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# I Technology Assessment Research at ITA

Over the last decades, technological development and societal change have steeply increased in pace and complexity, entailing significant impact for society. Technology Assessment (TA) investigates implications of technological change, 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, equity or sustainability, contributing to technology governance and influencing the shape of technologies to come.

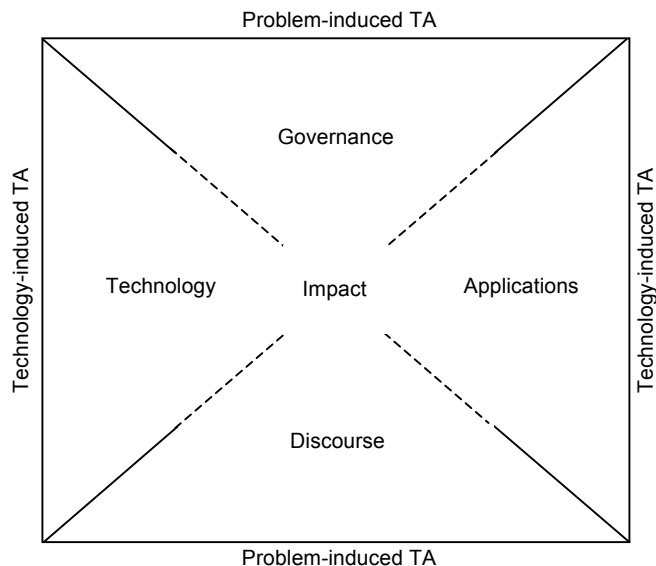
## **scientific TA research**

TA can be performed in various ways for a variety of addressees such as scientific peers, political decision makers or 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 opinion formation on societal aspects of science and technology through research reports, media and (in some instances) public events, targeting a broader audience including politicians, government officials, and the wider public.

## **public and political functions**

## **perspectives of TA analysis**

Societal impacts can be addressed from different analytical perspectives or starting points: 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 only one perspective or encompass several 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, e.g. the transformation of socio-technical systems, the generation and diffusion of different kinds of technologies or the dealing with missing scientific knowledge and irreducible risks, TA draws on various fields. 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.

To cover these aspects adequately, ITA is an interdisciplinary research institute, employing researchers trained in the social sciences and humanities as well as the natural and engineering sciences. Individuals, internal project teams or research groups with external partners carry out inter- and transdisciplinary as well as disciplinary analyses. They combine research results from different scientific disciplines, complemented by insights gained via participatory procedures. To develop its research portfolio, ITA monitors emerging technological trends and societal problem areas at an early stage via its international network.

***drawing on a combination of approaches***

***institutionalised inter- and transdisciplinarity***

## 2 Main Research Areas

As technological change 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, artificial life, biomedicine). Within these fields, ITA has acquired considerable expertise and contributed to academic insights as well as to societal deliberation and policy advice. Current research objectives include:

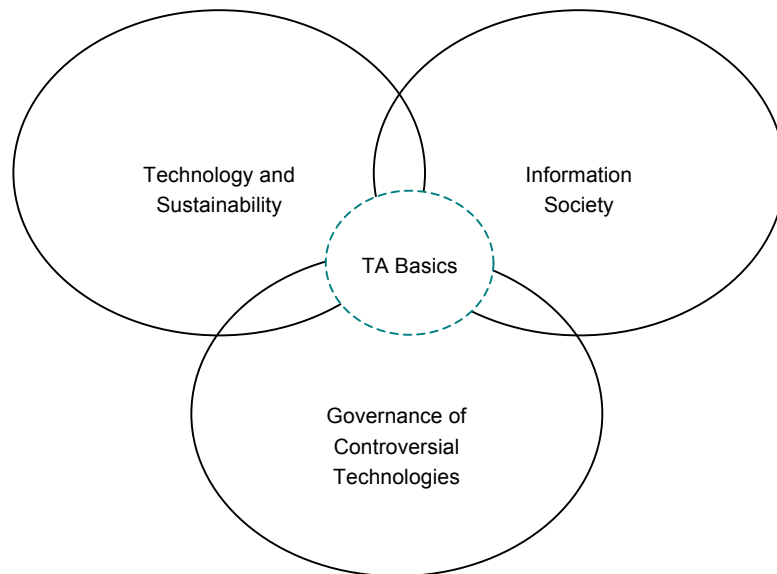
- investigating the impacts of novel information technologies, e.g. allowing for wide-spread surveillance or ubiquitous access to networked databases, on fundamental rights and civil liberties, on various societal relations such as between citizens and government, and on information acquisition and distribution;
- understanding implementation impediments for, and supporting the aim of, sustainable development in diverse fields from energy-efficient housing 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., and understanding ensuing or anticipated controversies;

***TA issues***

***research objectives***

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

Accordingly, the 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 ITA**

In all these areas ITA contributes to basic research with regard to understanding technology governance, controversy and diffusion 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 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  
three, partly inter-  
related, 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. 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*) is intrinsically fundamental to all technologies and applications constituting the information society. Second, *e-governance* emerges from the leading role and special interest of the state in establishing itself as a cornerstone of the information society. Third, *networked environments*, the interlinking of hard- and software, information and people, are an essential char-

acteristic of the information society, whose potentials and impacts need special attention of TA.

