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1 Technology Assessment Research at the ITA

Over the last decades, technological development and societal change have steeply increased in pace and complexity, entailing significant impacts for society. Technology Assessment (TA) investigates implications of technological innovation, i.e. consequences of and design options for novel or rapidly developing technologies from multiple perspectives. TA studies address social, political, legal and economic as well as health and environmental issues. TA attends to questions of uncertainty, risk, moral concerns, distributional equity or sustainability, contributes to governing technology in a scientific sound as well as participatory way, and tries to influence the shaping of technologies to come.

scientific TA research ...

... plus public and political functions

perspectives of TA analysis

TA is performed in various ways for a variety of addressees such as scientific peers, political decision makers, and the interested public. The Institute of Technology Assessment (ITA) is devoted to both, scientific TA research, addressing the scientific community through academic publications, as well as to public and political debate on societal, environmental, etc. aspects of science and technology through research reports, media and public events, targeting a broader audience including politicians, government officials, and the wider public.

Impacts can be addressed from different analytical perspectives: looking at basic technical innovations and the related infrastructures; at applications thereof; at societal governance processes or at the public discourse on technology with its potential for controversy. The first two perspectives are usually referred to as "technology-induced TA"; the latter two perspectives, as well as those studies that start with an observed impact, are summarised under the notion of "problem-induced TA". ITA studies may focus on one specific perspective or encompass a combination of perspectives.

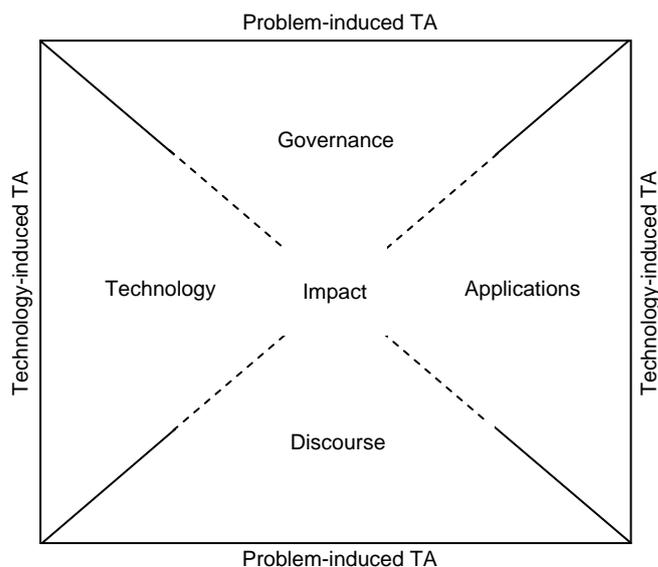


Figure 1: Perspectives of TA analysis

To generate new knowledge about the interaction between technology and society, scientific TA needs a theoretical understanding and advanced methodological tools as well as interdisciplinary collaboration. To gain insights into, for instance, the transition of socio-technical systems, the development and diffusion of novel technologies, or the dealing with missing scientific knowledge and irreducible risks, TA draws on various disciplinary strands. Social sciences contribute through science and technology studies (STS), policy studies, sociology of technology or innovation economics. Applied ethics deals with normative questions such as how to shape technology tailored to basic rights and public welfare. TA also builds on insights from a broad array of natural and engineering sciences as it addresses the implications of technological change and impacts such as risks for human health or the environment.

drawing on a combination of approaches

To cover these aspects adequately, the ITA as an interdisciplinary research institute employs researchers trained in the social sciences and humanities as well as the natural and engineering sciences. They bring in expertise from different fields of research in order to gain a comprehensive picture of the issue at stake. Moreover, the ITA staff is trained to integrate stakeholder expertise as well as local and to some extent situated knowledge when needed. Participatory TA involves the respective actors from stakeholder communities or the general public. As a rule, at the ITA internal project teams or research groups with external partners carry out inter- and transdisciplinary research.

