In: Klaus Jacob, Manfred Binder and Anna Wieczorek (eds.). 2004. Governance for Industrial Transformation. *Proceedings of the 2003 Berlin Conference on the Human Dimensions of Global Environmental Change*, Environmental Policy Research Centre: Berlin. pp. 201 – 207.

Industrial Transformation Between Ecological Modernisation and Structural Change

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Ecological Modernisation and its economic-technical and political potential

"Ecological modernisation" describes the wide spectrum of possible environmental improvements that can be achieved through technical innovations beyond end-of-pipe approaches (Jänicke 1985, 2000, Hajer 1995, Mol/Sonnenfeld 2000, Young 2000, Mol 2001). An environmental problem, for which we have a marketable technical solution, normally creates less political difficulty than one that requires "negative", restrictive intervention in the established production, consumption, or transport structures. The concept of ecological modernisation opens up both economic and political opportunities.

If the innovation is only incremental and its diffusion restricted to niche markets, the potential of a new technology to bring about environmental improvements is not fully exploited. Therefore, ecological modernisation as a political strategy essentially needs to aim at radical innovations with a maximum of market penetration. Given the global dimension of most environmental problems, a far-reaching penetration of the world market is required to realize the full environmental potential of the new technology.

Innovations in environment-friendly technologies increasingly tend to stand out by virtue of the following characteristics:

1. Environment-related innovation and diffusion processes are to a large degree politically determined (Porter/van der Linde, 1995; Wallace, 1995; Hemmelskamp et al. 2000, Jänicke/Jacob 2004). Due to market failure, they need political or at least societal support. Government therefore plays a role in environmental innovations that goes far beyond its role in R&D policy. Markets for environmental innovations are usually government-regulated or government-supported markets. In this context, NGOs such as Greenpeace can also play a market-creating role (e.g. the CFC-free refrigerator or the 3-liters-per-100-kilometers car).
2. Innovations in environment-friendly technology are a strong basis for environmental policy, by providing potential win-win solutionsn and hence open up new opportunities for action.

3. Environmental innovations are highly problem-related, which generally reduces the long-term uncertainty of predicting potential demand conditions (as normally encountered with "normal" consumer preferences). Given the increase in the world's population and industrial production and the decrease of the global environment's capacity to absorb the effects, the demand for environmental efficiency is likely to grow, thereby providing innovators with incentives to invest in environmental technologies.
4. Environmental problems have a world-wide dimension. Environment-friendly technologies, therefore, refer to "future global needs" (Beise, 1999: 3), which are very important for the creation of lead markets and represent a specific potential for international diffusion. That is why environment-friendly technologies have a good chance of meeting worldwide demand on global markets.
5. Contrary to fears of a competitive "race to the bottom" (Drezner 2001, Volgel 2001, Eliste / Fredricksson 1998), the environmental issue has to a certain degree become a dimension of the process of technological innovation in general. It has also become important in the competition for innovation between the highly developed countries (Jänicke/Jacob 2004). This is in conformity with the high correlation between an ambitious environmental policy and economic competitiveness (World Economic Forum, 2000). The causal relationship between the two is open to questions. But there seems to be a third explaining variable: GNP per capita. High national income means both, high *perceived* environmental pressure and high capacity to solve environmental problems. The combination of environmental pressure and capacity seems to be the crucial basis for environmental innovations and their early adoption in highly developed countries.

These findings explain why e. g. Porter/van der Linde have come to the conclusion, that "(h)ow an industry responds to environmental problems may, in fact, be a leading indicator of its overall competitiveness..." (Porter/van der Linde 1995). Many highly developed countries have formulated their strategy for sustainable developments in terms of a policy for innovation. The German red-green government, for example, which is in power since 1998, has explicitly adopted a program of "ecological modernisation".