### *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, 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 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 weak 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.

Our research on privacy will 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. This research is also informed by our monitoring activities in the field of nanotechnology indicating new developments e.g. in autonomous systems. Special attention will be devoted to new developments and the international scientific and political discourse on privacy. Milestones are the organisation and scientific planning of the TA-panel at the annual international Computer, Privacy & Data Protection conferences (CPDP). The project SMART NEW WORLD (2010–2012) aims at defining requirements for electricity grid operators and energy suppliers regarding systems design and implementation strategy of smart metering systems, which should be in line with fundamental rights and privacy. Policy recommendations will be developed on the basis of participatory activities involving consumers and stakeholders.

The project VALUE AGEING is a Marie Curie Industry–Academia Partnerships and Pathways Action (2010–2014), which 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 the research area Technology and Sustainability (see 2.2 below). The EU-funded project DESSI (2010–2013) deals with research on methodologies for the assessment of security investments

**political reassessment  
of security**

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

**basic research  
...and**

**policy  
recommendations**

**incorporating  
fundamental values ...**

**... and human rights**

and trade-offs between security and other societal objectives (in particular privacy and social cohesion).

#### *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, identification of citizens, law- and policy-making and political participation. E-governance denotes these technology-induced changes which range over all state functions. Following the implementation of online public service provision and digital registers, applications of ICT are being extended to further domains, in particular to institutions and practices of political participation. The transition to ICT-mediated interactions between state and citizens creates challenges also for integrated components such as traditional structures of handling identification and authentication of individuals, an indispensable requirement in many service relations and expressions of political will. Our research focuses on novel uses of ICT in these major branches of state functions: public services, political participation, and citizen identity management, aiming to improve the understanding of the nature of change, of design options and impacts on state and society.

#### **new challenges in e-government**

The advanced implementation of electronic services in public administration (*e-government*) has brought new challenges (e.g. cross-jurisdictional and cross-border service systems) calling for an assessment of design options and their social, economic, and political ramifications. This includes recent trends and technologies related to Web 2.0 in e-government, such as social network-based public services and wiki-based cross-agency collaboration. Further research topics will be challenges to policies and regulatory frameworks for access to and (re-)use of public sector information, reinforced by the advanced transformation towards digital data repositories and electronic access channels across the public sector. With the growing share of electronic transactions and personalised services, secure and trustworthy systems architectures become crucial. Identification of individuals is being transformed into systems for electronic identity (*e-identity*) management (e-IDM) with components such as electronic tokens and electronic registers. Our future research will concentrate on impacts of different techno-organisational systems designs at national level (maintenance of civil rights, equality of access, trade-offs between economic efficiency, security and privacy, back office applications of e-ID); differences between public and private sector e-IDM strategies; and the advancement of theoretical frameworks such as the 'system innovation' perspective along with the application in the e-IDM context.

#### **variants and impacts of e-identification systems**

#### **understanding system innovations**

#### **democratic quality and e-participation**

In the field of governance and political participation a key issue is to what extent ICT can contribute to remedying democratic deficiencies and to enhancing democratic quality (*e-democracy*), while at the same time allowing for efficient governance. Electronic participation (*e-participation*) spans three major levels of intensity (information, communication, collaboration) and, accordingly it includes manifold forms, e.g. e-parliaments, e-campaigning, e-consultation, e-deliberation, e-petitions, e-referenda, e-voting). Major research questions embrace 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).

#### **e-participation in climate policies**

The international project E2DEMOCRACY (2009–2012) aims at advancing the knowledge on use and effects of e-participation, thereby contributing to closing the "evaluation gap" in this field. In a comparative study involving citi-

zen involvement in climate policies at the local-level in Austria, Germany and Spain, ITA will assess the effects of e-participation with a multidisciplinary approach. Participation processes studied include citizen panels providing consumption data for calculating individual CO<sub>2</sub> balances at regular intervals, and participation in various forms of dialogue on climate protection and related strategies (both online or offline). Collaboration with ITA's working group on "Technology and Sustainability" promises mutual benefits in operationalising the approach and with regard to insights on new governance methods. Based on another project, EDEM-EU, assessments of the potential of Internet-based applications and societal impacts of e-participation shall also be extended to 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.