institutionalised inter- and transdisciplinarity

2 Main Research Areas

As technological innovation is multi-faceted, TA must deal with a variety of issues, for example opportunities and problems from established, but still rapidly evolving technological fields like the Internet; societal and/or environmental problems that could be mitigated by using novel technologies (e.g. global warming, the limited supply of fossil fuels, demographic change); or promising but potentially controversial emerging technologies (e.g. nanotechnology, synthetic biology, neurosciences). Within these fields, the ITA has acquired considerable expertise and contributed to academic insights as well as to societal deliberation and policy advice. Current research objectives include:

TA issues

- investigating the impacts of novel information technologies, e.g. enabling wide-spread surveillance or ubiquitous access to networked databases, on fundamental rights and civil liberties, on various societal relations such as between citizens and government, and on information acquisition and distribution;
- understanding implementation impediments for, and supporting responsible innovation processes aiming at more sustainable solutions in diverse fields such as energy-efficient buildings to assisted living and engineering education;
- researching the implications of potentially controversial new and converging technologies for scientific knowledge generation, risk perception, human health, etc., understanding ensuing or anticipated controversies;

research objectives

- reflecting the scientific and societal role of TA, monitoring trends in technology development and establishing and refining methods, for example determining when and how to involve citizens in technology design and policy.

Accordingly, this medium-term research programme defines four coequal research areas that complement each other and have a synergistic potential leading frequently to worthwhile and challenging new research topics (see Fig. 2).

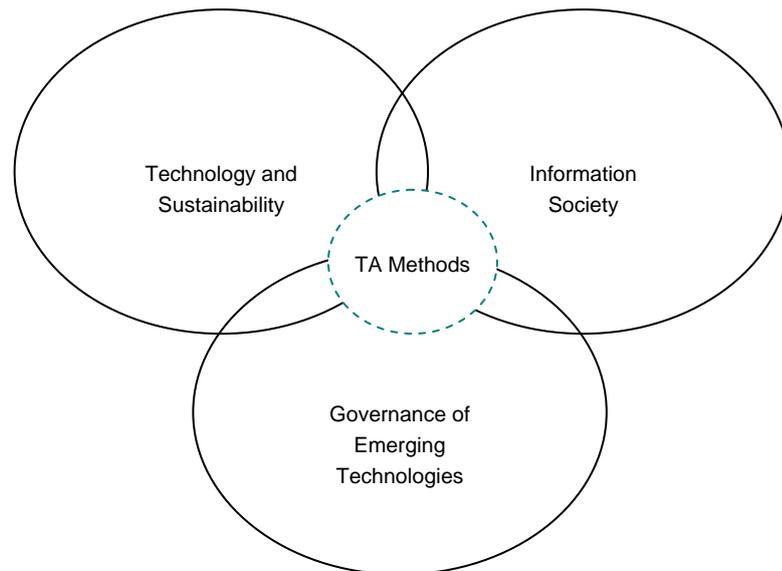


Figure 2: Main research areas at the ITA

In all these areas the ITA contributes to basic research with regard to understanding technology governance, the dynamics of technology controversies and innovation processes; to comparative evaluation approaches; to social learning; to the role of human rights and technology ethics; and to science and technology studies. ITA also explores and develops long-term visions and pathways as well as design options as a basis for policy advice.

2.1 Information Society

*within the wide field of
TA on the unfolding
information society ...*

*... ITA focuses on four,
partly interrelated,
particularly salient
topics*

The notion of the “Information Society” is well established in scholarly debates as a prominent interpretation of fundamental societal change. At the EU level in particular, it serves as an influential and encompassing political vision. Continuous rapid progress in information and communication technologies (ICT) and their multiple potentials for application open up a wide area of research for TA. The ITA has a long and successful research tradition in this field and covered many ICT-related topics over time. For the current period, we chose to focus on three, particularly salient topics that are partly interrelated. First, the relationship between the computerised world and the private sphere (*privacy*) constitutes an intrinsic area of actual or potential conflict for all technologies and applications comprising the information society. Second, *e-governance* emerges from the leading role and special interest of the state in establishing

itself as a corner stone of the information society. Third, *networked environments*, the interlinking of hard- and software, information and people, are an essential characteristic of the information society, whose potentials and impacts need special attention of TA. Fourth, we address the overarching topic of the *politics of information technologies*.

