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Transition to Sustainable Production Systems - Austria 2020 Foresight Brief No. 021

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Overview

As part of the Federal Austrian Research Programme “Factory of Tomorrow”, the project “Transition to Sustainable Production Systems” served to explore possible future pathways in selected areas of sustainable production. Based on the development of future scenarios for the areas of ‘bio-refineries’ and ‘wood-plastic-composites/biopolymers’, strategic options for research, industry and ‘policy were explored. A particular emphasis was put on the role of RTD-policy.

Managing Transitions to Sustainable Production Consumption Systems

The 'Transition to Sustainable Production Systems' project is a forward looking accompanying measure funded by the Austrian national research programme 'The Factory of Tomorrow'. It aims to contribute to the further development of the programme in terms of strategic and thematic orientation, as well as to the wider debate about coordination between research and technology policy on the one hand and sustainability policy on the other. Moreover, as it is necessary for a small country to concentrate on selected areas of research and technology development, impulses from programmes in that field need to be focused on some promising areas; in this specific case by selecting and focusing on the transition of some specific production and consumption systems towards sustainability. The contribution of research and technology

programmes to long term transition strategies towards sustainable production is investigated at two levels:

- First, recommendations for the conceptualization of and priority-setting within sustainable technology programmes are developed.
- Secondly, based on the example of two selected transition fields, the potential for a strategic reshaping of production and consumption systems towards sustainability is explored, together with an assessment of the potential contribution of public RTD programmes and of the coordination needs with other policies and actors.

The two transition fields selected for this project concentrate on the production-consumption systems related to:

- Bio-refineries and to
- Wood-plastic-composites and bio-polymers (WPCs).

More specifically, the objectives of this forward-looking project have been:



- To develop socio-technical scenarios of transition processes towards sustainability-oriented production and consumption systems for two selected transition fields.
- To provide orientation for future research and technology policy measures as well as for other relevant policy fields by developing 'guiding visions' at the level of transition fields.
- To generalize the results with respect to research and technology policy strategies and programmes and transfer to other transition fields.
- To support learning and community building in the two transition fields under investigation.

Transition Fields as Point of Departure for Change

The strategic approach behind this foresight project is inspired by the concept of 'Transition Management'. Transition Management understands transformations towards sustainability as long-term systemic processes which cannot be governed in a centralistic or hierarchical way but whose success requires long-term coordinated and distributed learning processes at the levels of socio-technical niches, regimes and landscapes. Transitions presuppose system innovations which - beside technological innovations - include organizational, social and institutional changes to support the uptake and adjustment of sustainable technologies.

By focusing on specific transition fields – in this case on bio-refineries and WPCs, a link can be established between concrete technology projects on the one hand and general sustainability goals and visions on the other.

In contrast to energy supply, water management or transport, heterogeneous areas like production require the investigation of transitions in comparatively narrow fields. In particular, by specifying general visions of sustainable production and by combining them with technological developments in the transition fields it is possible to identify concrete interdependencies between technological opportunities, user needs and institutional environments.

Scenarios at the level of the transitions fields have been developed in a participative process with participants in the programme 'The Factory of Tomorrow' and with other stakeholders such as firms, research institutes, policy-makers and associations, in order to create a common orientation towards future development of these fields. In a first exploratory workshop key influential factors have been identified and combined to storylines that gave subsequently rise to different framework scenarios. In the two following workshops these scenarios have been further elaborated and assessed with regard to their impacts on sustainability, in terms of promising R&D strategies, and in terms of needs or opportunities for robust and adaptive policy strategies.

Towards Sustainable Production Systems

Bio-refineries as a New Production Model

Bio-refineries are integrated systems that combine physical, chemical and/or biotechnological processes and plants in which biogenic raw material of different origins is processed into a whole range of industrial intermediates and/or final products. It is the hope of advocates of the bio-refinery concept that these technologies and production concepts brought together under this notion will fundamentally transform the production process of many industrial goods, once they are adopted by industry.

With the concept of the bio-refinery it seems possible to substitute an increasing share of fossil – with its increasing scarcity and price volatility – with biogenic raw materials thus reduce CO₂ emissions and other negative environmental effects of fossil fuel consumption. Moreover, it is argued that in addition to the energy and resource efficiencies they provide, bio-refineries will gain importance because they provide opportunities to produce completely new products with qualities desired by consumers that go beyond biodegradability but that cannot be provided on the basis of petroleum based products.

However, it is still far from clear which broader scenarios would be compatible with and conducive for an uptake of bio-refineries, what the specific conditions for a successful diffusion would be, and whether they would indeed contribute to the transformation of the production system towards sustainability. In Austria, for instance, decentralized and small-scale 'green bio-refineries' have been considered to be a promising and sustainable concept.

Scenarios for the First 'Transition Field' Bio-refineries

Three scenarios about the future application of bio-refineries in Austria have been developed together with stakeholders interested in relevant fields of R&D or in the possible application of the bio-refinery concept:

The first scenario called 'Made in Styria' features conditions for the close cooperation of regional actors (local industry, farmers etc.) who implement a decentralized form of bio-refinery adapted to regional conditions, strongly supported by active and integrated policies in favor of sustainable agriculture and substitution of fossil resources.

The second scenario named 'Big players push for bio-refineries' suggests that trans-national companies could adopt

the concept at a large scale: They could invest in own R&D efforts, realize big scale centralized plants and would probably buy standardized biomass at low prices from agriculture in the wider region as well as from the international market.

In the third scenario entitled ‘**Following on from bio-energy**’, the production concept of the bio-refinery is realized as a consequence of developments in the energy system. Due to the widespread operation of bio-energy plants for biogas and biomass combustion as well as the existence of an extensive infrastructure for distribution, the separation of specific biomass fractions to be processed in bio-refineries as a chemical feedstock and use of the remaining biomaterial for energy generation can be achieved at very low additional cost.

