the human brain is much slower than a computer, it does things that the computer cannot (yet) do: generate empathy for others and express emotions. Whether computers can be conscious is an open question. So far, it has not even been clarified what exactly is meant by "consciousness".

Making predictions about the future is high science if the predictions are not taken from the crystal ball but are based on knowledge, including knowledge about the reliability of the prediction. These predictions find their way into regulatory processes that are ideally negotiated so that they remain socially manageable. The example of the Commission on the Storage of High-Level Radioactive Waste in Germany shows that, besides being problem-oriented, the negotiation process must be transparent, public, and participatory. Guided by the concept of risk minimization and the precautionary principle, the Commission has developed rules, criteria, and requirements that a potential disposal site must meet.

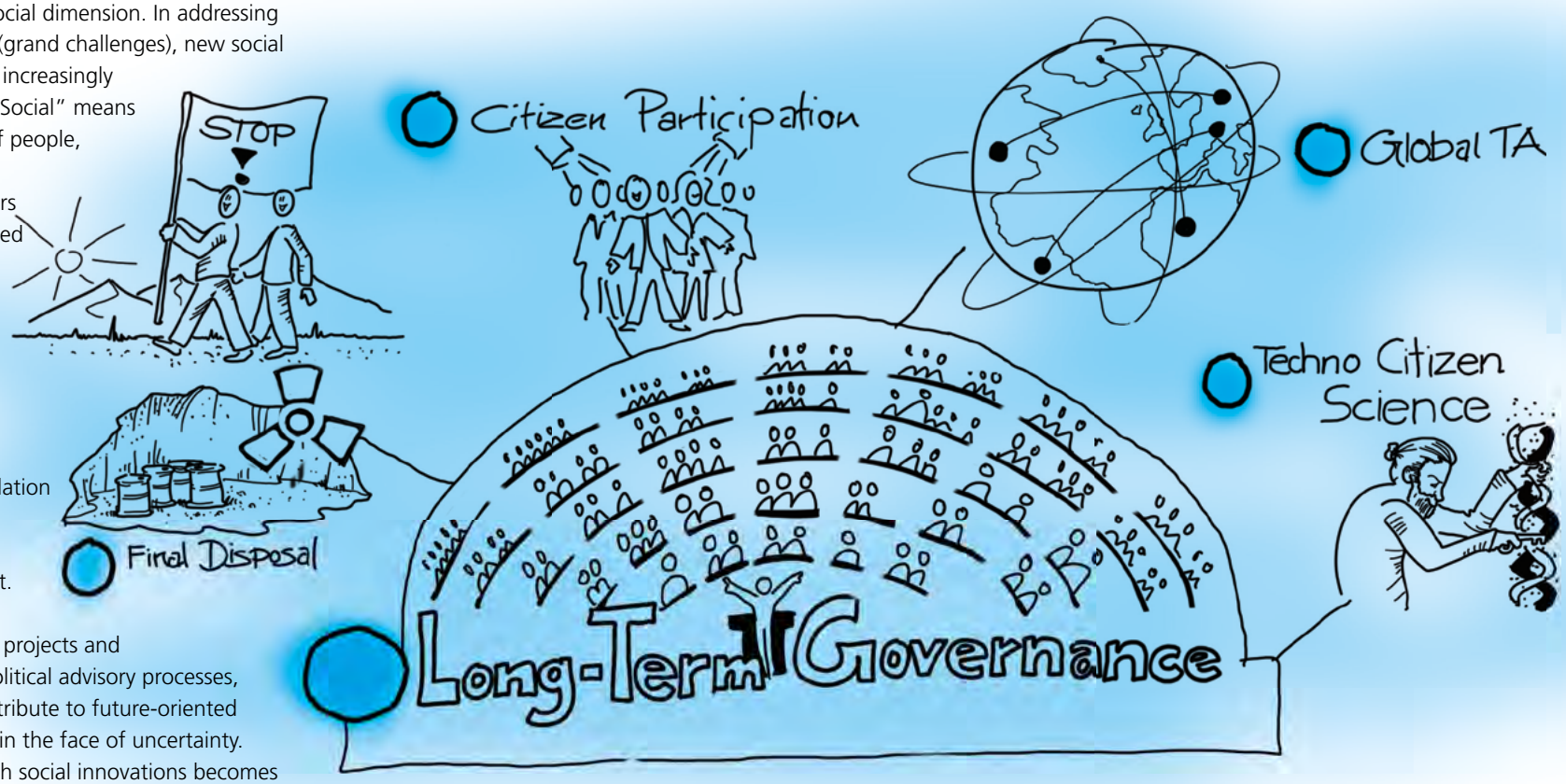
Research at ITAS

The energy transition, new traffic concepts and urban developments, and human-machine interfaces are examples of ITAS research topics representing the social struggle for the "best" solution. Such best solutions do not only include technical or organizational structures but must also take account of the social dimension. In addressing global problems (grand challenges), new social practices play an increasingly important role. "Social" means the interaction of people, of social groups, of decision makers with those affected (stakeholders). Here, too, boundaries become blurred: technical innovations can no longer be considered in isolation but are extended to include the social component.

With its research projects and experiences in political advisory processes, ITAS aims to contribute to future-oriented decision making in the face of uncertainty. Since dealing with social innovations becomes increasingly important as a social theory and political concept, ITAS continuously develops and evaluates new forms of cooperation and communication.