Privacy

When shaping the information society, a thorough analysis of the complex relations between technologies, human rights and social/political consequences is essential in order to be able to assess options in technology development. One starting point and core of the analysis is the impact of new and future ICTs on privacy. In a wider perspective, we also discuss impacts of technologies such as biometrics, biotechnology and human tissue banks, as well as further basic rights affected by ICT, in particular freedom of information and freedom of expression. The amount of personal data as well as the capabilities to store, to analyse them in-depth (“big data”), to use these data to predict and influence future behaviour, and for related potential misuses are growing; consequently, privacy and related human rights will be increasingly under pressure.

Over recent years, security has been politically re-assessed in the aftermath of terrorist attacks. This is our second point of departure for research in this field. As both the state and the private sector are focusing on security, biometric devices and open and covert surveillance technologies are spreading very rapidly. At the same time, the diffusion of privacy-enhancing technologies is hampered, as it was the case in the past. In terms of our focus on privacy, this means that we expect, on the one hand, the potential for societal conflict to grow further, and, on the other hand, that political backing for privacy enhancement may stay rather contested in the short term.

However, we can already observe that the emphasis on security, which has dominated many debates, is being challenged and increasingly debated in terms of human rights. In the same vein, one-sided security arguments are being questioned. The data-protection-friendly design of security technologies is becoming an important topic, but it is at the same time prone to conflicts. Based on the outcomes of concluded EU research projects on privacy enhancing security technologies and on privacy seals for IT products and services, we intend to contribute to the adaptation and further development of so-called fair information principles.

The ITA’s research on privacy continues to investigate the basics for the protection of and future threats for privacy, e.g. technical and legal means to meet the challenges for the right to privacy emerging in the domain of ubiquitous computing. Special attention will be devoted to new developments and the international scientific and political discourse on privacy. Policy advice on both, the national and EU levels include the scientific planning of a security and privacy panel at the annual international Computer, Privacy & Data Protection conferences (CPDP) and ITA’s involvement in the European Group on Ethics in Science and New Technologies (EGE).

The EU project VALUE AGEING (2010–2014) aims to foster co-operation between non-commercial and commercial entities on a joint research project about the incorporation of fundamental values of the EU in ICT for ageing. This is one of our cross-activities with ITA’s research area Technology and Sustainability (see below). The EU project SURPRISE (2012–2015) conducts a critical examination of the strained relation between security and privacy – often framed as a trade-off. Incorporating the citizens’ perspective on acceptance and acceptability of surveillance-oriented technologies is at the centre of analysis towards reconciling privacy and security as complementary

***political reassessment
of security***

***privacy-friendly design
of security technologies
and measures***

basic research ...

***... and policy
recommendations***

***incorporating
fundamental values ...***

... and human rights

concepts. Moreover, EU project IRIS (2012–2015) explores the interdependencies of surveillance and democratic societies; how surveillance measures alter the fabric of societies; and how they in response deal with security threats on the one hand and the curtailing of citizens' rights on the other. A focus is set on the empirical analysis of citizens' reactions and the societal capability of resilient responses towards the implementation of surveillance technologies.

E-Governance

The technological innovations of the Internet era opened up new applications of ICT in the realm of the state and in politics: novel forms of access to public sector information, of communication with the authorities, administrative procedures, public service delivery, digital registers, identification of citizens, law and policy-making, and political participation. E-governance denotes these technology-induced changes ranging over all state functions.

Today, ICT applications are being extended to further domains, in particular to institutions and practices of political participation. An on-going concomitant is the integration of mobile platforms and social media. Implementing these novel uses of ICT in state functions involves major challenges, for instance: How can increased public service quality and economic benefits be achieved together with maintaining basic principles such as service security, equal access and protection of privacy? To what extent can ICT contribute to remedying democratic deficiencies and to enhancing democratic quality, while at the same time allowing for efficient governance? The ITA's research aims to understand emerging new applications of ICT, the nature of change, of design options and impacts on state and society.