**wider societal effects**

#### *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. 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 academic practices). When researching the evolution of networked environments, an integral focus of interest is the involvement of discursive practices and normative design decisions (e.g. software engineering processes). The conflation of different domains also entails new requirements for standardisation and the effective protection of fundamental rights.

The more the global ICT infrastructure becomes "smart", the more this development calls for TA. We expect a far-reaching societal impact 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. a loss of autonomy, total surveillance, and new security problems due to technological dependencies as well as the appearance 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 further 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 repositories shaping social relations and the interaction of people with knowledge resources. We can already observe, on the one hand, the rise of powerful commercial Internet actors (such as Google or Facebook) and hence a trend towards commodification of knowledge resources, and, on the other hand, a strengthening open access movement for knowledge creation and sharing (e.g. Wikipedia). 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 publication, cooperation, communication and knowledge representation ("cyberscience"). In this particular field, ITA intends to further build on previous research. The current project INTERACTIVE SCIENCE focuses on the impact of the Web 2.0 (such as social network sites) on academic practices. This line of research will be continued, with papers and applications for additional research funds.

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

**cyberscience**

**reflective design  
research**

The impact of computer technologies on our quality of life increasingly involves researchers with practices of technology development. In this spirit, TA aims to anticipate societal impacts of information technologies and suggests reflecting the normativity of computational artefacts and incorporating social learning into development processes. Locating a potential for value-based intervention at the micro/meso-level of development practices, ITA investigates how societal discourses unfold in software design and suggests integrating value-based perspectives as part of the design process. A project planned for 2011–2013 (DECONSTRUCTIVE DESIGN) will deal with the implementation of respective learning routines in software engineering processes. On this basis, research on the development of networked environments will enable us to focus on the co-evolution of these environments and the societal practices in design processes.

## 2.2 Technology and Sustainability

**the relevance of  
sustainability in TA**

Socio-economic challenges such as urbanisation and demographic change, economic shocks, as well as environmental problems and global warming resulted in a strong claim for sustainable development which increasingly receives scientific, societal and political attention. To reduce sustainability deficits, the societal impact of technologies and the socio-economic context of their implementation need to be taken into account at an early stage of technological development. This includes a shift from analysing specific technologies towards dealing with socio-technical areas. At ITA, we not only explore and assess the potential consequences of new technologies, 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, it tries to prefer socially robust explanations and to capture a more systemic view. The sustainability approach includes the view of a society embedded in natural systems. As a normative concept, it tries to achieve basic values such as generational fairness, distributional equity, prevention of risks, protection of resources, and public participation in political decision-making processes.

**participatory  
assessment**

The concept of sustainable development calls for the integration of ecological, social, political, economic and technical aspects, both in a local and a global context. A promising way to address frequently appearing goal conflicts are participatory processes. Therefore at the ITA, we build on inter- and transdisciplinary expertise, but also on procedural competence (e.g. to tackle multi-dimensional trade-offs). A main research question in this field is on the conditions and limits for the integration of scientific expertise as well as of knowledge generated in participatory procedures in the assessment approaches.

**sustainability  
assessment and  
learning processes**

Sustainability-oriented assessments lead to results and recommendations with practical relevance, only if they include contexts of use and future scenarios. The contribution of a technology to sustainability depends to a large extent on the way it is integrated into societal use and everyday routines. We provide TA-derived knowledge to support the learning process of technological innovation for policy-makers, users and other relevant stakeholders. In addi-

tion, knowledge generated in this context informs studies in our other research areas, in particular when it comes to (potentially) controversial technologies.

In our research, we focus on socio-technical and economic areas of particular relevance for sustainability. Central issues thereby will be low-carbon and renewable energy technologies, climate technologies, sustainable production and consumption of goods as well as technology induced innovations. Future research at ITA will address TA of selected key technologies as well as the transformation of socio-technical systems as a contribution to sustainability studies.

It is largely agreed that our current energy system has to undergo a radical change in the near future. Research at ITA will focus on selected key technologies but also on the transformation of the energy system towards a low-carbon model. In 2011 and 2012 results of the project E-TRANS 2050 will be disseminated. Related to the project SMART NEW WORLD?, which focuses on privacy issues of smart electricity metering, in the project SMART RESPONSE we aim at a comprehensive assessment of scenarios for demand-side management in Austria, and in the project €CO<sub>2</sub> MANAGEMENT we accompany a field study with smart meters. Following an exploratory study on consumers as electricity producers a study on smart grids development is proposed for 2012 and beyond.