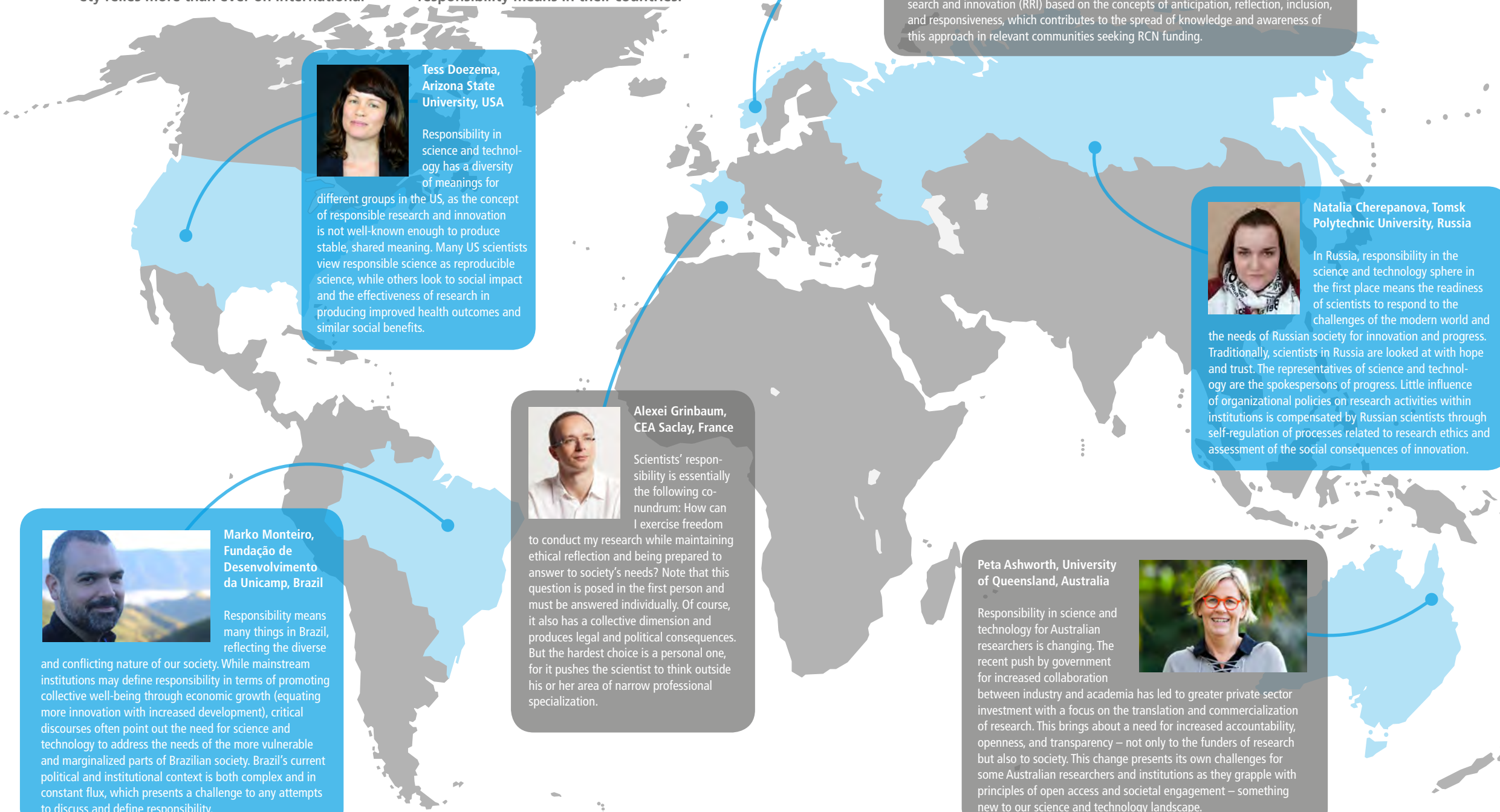
The reflections on the "global TA" concept provide an understanding of how to deal with the blurring of spatial boundaries. The common understanding of responsibility and the underlying social values driving technological innovation are seen as starting points. The blurring of boundaries also affects the interaction between science and policy: What should policy advice to parliament look like in the face of global socio-technical effects? Participatory methods are diverse and methodically challenging. An innovative approach is to invite randomly selected citizens to participate as equal members in the National Support Body, which was established by the German parliament in order to search for a final disposal site for nuclear waste. This project is used to reflect on what participation can contribute to dealing with unlimited responsibilities. Finally, in an interview the question is pursued: Why must the search for solutions to the storage of (ever-radiant) nuclear waste also be understood as a social experiment?

By Constanze Scherz



RESPONSIBLE INNOVATION AND GLOBAL TA
The RRI Practice Project

In times of grand challenges, acting cannot be limited to a national level. Responsible research aiming at positive effects on society relies more than ever on international networks and reflection. In the EU-funded RRI Practice project, ITAS connects partners from around the world. We asked them what responsibility means in their countries.



Tess Doezema, Arizona State University, USA

Responsibility in science and technology has a diversity of meanings for different groups in the US, as the concept of responsible research and innovation is not well-known enough to produce stable, shared meaning. Many US scientists view responsible science as reproducible science, while others look to social impact and the effectiveness of research in producing improved health outcomes and similar social benefits.