The advanced implementation of electronic public services has brought new challenges (e.g. cross-jurisdictional and cross-border service systems) and puts the assessment of design options as well as their social, economic, and political impacts on our research agenda. New research topics will also include Open Government Data approaches and challenges to policies and regulatory frameworks for information transparency, access to and (re-)use of government data. Reinforced by the advanced transformation towards digital data repositories and electronic access channels across the public sector, ITA will therefore explore the growth of transparency, accountability and responsiveness of government.

In the field of governance and political participation, major research questions embrace various e-participation instruments and their impacts on political engagement, processes, decisions and institutions. Integral aspects are design and regulation requirements (e.g. maintenance of democratic principles and fundamental civic rights, social inclusion). Assessments of the potential and societal impacts of e-participation shall also include a broader scope of applications and effects, e.g. participation in legislative processes, formal opportunities for citizens to participate at the European level, and implications for the public sphere. A special focus here will be on exploring the potential for and modes of linking top-down and bottom-up forms of e-participation.

Networked Environments

Technological and social innovations on the information and communication infrastructure level (e.g. the Internet) are key drivers of the information society's dynamic development. The ITA is interested in technological innovations generating networked environments (e.g. ubiquitous computing), in emerging new social networks and in consequences of new network-based services, e.g. for professional practices.

new challenges in e-governance

assessing Open Government Data approaches

democratic quality and e-participation

wider societal effects

The more the global ICT infrastructure becomes “smart”, the more this development calls for TA. The ITA expects far-reaching societal impacts in the form of the convergence and networking of miniaturised computer technology, sensor technology and robotics, which are permeating more and more areas of our daily lives and even the human body itself. Pervasive computing and ambient intelligence denote visions that are becoming increasingly real options of application. While they open up various new opportunities to enhance human capabilities and to create new services, they also contain new risks (e.g. loss of autonomy, total surveillance, security problems due to technological dependencies, and the threat of Internet crime and cyber war).

information technologies become ubiquitous and invisible

The Internet is the prime example of an emerging societal communication system that will have far-reaching economic, political and social consequences globally. This is inter alia reflected in the current evolution of Web 2.0 (social web) with its community-building and self-authoring tools. It will contribute to a diversified landscape of novel platforms shaping social relations and the interaction of people with knowledge resources. Knowledge implies semantics, thus the expected Web 3.0 (semantic web) will entail further transformation of societal systems. Inter alia, the Internet plays an important role in science and research, in particular with regard to new forms of publishing, cooperation, communication, and knowledge representation (“cyberscience”). In this particular field, the ITA intends to further build on previous research, in particular in the field of the digital humanities or crowd-sourced geosciences.

the Internet at the heart of a TA of the information society

cyberscience

The politics of information technologies

Information technologies are created in society and hence embody social, cultural and normative dimensions. Accordingly, the ITA addresses the question of how information technologies emerge along with hegemonic discourses, socio-political cultures, everyday practices and identities. The ITA focuses on political processes relating to the design of search-engine technologies and on the way certain values and worldviews find their way into engineering practices. By analysing different arenas and practices of technological development the implicit politics of information technologies can be identified and renegotiated.

The project GLOCAL SEARCH (2012–2015) looks at how search technology is shaped at the intersection of the global information economy and local socio-political cultures. It analyses how universal technologies like Google are negotiated in the specific Austrian context (e.g. media debates, policy guidelines, legal frameworks, economic forces, civil society) and how search technology can be governed on both the national and European levels.

the negotiation of search technologies

Locating a potential for value-based intervention at the micro/meso level of development practices, the project MATERIAL-DISCURSIVE PERFORMATIVITY IN SOFTWARE DESIGN (2013–2017) investigates how societal discourses unfold in software design. It focuses on how processes and methods of software development can be designed to create space for value-based innovations and socio-political reflection.