Sectoral Environmental Strategies for "Dirty Industries"

The crucial task of environmentally sustainable development is to change policy sectors in *co-operation* with "their" economic clientele. Therefore, we should turn to sectoral strategies for polluting branches ("dirty industries"). There are basically two options for such strategies (beyond end-of-pipe treatment):

- Ecological modernisation of the sector in the sense of technological innovation (e. g. Japanese Steel industry or the Swedish paper industry)
- Inter-sectoral structural change, i. e. the reduction or even phasing-out of an environmental intensive industry (e. g. coal mining). Structural change may also may be understood as intra-sectoral change, if the discussion is about sectors that encompass a broad number of products and process technologies (e. g. change of modal split in the transport sector, change of energy mix in the energy sector, or increased organic farming in agriculture).

Ecological modernisation may not be no a sufficient solution where (a) the inherent logic of certain economic sectors or branches is responsible for the intensive use of environmental resources and (b) adequate technological solutions are not available.

In this case, structural solutions, i. e. the relative or absolute reduction of a product or process, may be indispensable.

To illustrate my argument, I come back to the case of Germany using two different examples: one for structural change (the planned phasing out of nuclear energy) and one for structural rigidity (the structural persistence of lignite coal mining).

Phasing out nuclear energy

Nuclear energy is an industry which – regarding production, transportation and the final deposition of waste – causes heavy risks for health and the environment. Except some incremental technological risk reductions, an adequate technical solution is so far not available. Therefore, "structural" solutions have been proposed, especially since the Chernobyl accident. In 2002, the German "Atom Energy Law" was amended to phase-out nuclear energy (1/3 of the power production) until 2020 (Mez / Piening 2002).The policy was based on "consensus" which – however - was not completely voluntary (stick behind the door, increased liability costs, forced intermediate storage installations). The first shut down has just taken place in Stade in 2003. The consensus with the power industry may not survive the present red-green government. The German case is however not completely exotic, since other European countries have also turned away from atomic energy. In the OECD countries, the nuclear capacity will be – at least up to 2010 – lower than today (OECD/NEA 2003). Up to 2010, there is only one nuclear power station proposed for construction in the EU (Finland). Even France – traditionally the main proponent of nuclear energy in the EU - has announced its plans to create 7 Gas power stations and support another 7 wind parks and other kinds of renewables, while refraining from the creation of new nuclear power stations (PLATTS 2004). In other words, the structural solution to the nuclear risk in Germany was party due to favourable framework conditions (costs, liberalisation, public opinion), but can also be understood as a purposeful strategy of eco-restructuring. The German phase-out policy has had a positive side-effect on innovations: The role of renewables as substitutes for nuclear power was radically improved. In this case, structural change was a good pre-condition for innovation and ecological modernisation.

The structural persistence of the German (lignite) coal industry

The German coal-based power industry (RWE, Vattenfal) provides the opposite example. As long as the elimination of CO_2 is no technological option (at least up to 2020), there is a fundamental contradiction between climate protection and power production based of the CO_2-intensive lignite coal. Due to the stability (in the West) and even the revival of the lignite coal sector (in the East of Germany), the CO_2 emissions of the power industry have increased by 6,4 % since 1999. This was in obvious contradiction with the ambitious climate protection policy of the German government. Without this increase, the CO_2 reduction would have reached a remarkable 18 % until 2002, while the actual reduction was only around 15,4%. Moreover, in 2004 the national implementation of EU-emission trading directive was opposed by a massive, well-organised campaign of the coal and power industry, which included demonstrations of workers and mobilisation of the media. The coal and power industry did not even hesitate to revoke a voluntary agreement on CO_2 reduction (45 Mio t. 1998 – 2010) signed only in 2003 by the leading industrial organisation and the government. Furthermore, the highly incompetitive German hard coal will be happy to receive some 16 billion € until to 2012. The powerful coal and power industry – a stronghold of the trade union - and their supporters in some federal states were also able to prevent the expansion of CHP and of modern gas power stations. In general,

they were able to undermine the credibility of the established climate policy and the pioneer role of Germany. In this case, the structural rigidity of a powerful environment-intensive industry clearly caused restrictions for ecological modernisation in other parts of the economy. The German case is highly illustrative for the present restrictions to climate policy throughout the world (taken countries like the US or Australia). Here, we clearly face a "structural problem" that cannot be solved only by means of ecological modernisation. The solution can only be found in a sectoral strategy beyond mere technological improvements. The political difficulty of this undertaking has been demonstrated.