Ellen-Marie Forsberg, Oslo and Akershus University College of Applied Sciences, Norway

Responsibility in science and technology is highlighted as important by all stakeholders in the Norwegian research and innovation system, but stakeholders differ in how they conceptualize this. Some emphasize the importance of research integrity and research ethics more generally, some highlight sustainability and democratic values, and some speak of organizational social responsibility. The different stances on responsibility seem to reflect the mission and context of the different actors. The Research Council of Norway (RCN) has developed a framework for responsible research and innovation (RRI) based on the concepts of anticipation, reflection, inclusion, and responsiveness, which contributes to the spread of knowledge and awareness of this approach in relevant communities seeking RCN funding.

Natalia Cherepanova, Tomsk Polytechnic University, Russia

In Russia, responsibility in the science and technology sphere in the first place means the readiness of scientists to respond to the challenges of the modern world and the needs of Russian society for innovation and progress. Traditionally, scientists in Russia are looked at with hope and trust. The representatives of science and technology are the spokespersons of progress. Little influence of organizational policies on research activities within institutions is compensated by Russian scientists through self-regulation of processes related to research ethics and assessment of the social consequences of innovation.

Marko Monteiro, Fundação de Desenvolvimento da Unicamp, Brazil

Responsibility means many things in Brazil, reflecting the diverse and conflicting nature of our society. While mainstream institutions may define responsibility in terms of promoting collective well-being through economic growth (equating more innovation with increased development), critical discourses often point out the need for science and technology to address the needs of the more vulnerable and marginalized parts of Brazilian society. Brazil's current political and institutional context is both complex and in constant flux, which presents a challenge to any attempts to discuss and define responsibility.

Alexei Grinbaum, CEA Saclay, France

Scientists' responsibility is essentially the following conundrum: How can I exercise freedom to conduct my research while maintaining ethical reflection and being prepared to answer to society's needs? Note that this question is posed in the first person and must be answered individually. Of course, it also has a collective dimension and produces legal and political consequences. But the hardest choice is a personal one, for it pushes the scientist to think outside his or her area of narrow professional specialization.

Peta Ashworth, University of Queensland, Australia

Responsibility in science and technology for Australian researchers is changing. The recent push by government for increased collaboration between industry and academia has led to greater private sector investment with a focus on the translation and commercialization of research. This brings about a need for increased accountability, openness, and transparency – not only to the funders of research but also to society. This change presents its own challenges for some Australian researchers and institutions as they grapple with principles of open access and societal engagement – something new to our science and technology landscape.

"WE HAVE TO LEARN TRANSPARENCY"

Interview on citizen participation and the disposal of nuclear waste

ITAS researchers Sophie Kuppler and Peter Hocke focus on tensions and conflicts between science, the public, and authorities in the case of final disposal of nuclear waste. Here they talk about lessons learned from the past and challenges on the way forward.

Why is it important to involve the public in decisions about a nuclear waste repository?
Kuppler: Because the subject cannot be approached from the technical side only. A repository will always affect people living on the spot and afraid of being exposed to a risk they cannot influence themselves. Also the social consequences of a repository must be taken into account.

How far should public participation be extended?
Hocke: Citizens are always involved in decision-making in two modes of operation: either as voters who delegate or by directly influencing pending decisions in more or less complex processes. As a member of an automobile club, for instance, you bring pressure to bear on the management to ensure good driving conditions. With regard to many problems, this works without major upheavals. However, when it comes to repositories, conflicts are more deep-seated. In this case, affected citizens get in touch immediately, directly demanding their right to participate. The political system is compelled to take this seriously.

Have there been political mistakes in the past?
Hocke: Politics surely did not act in a way which made the public feel involved. The "Zeitgeist" always plays a role, even among political elites. I would phrase the question like this: If you do not learn from the past, how will you be able to act properly today?

Are there lessons learned – by whomever?
Kuppler: It is important not to look at one side only. Especially in other countries, such as Switzerland, where the selection process is much more advanced, we can see that these are intense learning processes for all involved. Citizens must learn public participation just as the administration has to.

So, public participation is also a social experiment?
Hocke: Well, at least it is continuous reinvention. There are no general rules of good participation. If you think of the most recent past and major technical conflicts, whether about airports or railway stations, you never know in advance what the adequate format will be. There are always institutions and stakeholder groups that want to put more emphasis on this or that or some other aspect. These negotiation processes require lots of resources.

What are the conclusions drawn by science?
Kuppler: To me, a central aspect is that participation in case of the repository problem means that authorities have to deal with public attention for decades. One major challenge in organizing long-term citizen involvement is to learn transparency. If citizens have access to 500 pages of technical reports, the party making these reports available can of course say, "I am transparent," but this does not enable those citizens to deal with these reports. If you want to have a high-level accompanying process that involves citizens, you must offer space for contradiction and conflict resolution.
Hocke: … and space for serious consultation. You never know in advance whether local knowledge will generate new things, which necessitate new research. The current buzzword is indeterminacy of modern procedures. However, this is often hard to tolerate.

Can we learn from other countries here?
Hocke: States with nuclear facilities have opened up at different speeds. In Germany, the idea for many decades was: high-safety facilities can only be handled by experts. With respect to participation, we have been a developing country for a long time. Switzerland or Sweden changed their decision-making culture much earlier. As a consequence of this lag, the conflict in Germany has become extremely political. This still has effects to this day.

In 2014, the German Federal Government dared a restart with its National Repository Commission. Will this be able to stop politicization?
Kuppler: Some of the old conflicts, such as different expectations regarding public participation or the historic refusal of some German federal states to support an open-ended site selection procedure, have so far not been taken up in the new process. How the new generation is going to handle it remains open. Much will depend on the specific design of the new procedure.
Hocke: Handling this aspect satisfactorily also means recognizing that it was not just an emotional conflict, but that there were questions behind many positions held which are not trivial. How safe is safe enough? What burdens must a region be able to sustain?

