Degrowth R&D Research

icta

UAB Universitat Autònoma de Barcelona

Conference proceedings

# The contribution of innovations in the energy system to degrowth patterns

**Petra Wächter[a], Michael Ornetzeder[a], Harald Rohracher[b], Anna Schreuer[b], Matthias Weber[c], Klaus Kubeczko[c], Manfred Paier[c], Markus Knoflacher[c], Philipp Späth[d]**

a Institute of Technology Assessment, Austrian Academy of Sciences
b Inter-University Research Centre for Technology, Work and Culture
c Austrian Institute of Technology
d Institute of Forest and Environmental Policy, University of Freiburg

*petra.waechter@oeaw.ac.at*

## Abstract

In Europe, energy efficiency has steadily increased while also energy consumption rates have undergone the same development. That means that the situation would be even worse without improvements in technological possibilities. On the other hand, it shows that measures aimed at fostering energy efficiency stabilize the mechanism of economic markets and follow the rules of the growth paradigm. It is obvious that a rethinking of our consumption patterns in combination with our current energy use and the exploitation of resources is required. Moreover, we have to tackle the problem of this rebound effect and decouple the introduction of more efficient energy technologies from the rules of economic markets. Therefore, for the emergence of a new energy system, it is also necessary that different norms and values towards more energy sustainability including new actors and institutions replace the previous structure. In the ongoing project, within the framework of two stakeholder workshops scenarios for a sustainable energy future were developed and evaluated. Based on the participant's evaluation three strategic key action fields were identified: the spatial organisation of energy production and use, governance strategies dealing with complexity and uncertainty and the role of the civil society in the transformation of the energy system. Within these fields some critical issues will be explored that are highly relevant for system innovation. The aim is also to make a contribution to a shift to a more sustainable energy future detaching itself from the growth paradigm.

## Key words

Energy transition, scenario analysis, degrowing energy

# 1 Introduction

Especially in the discussion about a more sustainable energy system we have to be aware of the distinction between reducing energy demand because of efficiency improvements and less general energy demand due to less production and use of consumer goods. Energy supply and demand and the related energy system is one of the main factors in each economic system that has to be considered with major importance.

Above all, talking about sustainable energy has to be more widen than assess the availability of alternative energy sources. In order to make a contribution to a degrowth paradigm it is necessary to reflect critically the demand and supply of energy. The question arises which are the players in the energy system who are in the position to implement and enforce an energy demand lower than today's level. Thus, the aim of this paper is to identify the necessary changes of actors and institutions on the way to a more sustainable energy system, to explore key actions fields with a high potential for system innovation and also to complement existing quantitative modelling efforts with qualitative transformations. Furthermore, the preliminary results of the ongoing project E-Trans 2050 will be discussed in the view of necessary changes for targeting lower GDP growth rates.

The paper proceeds as follows: In chapter 2, the chosen scenario approach is introduced and the three developed energy scenarios are briefly illustrated. In Section 3, we present the key action fields that were identified and discuss the potential for system innovations along various sub-fields. Finally, in Section 4, the preliminary findings to a future research agenda for 'energy social science' from a degrowth perspective are presented.