These scenarios were assessed with regard to the opportunities and threats associated to them, especially with regard to the sustainability of these production systems. A special focus was put on barriers and systemic effects, prerequisites and critical framework conditions for the realization of the more sustainable versions of the most likely developments.

For instance, the future of bio-refineries depends heavily on adequate EU policies in the fields of agriculture and the use of resources, and on a supportive framework in industrial, structural, and regional development policies.

Detailed plans for required R&D activities were drawn up, including important features of instruments for strategy development, network building and R&D support by the participants of the workshops themselves.

Scenarios for the Second ‘Transition Field’ WPCs and Biopolymers

Wood plastic composites (WPCs) and bio-polymers became the subject of the second pilot transition field, because they are an example of a renewable resource and they involve growing R&D activities in Austria. The three scenarios developed for this cluster of technologies differ in terms of framework conditions and the degree of innovation that is achieved with WPCs and biopolymers:

The first scenario is called ‘**Substitution Pays off – WPCs**’. It is based on the observation that WPCs are already in use in some applications. In the context of this scenario the future potential of wood plastic composites (WPCs) could be exploited particularly due to rising prices of crude oil.

Increasingly, enterprises start to replace conventional plastics by WPCs. Where technical characteristics, weight and geometry are of importance, likewise, wood is substituted in some applications. However, R&D efforts predominantly concentrate on the development of WPCs to substitute plastic products. To some extent, also wood products are being replaced. The presence of R&D actors, producers, suppliers of equipment and customers in Austria, many of whom are networked through a competence centre, gives justified hope to maintain technological leadership.

The second scenario ‘**Substitution Pays off – biopolymers**’ concentrates on the perspectives for biopolymers. It also assumes a high level of crude oil prices, but the success of the scenario depends on coordinated efforts of agriculture to provide the raw materials for biopolymers. In the medium term, a major potential for the use of bio polymers exists in biodegradable packaging. Assuming political support from agricultural policy and environmental policy, the Austrian industry can position itself in global niches. In the long term, however, also product properties gain importance, which cover long-lasting and technologically new products, since the market potential for purely biologically degradable biopolymers is limited.

The third scenario ‘**Lighthouse Products with Appeal**’ emphasizes the ‘trend-setting character’ of new applications and products based on the new materials and the importance of demand orientation. Advanced applications of the ‘new materials’ are being developed, that are used in innovative products. The success of the scenario is based on making use of special properties of these materials, and on the buyers’ emotional perception of well-designed and marketed products.

This special appeal requires major efforts in product development, marketing and image development in order to boost the demand for the new materials.

Similar to the case of bio-refineries an assessment of opportunities and risks was conducted for all three scenarios. The evaluation of the sustainable development in connection with the scenarios was accomplished in six categories:

- The Economy
- Employment
- The environment
- Regional development
- Knowledge and
- Networks.

Moreover, the feasibility of the scenarios was evaluated by experts and participants.

Improving the Design Process for a Transition to Sustainability

Apart from the specific recommendations for the perspectives and the future shaping of the two transition fields, conclusions were drawn with respect to the design of research and technology programmes for sustainability, and in particular for

the further development of the programme 'The Factory of Tomorrow'.

The concept of focusing on the development of 'beacons' as a guiding principle of the programme shall be linked with systemic considerations to assure the integration with other policy measures which are of importance for the mid- to long-term perspectives of the topics addressed by the programme.

The link to international developments could be further improved in the case of the two selected fields, but most likely also in other areas.

A broadening of the perspective would have been supportive to develop more realistic concepts for the future of these technology fields in Austria. ERA-Net initiatives have started to assure such an international perspective at the strategic programme level, but this is not yet sufficiently developed at the level of individual projects.

In accordance with the transition perspective but also with the 'beacon' concept the continuity of thematic fields within the programme is of major importance to provide long term incentives.

The systematic identification, accompanying evaluation and where necessary the closing down of key topics should be standard elements of any such programme.

In spite of the necessity to focus on key areas and key tasks, considerations relating to the sectoral specificities should be

taken into account more prominently when defining technology-oriented programmes and exploring interdependencies with other policy areas.

The transition perspective and the methodology of participative scenario development have helped to establish a link between the strategic orientation of a research programme and the more comprehensive sustainability strategies that are central to other policy domains.

However, beyond the level of individual programmes, the developed methodology can serve to support research and technology policy at different levels and in different phases of the political process. It promises to be particularly helpful for the design phase of RTD programmes for example by maintaining a focus on thematic areas that are not only desirable but realistic in terms of their systemic development potential.

This design phase requires interaction between 'bottom up' mechanisms for the generation of new ideas and 'top down' activities of subsequent focusing, i.e. a pattern that is characteristic of the participative development of socio-technical scenarios from transition perspectives.

For the project at hand, 'transition fields' have been considered and applied in the context of research and technology programmes. However, this approach could also be applied at the level of national strategies for research, technology and innovation policy.

Sources and References

The Final report will be made available soon at:
<http://www.fabrikderzukunft.at>

About the EFMN: Policy Professionals dealing with RTD, Innovation and Economic Development increasingly recognize a need to base decisions on broadly based participative processes of deliberation and consultation with stakeholders. One of the most important tools they apply is FORESIGHT. The EFMN or European Foresight Monitoring Network supports policy professionals by monitoring and analyzing Foresight activities in the European Union, its neighbours and the world. The EFMN helps those involved in policy development to stay up to date on current practice in Foresight. It helps them to tap into a network of know-how and experience on issues related to the day to day design, management and execution of Foresight and Foresight related processes.