What can technology assessment contribute to a solution?
Kuppler: We cannot solve the problems, but we can help handling them. In doing so, we particularly draw attention to the link between technical and social matters. Research on this link needs to continue in the future.
Hocke: In addition, we can provide policy advice. Technology assessment is not about having superior knowledge but about presenting things to a stakeholder to make decisions. Repositories require thinking over long periods of time. Future generations will ask: Do you have a plan for these problems? All decisions taken now must also involve the next generations.

Demanding their right to participate: Anti-nuclear protesters near the Gorleben Nuclear Waste Repository in 2010.

HOW ABOUT A BIT MORE CITIZEN?

The "randomly selected citizen" in controversial decision-making processes

Focus groups, round tables, consensus or citizens' conferences: Today, participative processes have become established ways to involve citizens in decision-making processes with a high potential for conflict. Hardly anyone doubts the necessity of including people in decisions about issues of central importance for the future. However, this does not always lead to the desired outcome.

When it comes to the disposal of high-level wastes in Germany, the participative methods used so far reach their limits. There are few things in Germany that are more difficult than the search for a nuclear repository (see interview on pages 52/53). Based on the Repository Commission's recommendations, the German parliament decided in 2017 to start the repository site selection procedure again from scratch with a "blank map" in order to rebuild the lost trust bit by bit. The question is: How can this work out?

As a central new body in this process, the German parliament established the National Support Body (NBG) in 2016. The main task of its nine members

Engaged as randomly selected citizens: Hendrik Lambrecht ...

(doubled to 18 by the end of 2018) is to critically support the search for a final repository site. As "a public-interest institution independent of authorities, parliament, directly involved companies, and expert institutions," the NBG shall create transparency and win back lost trust.

... and Jorina Suckow.

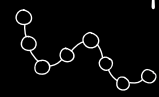
At the suggestion of the Repository Commission, a highly innovative approach was taken to choose the members of the body: One third of the members appointed by the German Bundestag and Bundesrat (federal parliament and federal council) are randomly selected citizens, so-called "Zufallsbürger". Using phone directories, these citizens were first contacted and asked for their willingness to take part. The resulting group, the so-called participation network, then selected three members. From the very beginning, these three persons were highly committed to their work in the NBG, in particular regarding public participation and building trust. Due to these special circumstances, they are often in the center of media attention. It is obvious that this innovation very much enriches the work of the NBG and strongly supports the completion of its mission.

The involvement of randomly selected citizens is a new participative format. It is an example of creative new approaches to adapting citizen participation procedures to the significance of pending decisions and special circumstances. In this sense, the method chosen for solving the repository problem is also a motivation and incentive for technology assessment to use innovative and custom-fit participation approaches more often.

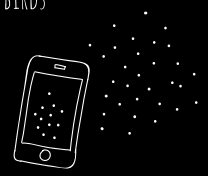
Essay by Armin Grunwald
The head of ITAS was member of the Repository Commission and has been appointed expert of the National Support Body for the repository site selection procedure. **» www.nationales-begleitgremium.de**

TechnoCitizenScience

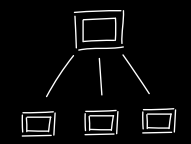
Counting birds



Folding proteins



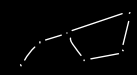
Measuring particulate matter with the smartphone



Providing computing power

What is citizen science?

In citizen science, citizens become part of the scientific process. Different forms of participation are possible: for example, citizens can assist scientists in their research (invited citizen science) or become scientifically active outside established research institutions on their own initiative (self-organized citizen science).

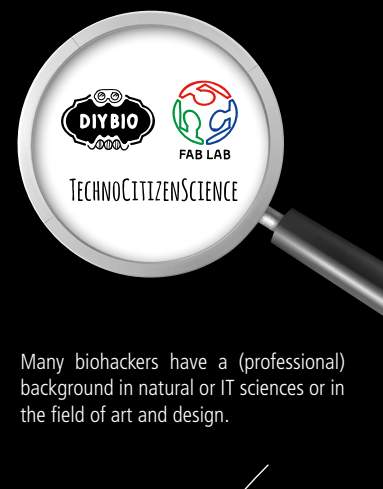


Astronomy

Collecting soil samples

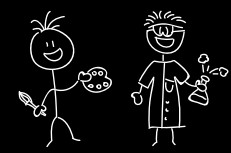
Origin and idea of TechnoCitizenScience?

The terms "maker" and "DIYbio" were first used around 2005. Both movements see themselves in the tradition of computer hackers. Accordingly, not only the do-it-yourself character is important for both makers and DIY biologists, but the open source idea plays a crucial role as well. Also (international) networking and the general openness for all who want to join are of central importance. Both movements are united by the objective to democratize science.



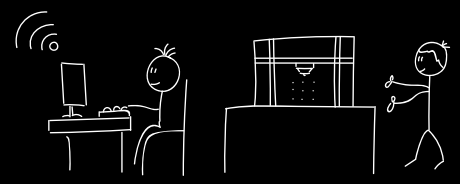
Who are the makers and DIY biologists?

Makers are often technophilic students, professionals, and hobbyists.



Many biohackers have a (professional) background in natural or IT sciences or in the field of art and design.

What and where do they research?



In makerspaces or fab labs, makers work on digital manufacturing technologies and their technical infrastructure, partly profit-oriented, partly serving the public good (e.g., 3D printing). Most of the projects are highly digitally connected and some of them even span the globe.