# 2 Beyond energy scenarios

Foresight or scenario studies about the further development of energy systems have already been carried out in abundance, often focusing on different geographical scales (from global, to EU, national and even regional levels) or particular elements of the energy system (e.g. electricity system, renewable energy sources). Most of these scenarios have a strong 'output orientation', i.e. they aim at quantifying future energy consumption. While forecasting projects and roadmaps rather target the potentials of new technologies for future energy use, scenario studies tend to model energy use under different sets of assumptions about external factors (e.g. energy prices), economic development (and resulting changes in demand), policy measures (e.g. carbon taxation), changes in lifestyles (e.g. size of houses), or market penetration of particular technologies (e.g. fuel-efficient cars). These parameters are usually grouped into different consistent scenarios, such as business-as-usual, enforced energy savings, etc. Obviously these models and scenarios are heavily dependent on the nature of these assumptions about future socio-economic, institutional and cultural developments. However, as Berkhout and Hertin (2002) and others correctly point out, not enough effort has so far been put into picturing social and economic futures as an essential component of the assessment of, e.g. climate change impacts. Without doubt, this deficit also has to do with some fundamental problems: 'indeterminacy (imperfectly understood structures and processes), discontinuity (novelty and surprise in social systems), reflexivity (the ability of people and organizations to reflect about and adapt their behaviour) and framing (legitimately diverse opinions about the state of the world).' (Berkhout et al., 2002). As a consequence, enriching scenarios with social and economic considerations will also mean to go beyond the quantitative projections of many current scenario models.

The perspective on energy system developments taken in the E-Trans 2050 project thus is not to add a further quantitative modelling of energy scenarios, but to complement existing scenario models by putting more emphasis on their socio-economic, cultural and institutional foundations and by asking whether

such socio-technical visions of the future may also result in additional perspectives and strategies to foster energy system change towards more sustainability. Also economists dealing with energy systems articulate the need for more qualitative research on possible transformations within economic theory (e.g. Georgescu-Roegen, 1976) towards less resource intensive energy use. He proposes the transition to a sustainable society by a declining economy in contrast to Herman Daly (1973), who sees the solution towards more sustainability in an economy of steady state.

## 2.1 Three possible scenarios to an energy transition

The question arises how such an economic and energy system looks like and how is it possible to reach the goal of less and also of more efficient energy supply and demand. In order to gain a more visionary picture of possible future developments three scenarios with different socio-economic framework conditions were developed and formulated. In a next step, stakeholders and experts of the energy field discussed and advanced the scenarios in two workshops. The participation of stakeholders from various backgrounds underlines the interdisciplinary character of the project and incorporates different perspectives to describe more profoundly the complexity of the energy transition. The three scenarios describe a situation of (1) business-as-usual, of (2) sustainability and of (3) a crises.

The first scenario (business-as-usual) was developed to make a description of what will happen if we apply the strategies from today to the energy system of 2050. The predominant discourse is the faith in technological development as the solution to energy related problems. The mainly liberalized markets mediate the development and further refinement of financially profitable products and services in the energy sector. The same political and economic instruments and measures as today are applied as the main part of environmental policy. An effective ecological taxation system leads to a moderate internalisation of external effects but it also compensates negative social impacts. The institutional setup of the energy system and the political system remain unchanged but some of the corresponding competences are organized in a new form, especially regarding the authorities of national, provincial and communal policy institutions. The vision of the BAU scenario should give the impression of a stadium where the ongoing growth paradigm determines any economic activity, the society still believes in the same ideals and values and the energy system is still dominated by fossil fuels.

In the scenario of sustainability, a deep economical and energy related crisis induces a radical change of the whole energy system and its corresponding actors and institutions. The crises as well as the change are not a single sudden event, but the decreasing fossil energy resources and the devastating consequences of fast climate change result in a profound change of society step by step. At the beginning of the transition phase political institutions have a strong regulatory influence on the distribution of energy resources. The strong commitment of society to a change towards sustainability supports the regulatory intervention and strengthens community orientated governmental decisions. Moreover, the engagement of civil society includes strong involvement in participatory decision processes and taking the responsibility in ecological, economical and social affairs. Energy demand is mainly covered by renewable energy resources. The strategy heads towards two directions: on the one hand, the local, decentralised grid is extended where there are high capacities to supply and on the other hand, the international grids are enlarged for better distribution of electricity from more remote plants based on renewable energy. The scenario is characterised by profound changes in individual behaviour, changes of values, consumption patterns and a strong solidarity to fellow human beings and stewardship for the environment. People have learned from the crises and put effort into improving the quality of life in a sustainable way.

