

Factsheet 5

Research and Education: Drivers of Transformation

The transformation towards a sustainable, low-carbon society is a societal search process (Factsheet 4/2011). Although specific sustainability objectives can be defined, it is not possible to provide an exact description of the state of the economy and the society ultimately aspired to. Research and education have a key role to play in this societal search process. In co-operation with policy-makers, business and society at large, the scientific community is tasked with developing visions for a low-carbon society, exploring various development pathways, and supporting sustainable technological and social innovations. Education should help to create problem awareness and promote systemic thinking, thus empowering people to participate in and shape the transformation process.

The WBGU's core messages: An overview

- › Transformation is a knowledge-based societal search process involving all social actors. It requires the scientific community to show a high degree of social responsibility.
- › In order to support this transformation, cooperation between and much closer integration of a range of scientific disciplines are essential; this must be enhanced by a systemic perspective.
- › Social and technological innovations need to be developed and disseminated, requiring broad-based scientific support.
- › The WBGU proposes the establishment of a new scientific discipline – ‘transformation research’ – which specifically addresses transformation processes.
- › Society's participation in developing research issues, in the research process itself and in the debate about its findings will be key factors determining the success of the transformation process.
- › Participative education which addresses issues of relevance to the transformation has an essential role to play in empowering society to make an active contribution to the transformation towards sustainability.

A new contract between science and society

A new contract between the scientific community, society and industry could help to align science and research more closely to the needs of the transformation process.

Freedom of research is a crucial element of the science system, as well as being vital for social progress. Nonetheless, science and research must be aligned more closely to the needs of the transformation process, so that they can make a greater contribution to solving the problems arising in this context.

Here, a new contract could potentially be forged between science and society. Within this framework, society's task is to (help) identify relevant problems and provide sufficient resources for their investigation and analysis. In return, an ever-increasing proportion of scientific and business activities would

need to be aligned to the social objectives of the transformation.

Moreover, research must not only be judged by its peers: it must also be judged by the extent to which it develops credible and appropriate solutions to the problems identified. This should not entail more politicisation of science or abrogation of the scientific procedures of self control. Policy-makers would not only need to provide more research funding but would also be tasked with initiating social dialogues about the wider goals of research and development activities.

The four transformative pillars of the knowledge society

In order to clarify the different roles played by research and education in the transformation process, WBGU proposes four different categories, which it terms 'transformative pillars' (Fig. 1).

1. *Transformation research* is a new scientific discipline which focuses specifically on our understanding of transformation processes in a historical and present-day context. It identifies specific determinants and causal relationships in the general context of transformations, and relates them to the future transformations towards a low-carbon society.
2. *Transformative research* actively advances the transformation by developing innovations in relevant sectors. It includes, for example, research into alternative patterns of consumption, which is essential for the development of new business models such as the shared use of resource-intensive infrastructures, as well as research into technological innovations, e.g. efficiency technologies.
3. *Transformation education* makes the findings of transformation research available to society and critically reflects on the basic requirements for transformative action.
4. *Transformative education* generates an understanding of action paths and possible solutions. Related educational content focuses, for example, on innovations that are likely to have, or have already had, transformative impact.

Structural challenges: 1. Inter- and transdisciplinarity

Due to the complexity of the transformation process, the various scientific disciplines should engage in problem-oriented joint research to a far greater extent and also draw on external knowledge.

An interdisciplinary approach ('interdisciplinarity') is an important element of transformation-related research and education. At present, most research is highly specialised within its separate disciplines. However, environmentally harmful activities impact on many different parts of the Earth System, affecting natural systems as well as various dimensions of human society. The causes of climate change, its effects and interdependencies are far too complex to be described and understood by a single-discipline approach. The impacts of the various solutions, too, can only be properly determined via a systemic and interdisciplinary approach: this is because the solution to one particular problem often has a knock-on effect in other areas. Existing interdisciplinary approaches are often confined to the exploration of a topic from various single-discipline standpoints, instead of adopting a systemic perspective on causes, effects,

and the linkages between them. Far-reaching transformations are the result of technological and institutional changes, as well as changes in individuals' behaviour, and their interaction. Only a systemic, interdisciplinary approach to research can take adequate account of this complexity and develop effective proposals for action. Accordingly, education programmes should overcome the boundaries between the various disciplines and impart an awareness of global interdependencies. Increasing education's relevance to society, also by integrating practical knowledge (such as local, traditional or indigenous knowledge), can be achieved by involving stakeholders, on a transdisciplinary basis, in identifying research issues and the objectives that it should seek to achieve. Stakeholders should also participate in the research process and in social discourses about its findings.

Structural challenges: 2. Participation

Increased participation (ownership) by society is a key factor for a successful transformation towards a low-carbon society. This applies to research and education as well.

More civil society participation in transformation-related research increases its social relevance and legitimacy, enables different stakeholders' knowledge to be integrated into the research process and, in an ideal scenario, enhances the legitimacy and acceptance of transformation-relevant policies.

Participation in the research process can take a variety of forms. For example, the acquisition and dissemination of knowledge about natural and environmental processes that is achieved via participation in research can promote a sense of ownership. One way of doing this is by involving non-scientists in the research process, e.g. in the identification of research topics and the generation

of data. This integration of 'laypersons' facilitates the public's identification with the research topic, and is a way of increasing acceptance of research processes in general and its findings in particular.

Here too, education and research are interlinked. Greater social participation enhances the quality of research by promoting analysis and debate about the norms, values and bodies of knowledge which exist in wider society. At the same time, knowledge about the research process is disseminated outside the science system. In terms of the present transformation in particular, it is important to understand and to act upon scientific probabilities.