DIY biologists are, e.g., interested in genetic engineering, bioinformatics, synthetic biology, and "bioart". They also produce some of the hardware and laboratory equipment themselves. They work digitally (and globally) connected: at the kitchen table, in the garage, in open labs, or affiliated to makerspaces or fab labs.

Relation to established sciences?

Close: many makers have a direct connection to the scientific system, e.g., labs at universities.

Ambivalent: DIY biologists often have an academic background, but for many of them the independence from established research is also important.

This infographic is based on the results of qualitative social research in the field of the maker and DIYbio movement in the TechnoCitizenScience project. More information can be found at: **www.itas.kit.edu/english/projects_seit15_tcs**

CONTESTED TECHNOLOGIES
Researchers open the doors for public dialogue

Technology assessment is dedicated to analyzing interactions between society and technology. "Talking to people" beyond the usual experts is therefore essential in this field and gives TA experts insights into citizens' fears, hopes, and expectations of (new) technologies. In 2014, a group of young ITAS scientists embarked on a mission to bring these interactions to their own doorstep, going beyond public lectures, expert workshops, or online platforms.

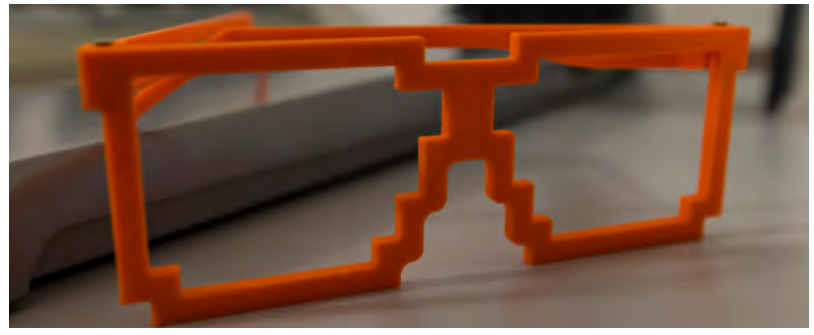
This gave birth to "technik.kontrovers", an event series where ITAS researchers open up the institute to the interested public with the aim to present current findings and issues as well as the controversial (public) discussions surrounding them.

"The unique aspect is that technik.kontrovers is not about presenting approved findings on topics such as robotics, digitalization, the future of work, or the mobility system," as the multi-headed event team likes to point out. "Rather, it is about questions without final answers – e.g., to what degree should robots be involved in elderly care, and how can privacy be guaranteed in light of big data and AI applications? What role do people play in a highly automated world of smart industries, and how do we want to feed the growing world population in the future?" Discussing these questions interactively with the public can lead to new ideas on how to shape technologies or how to frame the search for new technological innovations according to our wishes.

With that in mind, the technik.kontrovers team consciously leaves the well-trodden paths of expert lectures, employing also digital and artistic means. For instance, the first four events were accompanied by a local artist who created live documentations of the presentations and discussions – so-called visual recordings. During an evening event on sustainability assessment, the audience had to weigh decisions on purchasing coffee (price vs. taste and taste vs. sustainability) in a live online inquiry. On another occasion, ITAS researchers took the audience to three fictional future societies in the year 2038 and let them discuss in which one they would prefer to live. Each event was documented by live microblogging on Twitter and – for the last two years – as full-length videos.

After almost four years and twelve events, a technik.kontrovers evening is still challenging, requiring researchers to abandon their traditional roles as experts or lecturers and think of new ways to enter into dialogue with citizens. However, the efforts are worth it: Almost every event was packed with a diverse audience. Visitors, who were subsequently asked for feedback, highly valued the unique format. However, not only the guests left ITAS with new insights – the researchers themselves also received valuable input for their current and future studies. technik.kontrovers is far more than a small local event: it is a showcase to bring scientific knowledge into the public debate on how technology could benefit society as a whole. (jm)

» www.itas.kit.edu/technikkontrovers



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PERIOD 1 JANUARY 2016 TO 31 JULY 2018

Monographs

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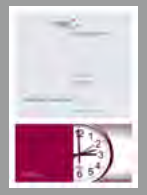
Hybride Wissensregime. Skizze einer soziologischen Feldtheorie. Baden-Baden: Nomos 2016
(Wissenschafts- und Technikforschung, Vol. 13)

Caviezel, C.; Revermann, Chr.
Bilanz der Sommerzeit. Berlin: Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag (TAB) 2016
(TAB-Arbeitsbericht 165)



Caviezel, C.; Grünwald, R.; Ehrenberg-Silles, S.; Kind, S.; Jetzke, T.; Bovenschulte, M.
Additive Fertigungsverfahren (3-D-Druck). Berlin: Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag (TAB) 2017
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Rückholung der Nuklearabfälle aus dem früheren Forschungsbergwerk Asse II. Dokumentation einer Vortragsreihe am Institut für Technikfolgenabschätzung und Systemanalyse (ITAS). Karlsruhe: KIT 2016, DOI: 10.5445/IR/1000063867

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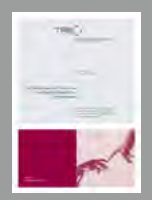

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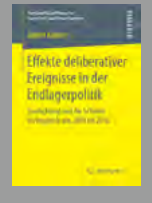
Strategien der Individualisierung. Neue Konzepte und Befunde zur soziologischen Individualisierungsthese. Bielefeld: transcript 2016