The scenario of “Break-down” should let us think about a possible unfavourable state of the future in order to be able to tackle energy problems in advance. It describes a situation of a prolonged economic and energy-related crisis. High and fluctuating energy prices lead to a rather protectionist behaviour and, as a consequence, to severe conflicts of resources. Economically well-situated countries still have the

power to protect themselves and their valuable energy sources, even with military power, and try to secure their access to fossil energy. Bilateral agreements are suspended where interests of the own country may be affected. Climate change is much faster and far-reaching than researchers expected and the effects therefore, lead to more problems than previously conceived. Even fossil fuels are decreasing fast and are sold at a high price. Renewable energy cannot replace fossil fuels to supply the energy demand, which further boosts the price, and they cannot fulfil the expectation of an 'energy revolution'. To some extent the negative impacts of climate change can be weakened, due to the ongoing economic crises resulting in reduced production and consumption and very high prices. Because of the severe consequences of climate change each country develops strategies to protect its natural resources and agriculture. The situation of break-down describes a stadium of economic and energy-related crisis and severe unfavourable consequences of climate change that are not possible to overcome because the society is hardly prepared. Basic needs can still be fulfilled and there are a few chances of a fast recovery of the ecological and economic systems.

# 3 Identified key action fields towards a sustainable energy transition

The concept of key action fields is central for the approach developed and applied in the context of the E-Trans 2050 project. Key action fields are centred on issues and options that are likely to be decisive for the future development trajectory to be taken. As such, key action fields can be interpreted as problem framings for key tipping or bifurcation points in the course of a transition trajectory. Key action fields offer different possibilities for shaping the future, and it will depend on specific actions taken which direction or pathway will prevail in the end.

*Identifying and selecting key action fields*

Several key action fields have been identified and selected at the expert workshops conducted in the context of the E-Trans 2050 project. The ones that were identified at the workshops cover, for instance, some well-known and well-established key action fields like economic instruments, international agreements, regulation, education and technological innovation, but also a number of socio-economic fields that may have been less prominent in the past debates about energy futures. However, the latter are complementary to the more prevalent key action fields and provide important enabling conditions for unlocking the potential associated to the former. Socio-economic issues represent important barriers to and enablers of the realisation of a more sustainable energy transition. In line with the purpose of our research work, namely to deepen our understanding of the role and the possibilities associated with socio-economic factors for the realisation of transition pathways, we subsequently focus on three socio-economic key action fields that were given priority in the E-Trans 2050 expert workshops:

1. The spatial organization of energy production and use
2. Reflexive governance
3. The role of civil society

*Specifying and describing key action fields: from key action fields to sub-fields*

Whereas the key action fields simply capture the decision areas that are critical for determining the direction of a future energy pathway, they do not yet address the question which actions to take and which specific issues to address in order to ensure a shift towards the most desirable, i.e. sustainable, pathway. Therefore, within each of the key action fields, we can identify more specific sub-fields that would allow shifting the transformation process in the direction of the most desirable scenario, and for avoiding the less desirable ones.

These sub-fields point at critical issues, i.e. at important pre-conditions to be met and potential conflicts that need to be resolved. Identifying and specifying these critical issues, positive as well as negative ones, is what we attempt to do for the three selected key action fields. The first key action field will be discussed in Section 3.1 more profoundly than the two following ones; the intention is to get an idea of what is meant by a subfield and its critical issues rather than describing all subfields.

## 3.1 The spatial organization of energy production and use

The aspect of land use and space in the energy sector is a far underdeveloped research topic. The significant increase in average living space per person and the ongoing urban sprawl all have severe implications with regard to energy consumption. Deficits in the implementation of spatial development plans and the distribution of relevant competences on national, regional and local level often lead to unplanned settlement in the open country and therefore to an increasing demand for energy intensive resources. The sustainability scenario highlights the need for new forms of spatial planning, moving towards more coordinated procedures. It underlines the need for legislative reforms, including a variety of spatial planning instruments such as establishing development axes and changing incentives related to transport.