a socio-political approach to design practices

2.2 Technology and Sustainability

Socio-economic challenges such as urbanisation and demographic change, economic shocks, as well as environmental problems like global warming result in a sturdy claim for sustainable development which increasingly receives scientific, societal and political attention. To be able to contribute to a serious

the relevance of sustainability in TA

reduction of sustainability deficits, potential impacts of novel technologies and the socio-economic context of their implementation need to be taken into account from early on. This includes a shift from analysing specific technologies towards dealing with broader socio-technical areas. At the ITA, we not only explore and assess the potential consequences of new technological options, but also consider the framework conditions necessary for specific technologies to contribute to sustainable development.

what is sustainability?

In our view sustainability has to be considered both as a normative concept and as a frame to address problems and solutions with their interconnectedness on different levels and scales. Thus, sustainability research tends to be inter- and transdisciplinary, preferring socially robust explanations based on a variety of (non-)scientific expertise. As a normative concept, sustainability is devoted to basic values such as generational fairness, distributional equity, prevention of risks, protection of resources, and public participation in political decision-making processes.

***sustainability
assessment and
learning processes***

The contribution of technology to more sustainability depends to a large extent on the way it is integrated into societal use and everyday routines. We provide policy-makers, users, and other relevant stakeholders with TA-derived knowledge to support the learning process related to technological innovation. In addition, knowledge generated in this context informs studies in our other research areas, in particular when it comes to (potentially) controversial technologies.

research topics

In our research, we focus on socio-technical and economic areas of particular relevance for sustainability. Central issues thereby will be low-carbon, renewable, and highly efficient energy technologies, climate technologies, sustainable production and consumption of goods. Future research at the ITA will address selected key technologies as well as the transition of socio-technical systems as a contribution to sustainability studies. A special focus will lie on the interconnectedness of technology development and the economic system. Innovation processes driven by a combination of normative, common-goods oriented goals and economic benefits play a crucial role in sustainability studies. To be able to cope with those new challenges TA has to deal with new models of economic activity and criteria to assess economic impact.

***sustainable energy
technologies***

It is largely agreed that our current energy system has to undergo a radical change in the future. Research at the ITA will focus on selected key technologies but also on the transformation of the energy system towards a low-carbon model. The ITA contributes to the advisory work of the energy steering panel of European Academies Science Advisory Council (EASAC). In forthcoming projects we will focus on quantitative and qualitative assessments of the rebound effect in urban areas, and on the diffusion of various energy technologies in Austria and selected European countries applying a new theoretical approach aiming at a framework to categorize and compare different technological areas. Moreover, we will continue research on climate technologies (such as heating, ventilation and air-conditioning) and their development and diffusion in Austria. Furthermore, we will continue to focus on engineering education as an important instrument to incorporate sustainability thinking and assessment at an early stage.

contributing to EASAC

***global warming
as a challenge***

engineering education

ageing society

The research results in the area of technology and sustainability continuously provide insights into how stakeholders, policy-makers, users, and the general public are involved in the transformation of selected technologies within the socio-economic system. Additionally, we are interested in the identification of the underlying values for these changes. This is currently being addressed in the project VALUE AGEING (2011–2014), which as a cross-cutting project is aiming at incorporating European fundamental values into ICT for ageing. In the next decades the number of older adult persons will continue to increase,

constituting a group of technology users which will neither be homogenous nor easy to address. In this context the promised contributions to an economically and socially sustainable development of ageing societies need to be scrutinised critically. The project CIVISTI-AAL (2013–2014) contributes to this debate from a citizens' perspective on the local (Viennese) level.