Kuppler, S.
Effekte deliberativer Ereignisse in der Endlagerpolitik. Deutschland und die Schweiz im Vergleich von 2001 bis 2010. Wiesbaden: Springer VS 2017, DOI: 10.1007/978-3-658-18360-8



Moniz, A. Brandão
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Oertel, B.; Kahlisch, C.; Albrecht, S.; in collaboration with Odenbach, J.
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(KIT Scientific Report 7746)

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Sand, M.
Futures, visions, and responsibility. An ethics of Innovation. Wiesbaden: Springer VS 2018, DOI: 10.1007/978-3-658-22684-8

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Designing sustainable urban futures. Concepts and practices from different countries. Karlsruhe: KIT Scientific Publishing 2016, DOI: 10.5445/KSP/1000055831

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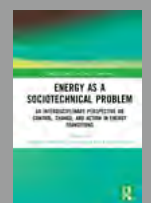
Experimentelle Gesellschaft: Das Experiment als wissensgesellschaftliches Dispositiv. Baden-Baden: Nomos – edition sigma 2017, DOI: 10.5771/9783845285450-7
(Gesellschaft – Technik – Umwelt, Neue Folge 19)

Bowman, D.M.; Dijkstra, A.; Fautz, C.; Guivant, J.S.; Konrad, K.; Shelley-Egan, C.; Woll, S. (Eds)
The politics and situatedness of emerging technologies. Berlin: AKA 2018
(Studies of New and Emerging Technologies, Vol. 8)

Büscher, C.; Schippl, J.; Sumpf, P. (Eds)
Energy as a sociotechnical problem: an interdisciplinary perspective on control, change and action in energy transitions. London, New York: Routledge 2018



PUBLICATIONS

PERIOD 1 JANUARY 2016 TO 31 JULY 2018

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„Grand Challenges" meistern: Der Beitrag der Technikfolgenabschätzung. Baden-Baden: Nomos – edition sigma 2018, DOI: 10.5771/9783845283562-11 (Gesellschaft – Technik – Umwelt, Neue Folge 20)

Dieckhoff, C.; Leuschner, A. (Eds)
Die Energiewende und ihre Modelle. Was uns Energieszenarien sagen können – und was nicht. Bielefeld: transcript 2016 (Science Studies)

Dominguez-Rué, E.; Nierling, L. (Eds)
Ageing and technology. Perspectives from the social sciences. Bielefeld: transcript 2016, Open Access

Hawel, M.; Braunersreuther, C.; Frey, P.; Fritsch, S.; Pohl, L.; Schwanke, J. (Eds)
Work in progress, work on progress. Hamburg: VSA 2017 (Beiträge kritischer Wissenschaft: Doktorand_innen Jahrbuch 2017)

Heil, R.; Seitz, S.B.; König, H.; Robienski, J. (Eds)
Epigenetik – Ethische, rechtliche und soziale Aspekte. Wiesbaden: Springer VS 2016, DOI: 10.1007/978-3-658-10037-7 (Technikzukünfte, Wissenschaft und Gesellschaft)

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Epigenetics – Ethical, legal and social aspects. Wiesbaden: Springer VS 2017, DOI: 10.1007/978-3-658-14460-9 (Technikzukünfte, Wissenschaft und Gesellschaft)

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Scientific knowledge and the transgression of boundaries. Wiesbaden: Springer VS 2016, DOI: 10.1007/978-3-658-14449-4 (Technikzukünfte, Wissenschaft und Gesellschaft)

Lindner, R.; Aichholzer, G.; Hennen, L. (Eds)
Electronic democracy in Europe. Prospects and challenges of e-publics, e-participation and e-voting. Cham, Heidelberg et al.: Springer 2016, DOI: 10.1007/978-3-319-27419-5

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Technology assessment in Japan and Europe. Karlsruhe: KIT Scientific Publishing 2016

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Smeddinck, U.; Kuppler, S.; Chaudry, S. (Eds)
Inter- und Transdisziplinarität bei der Entsorgung radioaktiver Reststoffe. Grundlagen – Beispiele – Wissenssynthese. Wiesbaden: Springer Vieweg 2016, DOI: 10.1007/978-3-658-12254-6 (Energie in Naturwissenschaft, Technik, Wirtschaft und Gesellschaft)

NEW DESIGN AND MAXIMUM OPENNESS

Editorial team at ITAS has relaunched the TATuP journal

Goodbye ivory tower: The concept of "open science" is to make science more transparent and democratic and to open up new perspectives for researchers. What exactly is meant by the new "openness" promoted by the EU and other powerful players? Are the high expectations realistic? And how can public participation be realized in practice?

These questions were addressed in the TATuP entitled "Open Science zwischen Hype und Disruption" (Open science between hype and disruption) – the first issue after a comprehensive relaunch of the ITAS-based journal in summer 2017.

"The subject was perfectly suited for our first issue after the relaunch," says Constanze Scherz, editor and deputy head of ITAS, who worked closely with the publisher oekom to realize the modernization of the journal. "As experts in technology assessment, we are interested in new ways to involve the public." TATuP therefore is committed to a large degree of openness and transparency: Online access to all articles as well as subscription to the printed edition, published three times a year, are free of charge, continuing TATuP's open access policy pursued ever since the first volume in 1992. After the relaunch, all texts are published under a Creative Commons license. The editors explicitly welcome further distribution via reprints and reproductions, for example, for edited volumes or electronic course reserves.