Three highly relevant subfields could be identified so far which seem to have the potential for a profound system innovation:

*a. Energy issues in spatial planning*

Especially in Austria an ongoing tendency can be observed of uncoordinated settlement in the open country on the one hand and an increasing demand for space in the household and in the service sector on the other. This leads to a range of energy related problems: immense traffic volume, expenses and environmental effects of the accompanying infrastructure (sewage systems, grids, streets, increasing demand for water, electricity, heating, etc.). Sustainable spatial planning would therefore need to secure sustainable development from a long-term perspective. One very effective instrument could be the zoning/designation of areas on a more centralised level. Nowadays, most of the planning decisions are made at the level of municipalities, which can imply role conflicts and leading to outcomes inconsistent with the political objectives at higher levels.

In urban as well as in rural areas, urban sprawl is increasing due to a rising demand for land, especially in the household and service sector but also for industry. The related traffic emissions are increasing due to the resulting longer distances for going to work or to the supermarket. Two challenges can be identified to overcome this development: On the one hand, with a foresight-oriented spatial planning, new districts can be planned sustainably by avoiding long distances to fulfil the basic needs including work, schools, shops, medical provision and with a reasonable connection to public transport. On the other hand, on a more regional level, the enforcement of growth axes can provide chances for sustainable development by strengthening and expanding existing infrastructure. The availability of energy resources and public (line bound) modes of transport in an area should be one of the main decision criteria where these axes are developed. Concentrated housing in combination with the supply of public transport can be optimised according to the specific regional situation.

*b. The spatial distribution of energy production*

Also on the side of energy production, transition processes towards more sustainable systems of energy provision are likely to be tied up with far-reaching changes in its spatial organisation. As Patterson (2007) notes, siting decisions for power plants have for a long time followed the rationale that ‘a better power station was always a bigger power station farther away’. However, the introduction of renewable energy technologies and combined heat and power generation challenges this approach and introduces a much more decentralised distribution of energy generation, moving energy production closer to consumption

sites. What is more, this potential for decentralisation is not restricted to the technical infrastructure alone, but also applies to governance mechanisms, economic value chains as well as ownership patterns in the energy sector. Beyond that, regardless of the degree of (de)centralisation, new forms of energy generation are opening up new land use patterns, such as agricultural land used for energy crops or wind power plants in grasslands and mountain pastures.

While this creates opportunities, such as an increased use of regional resources, contributing to regional economic development and security of supply, it also involves risks, such as conflicts over land and a potential scarcity of usable areas as well as new challenges e.g. in load management. A considerable array of policy measures will be needed to deal with a more decentralised system of energy generation and new land use patterns. This includes technical issues such as grid regulation and load management but also new support programmes for regional energy initiatives, road maps for a variety of renewable energy technologies, and an adaptation of land use planning policies at various governance levels (detailed discussion in ÖROK, 2009) including measures to increase the coordination between different governance levels.

*c. New transport infrastructure*

The transport sector makes up almost one third of final energy consumption in the EU. What is more, it is the sector with the highest growth rates in the last decades (average annual rate of 1.8% from 1990 to 2006), mainly caused by growing fleets of passenger and goods road vehicles and a strong increase in the provision of air transport services (Huggins, 2009).

Spatial planning can influence energy consumption caused by transportation not only by re-organising settlement patterns (see above) but also through adaptation of existing and development of new transport infrastructure. Examples are intelligent transportation systems (including electronic toll collection and traffic management systems), city-logistic systems (e.g. advanced freight villages), underground cargo systems (e.g. 'classic' pipeline, cargo-caps), automated people mover systems, infrastructure for e-mobility (charging stations or exchange stations, use of renewables, integration to the existing grid) and new or revitalised inland waterways. It is obvious that the establishment of such infrastructure systems goes far beyond the strategies and measures provided by spatial planning. However, it is also clear that in all these cases questions of space use have to be dealt with.