From a broader point of view, findings of the ITA's research contribute to national and international scientific debates on questions like "What is sustainability from a TA perspective?" and "How can technology contribute to developments towards (more) sustainability?"

two meta research questions

2.3 Governance of Emerging Technologies

The rapid growth of knowledge and the close coupling of science and technological development in the context of nano-, bio-, info-, and cogno-technosciences bring about technological innovation, but also new uncertainties and controversies. Past experiences with new technologies such as biotechnology suggest that future controversies may pertain to both concrete applications and the question of how research should be governed. Both manifest and expected controversies serve as starting points for our research. We aim at understanding sources and reasons for their existence as well as their dynamics and possible outcomes, providing a basis for critical reflection and policy advice.

controversies about new technologies as a starting point for TA

Technology controversies have different bones of contention and problem dimensions (such as risk issues or moral concerns); they develop in various ways with different groups involved at varying intensity. Decision-makers try to accommodate to such controversies. The resulting governance regimes mirror the diversity of conflicts including specific forms of expertise, participation, decision-making, legitimisation and problem framing.

co-evolution of conflicts and governance regimes

Problems addressed often differ according to particular fields at stake. For example in the past, questions of uncertainty and risk were raised primarily in the context of agri-biotechnology, whereas ethical issues were mostly at stake in the biomedical sector. Although this specificity may change, it not only shapes the societal discourse but also impinges on the further development of novel technologies.

risk and ethics as problem frames

Political decision-makers and technology developers have become increasingly sensitive not only to manifest but also to expected technology controversies: with regard to particular technologies, controversies are anticipated even before they actually occur. This triggers the development of various anticipatory governance approaches. Prime examples are nanotechnology, synthetic biology and the neurosciences, all predicted to carry enormous potential for economic and societal benefit while raising ethical and risk issues similar to biotechnology two decades earlier.

In the course of technology controversies, both new and established actors have a role to play – groups of concerned individuals, NGOs, expert bodies like bioethics committees, and ELSI (ethical, legal and social implications) research groups. These actors approach possible consequences from different, often conflicting perspectives, flagging up diverse issues. They so engage in a plural assessment of emerging technosciences with a view to influencing politics. At the same time, contradicting claims and views demand political decisions.

plural assessments

<i>analysis of technology controversies</i>	The ITA's research addresses the governance of emerging technologies such as synthetic biology, nanotechnology or the neurosciences. From past analyses of the typical structures and the development of controversies we explore paths towards new modes of responsible governance.
<i>engineering life: synthetic biology</i>	Synthetic biology and cognitive sciences are important fields of expected controversies. In the EU project SYNENERGENE (2013–2017) we investigate the role of public dialogue events with regard to mutual mobilisation and learning and their contribution to new forms of governance. The EU project NERRI (2013–2016) applies a similar perspective to neuro-enhancement, i.e. the artificial boosting of performances of the human brain. Again, through participatory procedures the project seeks to uncover new avenues towards responsible research and innovation.
<i>systems biology between complexity and reductionism</i>	Nanotechnology is a heterogeneous research area with a multitude of emerging phenomena of scientific, technical and societal interest. The project NANO-TRUST (2007–2016) draws upon research results from investigating previous technology controversies. It combines an analysis of on-going regulatory approaches, of current knowledge regarding potential health, environmental and safety concerns and of approaches at dealing with uncertainties in the field of nanotechnologies. The aim is to provide structured information for regulatory opinion formation and to contribute to the cognitive discourse on anticipatory risk governance in this field. From 2013–2016, the ITA chairs the Austrian Nano Information Commission, appointed by the Ministry of Health.

2.4 TA Methods

<i>expert interviews</i>	Interdisciplinary basic research is a central activity of the ITA and contributes significantly to its identity. With respect to its methodology, it mainly relies on quantitative and qualitative methods of empirical social research. At the ITA, we significantly contributed to the reflexion of qualitative interviewing. In the future, further contributions to the development of research methods with a particular emphasis on expert interviews and mixed-methods approaches will strengthen this focus.
<i>participatory TA</i>	Procedures developed under the label of participatory technology assessment (pTA) complement the more canonical methods. Mainly, we aim at collecting knowledge and values from non-scientific actors to comprehensively assess the consequences of technologies or of (further) developing them. Furthermore, we aim at jointly developing citizens' visions and wishes concerning future research and technological innovation. Innovation-oriented TA approaches, such as constructive or real-time technology assessment, directly try to influence the design of technologies. Here, similar to pTA, scientific methods are mixed with interactive modes of knowledge creation. In recent years, the ITA had been involved in several projects applying such approaches. Based on these experiences and the state-of-the-art in this field, we will contribute to the methodological reflexion of innovation-oriented approaches in the coming years. Both participatory and innovation-oriented TA are being applied where TA depends on local knowledge, or knowledge gained from experiences, to avoid neglecting important aspects.
<i>constructive and real-time TA</i>	