Another socio-technical area, related to the challenge of climate change, we will focus on in 2012, is the field of climate technologies (such as heating, ventilation and air-conditioning) and their contributions to quality of life as perceived by the different actors as well as their economic perspectives. After an initial scanning phase in 2011, we will specify the research concept according to the definition of the related socio-technical system. This research also profits from our current and future work on the economic evaluation and the public perception of climate technologies and climate change issues.

In the next years a study on methodologies used for assessing the contribution of technologies to a sustainable development will focus on available and required inter- and transdisciplinary approaches of sustainability assessment and TA relevant methods in different engineering fields. In this context, we will continue to focus on engineering education as an important instrument to incorporate sustainability thinking and assessment at an early stage.

The research results in the area of technology and sustainability continuously provide insights on how stakeholders, policy-makers, users and even the general public are involved in the transformation of the whole life cycle of selected technologies within the socio-economic system. Additionally, we are interested in the identification of the underlying values for these changes. This will be addressed for example 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. This aim implies a need for accessible and usable products and services contributing to the well-being of older adults. With this we will address the social dimension of sustainability emphasizing socio-technical impact on the elderly. The following trade-offs have to be addressed and analysed in different future scenarios: the challenge to integrate various user groups and stakeholders into technical R&D processes and therefore confronting various world views and values (e.g. autonomy and privacy of individuals on one side and efficiency of systems on the other side); long-term versus short-term socio-economic

### **research topics**

### **sustainable energy technologies**

### **global warming as a challenge**

### **quality of life**

goals; social equality, social acceptability and affordability versus technological feasibility.

**two meta research questions** From a broader point of view, findings of our research contribute to national and international scientific debates on the questions “What is sustainability from a TA-perspective?” and “How can technology contribute to developments towards (more) sustainability?”

## 2.3 Governance of Controversial Technologies

### **controversies about new technologies as a starting point for TA**

The rapid growth of knowledge and the close coupling of science and technology development in the context of nano-, bio-, info-, and cognotechnosciences bring about technological innovation, but also new uncertainties and controversies. The focus of controversies is both on concrete applications and on the question of how research should be done and what its aim should be. Similar to benefits expected from the application of a technology, controversies are not yet manifest but anticipated to emerge. 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; this knowledge also contributes to our governance-related analyses in other research areas.

### **co-evolution of conflicts and governance regimes**

Technology controversies have different bones of contention and problem dimensions (such as risk issues or ethical 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.

### **risk and ethics as problem frames**

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.

Political decision-makers and technology developers have become increasingly sensitive to manifest, but also to latent 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.

### **plural assessments**

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.

### **analysis of technology controversies**

In our research we address the governance of controversial technologies such as novel biomedical technologies, nanotechnology or synthetic biology. We look for insights into the typical structures and the development of controver-

sies and explore paths towards new modes of governance. We empirically analyse different types of controversies over knowledge claims, values or interests, the way the general public perceives problems as well as different forums and ways of negotiating solutions. Furthermore, we prepare for possible next “big issues”, e.g. converging technologies – the expected coalescence of bio-, info-, cogno- and nanotechnologies – or perspectives of human enhancement via neuro-scientific applications.

Synthetic biology and cognitive sciences are important fields of expected controversies. In the project MAKING PERFECT LIFE for the European Parliament we investigate these new approaches towards engineering the human body, the brain, and intelligent objects. On the basis of a case study, potentially controversial issues will be identified such as the claim of creating life. In the project TOWARDS A HOLISTIC CONCEPTION OF LIFE? (2010–2013) systems biology is investigated as a practical field of research as well as an object of discourse. The project aims at a detailed description of systems biology research in Austria, its inherent preconditions and social implications, and at engaging in a dialogue with scientists and societal actors connected to the diffusion and regulation of systems biology. The project REFLEXIVE SYSTEMS BIOLOGY (2010–2012) addresses the tension between complexity-oriented approaches and traditional quests for reductionism in biology. The aim is to explore how scientific controversies relate to public discourse.

Nanotechnology is an emerging field where conflicts are expected in particular, not the least because of intractable risk claims. The project NANOTRUST (2007–2013) draws upon research results from investigating previous technology controversies. It combines an analysis of on-going regulatory approaches, of current knowledge regarding potential health risks 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 academic debate on anticipatory risk governance in this field.