New transport infrastructures certainly have the potential to reduce traffic volume of existing systems (e.g. due to transport of goods underground), to organise transport more efficiently (e.g. due to intelligent steering), or to stabilise the overall energy demand of the transport sector on a significantly lower level (e.g. due to higher efficiency of electric vehicles). Infrastructure to run electric vehicles on a large scale may also result in additional effects to reduce the energy demand. Electric cars, for instance, could be used as decentralised power stations; they also could provide power to help balance loads and buffer renewable energy sources. In general new infrastructure systems in the transport sector could help to change use patterns and to slow down growth rates permanently. Critical issues in this subfield include financing, the role of public authorities as main investors, the definition of standards, or potential competition (e.g. oil companies versus utilities).

These subfields should be explored according to their relevance with regard to potential system innovation.

## 3.2 Reflexive governance – governance strategies dealing with complexity and uncertainty

As the long-term development of the energy system involves high levels of risk and resilience, the question arises what governance structures would best support the transition to a more sustainable energy system. Social systems cannot be fully controlled but are governed through irritations and

interventions. Seeing social systems as autopoietic, operationally closed systems (Luhmann, 1985), means that policy makers and civil society alike have to accept that definite answers and fall-back solutions cannot be developed in advance and that all planning has to allow for surprises and experiments.

Conceptually, the 'reflexive governance' approach is a useful starting point to capture the topics that were raised in the scenario process. 'Reflexive governance refers to the problem of shaping societal development in the light of the reflexivity of steering strategies – the phenomenon that thinking and acting with respect to an object of steering also affects the subject and its ability to steer.' (Voß and Kemp, 2006). The identified subfields and critical issues address production-consumption systems and reflexive governance, reflexive policy making and knowledge production and dissemination as the basis for reflexive governance.

### 3.3 The role of the civil society

A prominent topic in the scenario discussions, especially for the scenario of radical change towards greater sustainability, was the crucial role civil society would have to play in such a transition process. Workshop members expressed concern about the need 'to radically reform our concept of policy making and rely less on the state and regulation as a panacea for change', or about the need to 'counteract the increasing concentration of power in the hands of a closely interwoven network of political and economic elites (especially in the Austrian corporatist system of 'social partnership' and the perceived influence of the utility industry on policy decisions).' Only widespread public concern possibly triggered by an experience of crisis or even catastrophe would lay the foundations for appropriate political and economic action. Without broad social support, the policies required for energy system transformation would not be feasible and effective, though at the same time a broad social movement without support from institutionalised politics would not have good chances for success either. These (certainly arguable) stakeholder opinions led to the conclusion that an increased role of civil society and participative, public deliberation procedures are of crucial importance to achieve a sustainable energy system and would mean a radical departure from current policy practices. Public policy needs to create better institutional frameworks for the participation of civil society. Without such changes the advent of increased hierarchisation and authoritarian policy regimes would be a real threat in face of an increasing energy and climate crisis and the complex social challenges we are confronting. The subfields discussed in the project are public participation in the energy field, citizens as energy producers, changing lifestyles and behaviour and open innovation processes.

## 4 Conclusions and implications for degrowth

The selected key action fields offer a first rough orientation for future research. Putting a stronger focus on spatial aspects of energy use and production, reflexive governance strategies and the role of the civil society could certainly deepen our understanding of the social conditions of long-term oriented socio-technical transformation processes.

The question arises what does the transition to a more sustainable energy system means for a transition to degrowth. Energy itself can be considered as one of the main factors for each economic system. The production and the use of energy determines the every day life of individuals as well as each production process. Because of the deep dependency on energy in all our activities and because of its strong influence on the economic system, changes in the production and use of energy leads to profound changes in the economic system as well. If the structures of supply and demand change in a way that it results in an equilibrium demanding less resources than today it would be indeed a major contribution to a degrowing economy.