The ITA performed and will continue to perform pTA activities in three inter-related areas: (1) the further development and trials of participatory procedures (e.g. FUTURE-FOODS 2013–2016); (2) the in-depth analysis of participatory procedures with a view to further developing them (e.g. SYNENERGENE 2013–2017; PACITA 2011–2015); and (3) trans-disciplinary research (e.g. SURPRISE 2012–2015; CIVISTI-AAL 2013–2014). Across all content-related areas, the ITA will continue to further develop pTA. In particular, we will try out and optimize particular pTA instruments with a view to supporting society at large (aka. Gesellschaftsberatung), for instance through scenario workshops. Another aim is to fundamentally reflect the role of participation in TA and in technology policy (participatory governance of science and technology).

reflecting the role of participation in technology policy

More recently, the reflection of TA-specific research designs led the ITA to more intensively deal with inter- and transdisciplinarity. In the future, this debate with a close link to participation will become even more intense. Especially with emerging technologies (such as synthetic biology), TA has to deal with research areas or technology projects where the respective inter- and trans-disciplinary cultures need to be analysed to render the analytical approach for assessing potential consequences more specific.

transdisciplinarity

Finally, the above differentiation of TA needs to be reflected on an institutional level as well. The ITA therefore contributes to projects discussing, and practically contributing to establishing, links between TA and the respective national Parliaments (PACITA 2011–2015; a successor project is planned). This provides an opportunity to reflect, on a European level, the forms of institutionalization that may best support TA in performing its role in research and policy advice.

TA and Parliaments

3 Beyond 2017

***emerging technologies
and society as moving
targets***

The challenges posed by the information society, by new and emerging technologies as well as by the on-going demand for sustainable development are moving targets the ITA needs to be continually responsive to and is well placed to do so.

***trend monitoring as a
key activity of ITA***

Beyond 2017 as well, typical areas for TA will include societal problems that could benefit from the application of novel technologies; the governance of emerging technologies; and developments in established but rapidly evolving technological fields that give rise to new opportunities and challenges. Together with the work on advancing research in the projected areas of specialisation of the present period, the ITA will adapt its research programme based on trend monitoring. Via our international network we are in a favourable position to detect emerging technological trends and societal problem areas at an early stage in order to develop ITA's research portfolio accordingly. Criteria for research questions will continue to be: scientific potential and general insights into the interface between science, technology and society, relevance in a national and global context, social and political urgency for analysis, and feasibility for tackling the issue with the expertise and resources available.

***expected main trends to
shape the TA agenda:***

***- sustainable
development fosters
mission orientation***

***- the challenge of
governing
technosciences***

***- the infrastructure of
the information society
becoming "intelligent"***

We expect the following main trends to shape our agenda in the next decade:

- In the light of sustainable development, technological innovation will become even more mission oriented. Future research at the ITA in this field will address promising technological options to address pressing societal problems as well as socio-technical areas and their potential to foster change (towards sustainable development) and to effectively respond to climate change.
- New interdisciplinary research areas contribute to a rapid rise of scientific knowledge while technology development is becoming almost indistinguishably linked to basic science (depicted as "technosciences"). This poses salient governance issues that are at the core of TA, for example how to cope with uncertainty.
- The information society will further unfold, driven by social and economic uses of ICT as well as emerging new tools, many of them based on the Internet (of Things). The more the global information and communication infrastructure becomes "smart" the more relevant TA gets. Among other issues, privacy, human autonomy and dignity, digital divide, and the re-definition of digital citizenship will be central in a world with ambient intelligence, autonomous systems and smart security technologies.