But TATuP also explores other new grounds. Ulrich Ufer, TATuP's editor-in-chief, reports positive experiences with the journal's unconventional open peer-review process for scientific research articles: "The fact that authors and reviewers know each other by name leads to equal, fair, and cooperative interaction and guarantees scientific quality as well as a comprehensible language that addresses our inter- and transdisciplinary readership." The new design, varied news, the use of figures and pictures, as well as a new interview section also appeal to non-scientist readers.

TATuP – Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis is currently referenced in the Directory of Open Access Journals (DOAJ) and in other databases for open access journals; decisions on applications for prominent scientific databases such as Clarivate Analytics (formerly Web of Science) or Scopus are pending.

» www.tatup.de

Further publications:
During the reporting period, scientists at ITAS held 649 scientific talks at conferences, contributed to 30 proceedings, published 28 research reports, 147 contributions to anthologies and, last but not least, 186 articles, 114 of them in journals listed in Web of Science or Scopus. Also eight dissertations were published during this period. All publications can be found at

» www.itas.kit.edu/english/publications

ITAS PROJECTS **Ongoing (until July 2018)**

Federal Anti-Discrimination Agency

Risks of discrimination by algorithms

Federal Ministry of Education and Research

ComplexEthics. Perception and orientation tool for the ethical, anthropological, sociological, and informatics evaluation of complex socio-technical arrangements in a digitalized living environment

INOPRO – Intelligent Orthotics and Prosthetics

Assessing Big Data (ABIDA)

Autonomous mobility for blind and visually impaired people in the urban space through audio-tactile navigation (TERRAIN)

Collaborative project eXtremOS – Flexibility in the context of European electricity market coupling with extreme technological, regulatory, and social developments

"Klausurwoche" (week of closed meetings) on ethical, legal, and social aspects of modern methods of genome editing and their possible applications

PAKoS – Personalized, adaptive cooperative systems for automated vehicles

PROPHECY – Process Concepts for Photocatalytic CO_2 Reduction Combined with Life-Cycle-Analysis

Prospective systems analysis for battery systems (ProSyBatt)

The Future of the Body in the Light of Neurotechnology

APV-RESOLA – Innovation Group Agrophotovoltaic: Contribution to a Resource-Efficient Land Use

Federal Ministry of Education and Research / Kopernikus

Kopernikus: An Energy transition navigation system for collecting, analyzing, and simulating systemic connectivity (ENavi)

Kopernikus: ENSURE

Kopernikus: Power2X

Kopernikus: SynErgie

Federal Ministry of Health

NoWa – Norms in the light of demographic change

Federal Ministry for Economic Affairs and Energy

InNOSys – Integrated sustainability assessment and optimization of energy systems

Methods and measures to deal with socio-technical challenges in storage and disposal of radioactive waste (SOTEC-radio)

Federal Roads Office (FEDRO), Switzerland

Impacts of automated driving. Subproject 1: Use cases and impacts

Federal Office for Agriculture and Food

Potential of beech-fir mixed forests to adapt from the climate change impacts in commercial forests (BuTaKli)

German Bundestag (parliamentary policy advice by TAB)

Algorithms in digital media and their influence on opinion formation

Autonomous weapons systems

Challenges for plant breeding. Impact of the structural change in plant breeding on genetic diversity, diversity of varieties, and performance of domestic agriculture

Current status and developments of prenatal and preimplantation diagnosis

Data-Mining – social and legal challenges

Dealing with ignorance in exploratory experiments

Digitisation of agriculture

Expansion of renewable power generation – ecological and other consequences in an integrated socio-economic and ecological overall assessment

Health Apps

Human genome editing

Legal Techs – algorithmic legal consulting

Light pollution – extent, societal and ecological impacts, as well as approaches

Medical and veterinary active ingredients in drinking water and watercourses – quantitative analysis and risk assessment

Observation technologies in the field of civil security – opportunities and challenges

Possible health impacts due to different frequency ranges of electromagnetic fields (HF-EMF)

Potentials of mobile Internet and digital technologies for a better participation of persons with disabilities in society

Sustainability assessment of farming systems – challenges and perspectives

Sustainability potentials of bioeconomy – 3rd generation biofuels

Virtual and Augmented Reality – development paths, application potentials, technology impacts

German Research Foundation (DFG)

Specialized portal Technology Assessment (openTA)

The impact of computer simulations on the epistemic status of LHC Data

European Commission, Horizon 2020

ABACUS – Algae for biomass applied to the production of added value compounds

FASTGRID – Cost effective FCL using advanced superconducting tapes for future HVDC grids

KEROGREEN – Production of sustainable aircraft grade Kerosene from water and air powered by renewable electricity, through the splitting of CO_2, syngas formation, and Fischer-Tropsch synthesis

Photofuel – Biocatalytic solar fuels for sustainable mobility in Europe

PRISMA – Piloting RRI in Industry: a roadmap for tranSforMAtive technologies

REFLEX – Analysis of the European energy system under the aspects of flexibility and technological progress

Responsible Research and Innovation in Practice (RRI Practice)

Shape Energy: Social Sciences and Humanities for Advancing Policy in European Energy

VI-DAS Vision Inspired Driver Assistance Systems

Global Consortium for Sustainability Outcomes (GCSO)

CapaCity: Building Capacity for Climate Resilience and Sustainability in Cities

Implementing Off-Grid Renewable Energy to Create Soial Value and Community Development

Helmholtz Association of German Research Centres

Helmholtz Research School on Energy Scenarios

Helmholtz-Initiative Energy System 2050

Energy Systems Integration (ESI)