The analysis of the spatial organisation of energy raised some critical issues. The massive extension of renewable energy sources may lead to land use conflicts because there is not enough land available to fulfil the needs if the demand on energy keeps on rising like in the past years. Competitive land use may lead to conflicts between different renewable energy sources but also between food and fuel production. Besides, using renewables does not necessarily mean producing energy in the most sustainable way possible. The erosion of land by planting monocultures of trees for biomass or large hydro power plants are only two examples where renewables have severe negative consequences for the environment although producing less greenhouse gases. Therefore, the scarcity of land makes a pressure on a growing economy demanding more energy. The maintenance of energy use on a stable or even lower level is a contribution to stabilize the economic circle on a lower level than today. Driven by natural limits of energy sources less energy use can be seen as the basis towards degrowth. As a result, the impact on degrowth reflects the importance of the spatial organisation of energy use.

Governing the structures of lower energy also requires different forms of organisations. Reflexive governance strategies provide the ability to impose a system flexible enough to react on different developments adequately. Reflexive policy making consists of a horizontal coordination of policy fields (energy, agriculture, climate, transport, construction and public procurement), a vertical coordination (between operative, administrative, and political decision making levels) and a multi-level coordination (between global, EU, national, and sub-national levels). The new forms of organisation of governance give the chance to long term changes which is a necessity to impose a degrowing society.

The role of the civil society interfering in reflexive governance structures is a main factor for the success of varying regional concepts. It is also (but not only) the civil society's responsibility to enforce a value change towards degrowth, also regarding new forms of civil engagement and innovations of actors and institutions, and to make a contribution to more stability in the energy system to maintain the ecological and economical capacities on a sustainable level. Moreover, the different valences and attitudes rely strongly on the access to information and exchanged knowledge, also to avoid unfavourable behaviour like rebound effects through energy and therefore money saving measures.

Linking the three key actions fields is unavoidable towards a transition to a degrowing economy with less energy use. Sustainable spatial planning is strongly related to governance structures which in turn has effects on the engagement of the civil society and vice versa. The analysis so far has shown that imposing new forms of organising a sustainable energy system is more than implementing efficient energy use and renewable energy resources.

## References


Berkhout, F., Hertin J., 2002. Foresight futures scenarios - developing and applying a participative strategic planning tool. Greener Development Management International 37, 37-52.

Berkhout, F., J. Hertin J., et al., 2002. Socio-economic futures in climate change impact assessment: using scenarios as `learning machines`. Global Environmental Change 12, 83-95.

Daly, H.E., 1973. Towards a steady state economy. Freeman, San Francisco.

Georgescu-Roegen, N., 1976/1972. Energy and economic myths, in: Energy and Economic Myths: Institutional and Analytical Economic Essays. Pergamom Press, New York, pp.3-35.

Huggins, D., 2009. Panorama of Transport, 1990-2006. eurostat: Statistical books, E. Commission, Luxembourg.

Luhmann, N., 1985. Soziale Systeme: Grundriß einer allgemeinen Theorie. Suhrkamp, Frankfurt/Main.

ÖROK, 2009. Energie und Raumentwicklung – Räumliche Potenziale erneuerbarer Energieträger. Schriftenreihe der österreichischen Raumordnungskonferenz, Wien.

Patterson, W., 2007. Keeping the Lights on: Towards Sustainable Electricity. Earthscan, London.

Voß, J.-P., Kemp, R., 2006. Sustainability and reflexive governance: introduction. Reflexive Governance for Sustainable Development. J.-P. Voss, D. Bauknecht and R. Kemp. Cheltenham, Glos, UK ; Northampton, MA, Edward Elgar: 3-27.

UNIVERSITAT DE BARCELONA

ECOLOGISTAS en acción

INITIATIVE INTERNATIONALE POUR REPENSER L'ÉCONOMIE

www.degrowth.eu