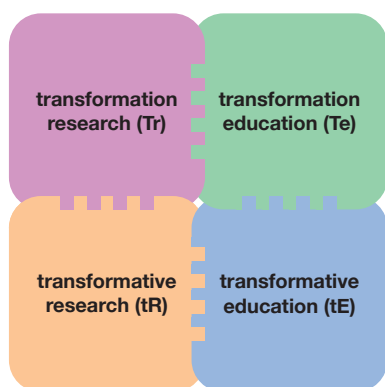


Figure 1
Typification of transformation research and education.
Source: WBGU, Flagship Report 2011

Transformation research – a new scientific discipline

A new scientific discipline should promote a greater conceptual understanding of factors of relevance to the transformation and their catalysing effects and interactions.

Transformation research aims to identify, at an early stage, key factors of relevance to transformation, including potential barriers. It seeks to pool knowledge about technological, social and environmental factors from a variety of disciplines in order to gain deep insights into the multitude of causal connections between them. It aims, inter alia, to analyse transformation processes that have occurred over the course of history in order to identify their transformative elements and assess their relevance to the present-day context. To that end, new interdisciplinary methodologies must be developed in close cooperation with futures studies and systems research; the insights gained should feed into transformative research.

Requirements for transformative research

The criteria governing transformative research need to be developed on the basis of the challenges which lie ahead (Table 1).

In order to achieve significant impacts, research should focus to a greater extent on issues of relevance to the goal of achieving the transformation towards a low-carbon society within the context of global sustainability. In order for research to provide effective support for this transformation, its findings must address three essential components: (1) they should help to develop

and evaluate technological and social low-carbon innovations, (2) they should assess the social conditions required for their dissemination, and (3) they should develop strategies and policy options to shape the transformation process. This will require an inter- and trans-disciplinary framework.

Table 1
Requirements for research for the transformation.
Source: WBGU, Flagship Report 2011

Goal	Structure	Result components
Global transformation towards a low-carbon society by 2050	Systemic Interdisciplinary Cross-disciplinary	Low-carbon innovations Conditions for diffusion
Global sustainability context	International cooperation Reflexive Long-term	Political strategies

Transformation education for participation

Education programmes should offer opportunities for creative debate about the scientific findings relating to global change and its social implications.

Education facilitates active engagement by civil society within the societal search process of the transformation. Here, it is particularly important to develop a broader social understanding of what transformation means, and disseminate the findings of transformation research in a clear and comprehensible way.

Stakeholders should be encouraged to think more deeply about the role of actors and agency: for example, a focus on agents pioneering the transformation can pro-

mote an understanding of the role of the individual as a stakeholder and participant in global processes. This should aim to establish the bases for a normative discourse on future development pathways while encouraging self-reflection and ‘ownership’.

In order to ensure that this is achieved, a participatory approach should be adopted here too, in order to encourage analysis, debate and identification with the issues in question.

Transformative education

Subject-specific education should be expanded to include content of relevance to transformations. This could help to create future research capacities and increase acceptance of innovations.

Like transformative research, transformative education should establish links to key transformation factors within various disciplines. For example, physics lessons in schools could be used to convey a basic understanding of renewable energies and related technologies, while in parallel, international energy partnerships are discussed in the social science subjects. Here too, the boundaries

between the different disciplines should be transcended in order to promote a systemic understanding of broader global contexts. In economics, for example, global material flows, from resources to waste products such as CO₂, could be analysed in order to foster comprehension of the linkages between economic structures and environmental impacts.

Selected recommendations for research and education

- › Science and education should dedicate themselves even more to the challenges associated with the transformation towards a sustainable, low-carbon society, with more research on issues and topics of relevance to this process. The WBGU proposes the establishment of a new scientific discipline dedicated to the study of transformation processes.
- › In order to meet the challenges associated with the transformation, a substantial increase in R&D funding is required. In parallel, research should be better coordinated at the international level, as no country can develop all the necessary solutions on its own. This applies especially (although not exclusively) to the energy sector as a key transformation field, where a ten-fold increase in resources is called for. Funding already committed to energy generation from nuclear fusion could be extended over a longer term to release funds for higher priority tasks.
- › In order to encourage more interdisciplinary research, existing incentive schemes should be modified and new schemes introduced. The WBGU proposes that, among others, the German Rectors' Conference, the Joint Science Conference, the German Research Foundation and the Academies of Sciences meet to consult on recommendations and directives for the implementation and evaluation of interdisciplinary transformation research.
- › Internationally, Germany and the EU should forge stronger research alliances with the emerging economies. Within the framework of its development cooperation, Germany should increase its funding and support for education, science and research capacities in the less developed countries.
- › The channels of communication between the research community, society and policy-makers should be further improved. Research findings should feed back into the political process to a greater extent.
- › Transformation-related education should be given higher priority in the German Sustainability Strategy and all ministerial strategies. It should also be integrated into school and university curricula, vocational training and further studies.
- › Thematically relevant education and training systems should focus more strongly on sustainable development issues.
- › The WBGU proposes an extensive education and research programme 'Participation in the Science for Transformation', aimed at education and knowledge for the benefit of the environment and sustainability, achieved through participation of non-scientists. Research policy and science should initiate scientific and social dialogues in order to strengthen participatory and inclusive research in support of the transformation. Civil society should thus be directly involved in developing and implementing the visions guiding the transformation process.
- › The WBGU proposes the introduction of a voluntary social year focusing on 'education and science'.

German Advisory Council on Global Change (WBGU)

The German Advisory Council on Global Change (WBGU) is an independent scientific advisory body set up by the German government. The WBGU provides policy-makers with recommendations for action and research. Its flagship report 'World in Transition – A Social Contract for Sustainability' can be downloaded from the WBGU website.

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