**engineering life:  
synthetic biology**

**systems biology  
between complexity  
and reductionism**

**nanotechnology  
governance**

## 2.4 TA Basics

The relation between different tasks and functions of TA such as knowledge generation and policy advice raises questions regarding conceptual claims and practical perspectives. As a major institution within the European TA network, ITA engages in more general discussions over these tasks and ways to meet them. In the past, such endeavours resulted in contributions to the literature on issues such as institutional settings and relations (e.g. TA and parliaments), methods (e.g. participatory approaches, Delphi, expert interviews) and other generally TA-relevant topics (e.g. inter- and transdisciplinarity). In a mid-term perspective ITA will continue to collect, systematise and assess different practices and forms of institutionalisation, refine and develop the methodological toolbox of TA, and explore areas that may prove relevant for future TA research. Important arenas for these cross-cutting activities are – apart from dedicated projects – our annual international TA conferences, which frequently lead to special issues of scientific journals or thoroughly edited proceedings.

The practice and evaluation of interdisciplinary research aimed at political advice often needs to reconcile divergent requirements. There are various approaches within TA that fulfil these requirements differently. TA therefore appears multi-faceted, yet there are strong communalities. To specify the different approaches, to further develop these communalities and to enhance

**ITA contributes to**  
- **institutional issues**  
- **basic concepts**  
- **methodology**  
- **monitoring**

**elaborating  
conceptual  
frameworks**

	<p>performance, the international network of institutionalised TA engages in elaborating new or improving existing conceptual frameworks in an ongoing process. The project work at ITA addresses, for example, normative foundations and epistemic specificities of different scientific fields; we aim at taking these findings to a more general level to render them useful for the international TA community.</p>
<p><b>refinement of TA-relevant methods</b></p>	<p>TA-relevant methods include the proven toolbox of empirical social research as well as TA specific instruments such as scenario workshops or backcasting. In the coming period, special emphasis will be put on integrating methods to assess economic impacts of novel technologies, another on participatory TA methods.</p>
<p><b>exploring and assessing the potential of participatory TA (pTA)</b></p>	<p>Particularly in technology conflicts and in approaches to shaping technologies, participation of citizens and/or stakeholders is relevant. However, participatory activities have not always been able to fully meet the high expectations towards such procedures. In order to determine the potential of participatory technology assessment (pTA) ITA considers carrying out a comprehensive survey over experiences with past participatory exercises in the context of TA. Since the 1990s, ITA has been exploring and evaluating participation experiments theoretically and conceptually in order to gain insights into their functioning and appropriateness, which it will continue to do. More recently, ITA also actively organised and facilitated a number of pTA projects (WWVIEWS and CIVISTI). Depending on topicality, ITA will continue to include participatory methods in relevant proposals provided experiences from pTA projects can be fed back into scholarly reflections on participation.</p>
<p><b>PACITA: enhancing TA in Europe</b></p>	<p>The new EU project PACITA (2011–2014) is a major endeavour within the ‘TA Basics’ research area that involves multiple tasks. On an international level, it aims at increasing the capacity and enhancing the institutional foundation for knowledge-based policy-making on issues involving science, technology and innovation, mainly based upon the diversity of practices in parliamentary TA. PACITA will document these practices, describe schemes for using them trans-nationally and at the European level and establish a set of training schemes for users and practitioners. Furthermore, PACITA will provide three large exemplary projects on expert-based practice, stakeholder involvement and citizen consultation. This effort will be supported by a strong dissemination strategy towards the scientific community, media and other European countries. Thus, it will collect, analyse and make accessible in a systematic way various TA approaches and methods including pTA with a view to further enhance TA in Europe.</p>
<p><b>monitoring, trend observation, horizon scanning</b></p>	<p>The systematic observation of technological trends and societal developments in technology policy is an integral part of TA. Horizon scanning workshops with external experts and thematic focuses will serve to identify emerging research questions. As with nanotechnology, synthetic biology or systems biology in recent years, we have now started to observe so-called converging technologies and ubiquitous computing, which will eventually lead to new projects. We will use the CIVISTI methodology to identify emerging topics for R&amp;D policy at national and European level through citizens’ consultation processes.</p>

### 3 Beyond 2014

Both emerging technologies, i.e. novel technological developments that are subsumed under a common term but are still elusive with respect to their characteristics, and the challenges of a changing society are moving targets ITA needs to be continually responsive to and is well placed to do so.

Beyond 2014 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, ITA will adapt its research programme based on trend monitoring (section 2.4 above). 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.

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 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).
- 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. The more the global information and communication infrastructure becomes “smart” the more relevant TA gets. Among other issues, privacy, human dignity, digital divide, and the redefinition of digital citizenship will be central in a world with ambient intelligence, autonomous systems and smart security technologies.

**emerging technologies and society as moving targets**

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

**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”**