Energy transformation in dialogue – from real-world lab to Karlsruhe's transformation center

INTERREG (North-West Europe/Oberrhein)

ALG-AD-Creating value from waste nutrients by integrating algal and anaerobic digestion technology

Upper Rhine Cluster for Sustainability Research (URCforSR)

Ministry of Science, Research and the Arts, Baden-Württemberg

Analysis and scenarios for the use of microalgae as food

Karlsruhe Transformation Center for Sustainable Futures and Cultural Change (KAT)

Tech Center a-drive: Conditions of possibility and impacts of automated driving

Research Council of Norway

Assisted Living Project – Responsible innovations for dignified lives at home for persons with mild cognitive impairment or dementia

Volkswagen Foundation

Exploring University communications: Organization of University communications in relation to the form of university

Poetic Modelling and Energy Transition – Development and Application of a Transdisciplinary Theory of Models

EMPLOYEES OF ITAS **June 2018**

Dr. Matthias Achternbosch
Dr. Steffen Albrecht
Damaré Araya Valenzuela *

Eser Bakdur
Armin Bangert
Martina Baumann
Dr. Manuel Baumann
Elske Bechthold
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Philipp Frey
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Sylke Wintzer
Silvia Woll
Nele Wulf

Lei Xu

* Guest researcher

Disciplines and qualifications

WORKING AT ITAS

Currently, the scientific staff of ITAS consists of 109 researchers and four guest researchers. They are supported by 15 employees in administration. The majority of the staff work at the institute's main office in Karlstraße 11. ITAS is also represented in Berlin by 13 staff members working at the Office of Technology Assessment at the German Bundestag and at its own Berlin office. To contribute to the promotion of young scientists, ITAS colleagues supervise 30 dissertations and seven Master theses.

» www.itas.kit.edu/english/staff

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www.twitter.com/TAjournal (TATuP – Journal of Technology Assessment in Theory and Practice)

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www.itas.kit.edu/youtube

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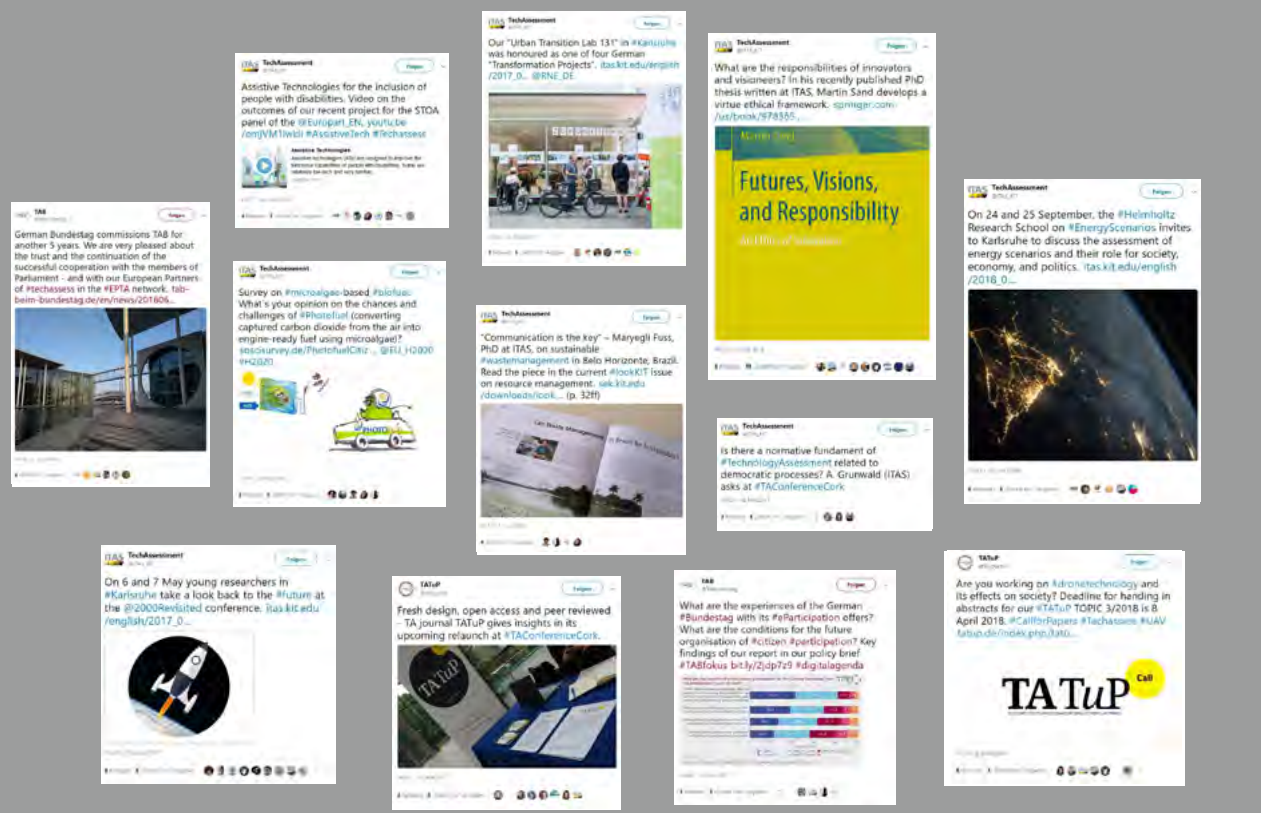
www.itas.kit.edu

www.itas.kit.edu/newsletter (German)



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