Limits of Ecological Modernisation

The German case illustrates that environmental innovations do not necessarily lead to structural change. Structural rigidities can even prevent innovation or at least their diffusion; this could already be learned from the work of Schumpeter. Without overcoming the structural resistance of traditional environment-intensive branches, environmental innovations often remain within niche markets.

Sectoral strategies of eco-restructuring are not least relevant where ecological modernization reaches its limits. Ecological modernisation, as mentioned, relates to technical, system-compliant solutions to environmental problems (Jänicke 2000). The potential of this technological approach is remarkable - the present energy consumption of the world could be supplied by renewable energies. But potentially marketable technological solutions to environmental problems are not always available. The so far unsolved "persistent environmental problems" - namely climate change, but also land consumption, bio-diversity, threatened species and soil erosion as well as final storage for nuclear waste – illustrate these limits.

On top of this comes the fact that incremental increases in ecological efficiency are still no causal, sustained solution. They are easily wiped out by subsequent growth processes (e.g. specific emission reductions subsequently neutralised by increasing road traffic). These facts were recognized as early as the late 1970s as the "dilemma of the N curve" (Jänicke, 1979: 111). This up-down-up curve can be observed, when a problem has to be addressed in the context of growth imperatives and is treated not as a cause but as a symptom. This dilemma does not only apply to "clean-up" environmental protection (end-of-pipe treatment) but even to efficiency improvements. For example between 1973 and 1985, Japanese industries succeeded in saving energy and raw materials in a remarkable way, but the high industrial growth simply cancelled the positive effects.

Ecological modernisation therefore is, despite its impressive potential, not sufficient to ensure long-term environmental stabilisation. This is not only due to its inability to cope with all environmental problems, but also to a double "hare-and-hedgehog dilemma" of ecological modernisation. Firstly, we have the afore-mentioned race between incremental environmental relief and economic growth, and secondly ecological modernisation is confronted with structural limits imposed by "modernisation losers": If industries and private households save energy, cut their consumption of valuable raw materials, or use environmentally less intensive substitutes, all this will cause losses in the affected (supplying) industrial sectors e. g. mining, raw materials industry, power generation. However, these old industries, with established structures of power and influence, nonetheless often succeed in opening up new sales possibilities. For example, the power sector finds new uses for electricity, which in turn neutralize the above-mentioned efforts to save energy. Similarly, the successful environmental protection campaigns against using chlorine have since been counterbalanced by the expansion of chlorine uses in other areas. As long as environmentally intensive

sectors try to counteract ecologically desirable decreases in its production, we must go on reckoning with an environmental "N" curve. Ecological modernisation is thus severely hampered by the absence of genuine restructuring and by evasive behaviour on the part of the modernisation losers. Their reaction is of course all too understandable – as long as the adversely affected industries and regions have no alternative perspectives and change takes place in ways that are not economically and socially acceptable.

This is why the distinction between the system-compliant and very often successful path of ecological modernisation and the much more difficult, so far often unsuccessful, but indispensable path of ecological restructuring is necessary. Problem-solving in the form of ecological restructuring affects systems of behaviour which – irrespective of technical eco-efficiency improvements – stand out by their high environmental intensity. The distinguishing feature in most structural solutions is that they involve no marketable technologies and thus cannot use the inherent logic of the economic system as their driving force. Rather they rely on political-social mechanisms and capacities being set up over a long time, which require a different and disproportionately greater effort.

Green Industrial Policy as a Sectoral Strategy

Strategically, ecological industrial policy is above all to foster industrial restructuring by means that make it socially and economically acceptable (Binder/Petschow/Jänicke 2000). A strategy of eco-restructuring can promote diversification in other product types. The diversification even from heavy industry to tourism (as in the case of the Preussag AG) has proved to be possible. Industrial policy can also support reductions in production capacity where these are economically acceptable. It can also provide social cushioning, retraining as well as conversion and reorganisation assistance. The change is optimal if investment cycles are used for the transition to environmentally more applied products or processes. It makes a fundamental cost difference whether the transition follows this normal path of change or whether it is caused by sudden political interventions demanded by an alarmed public. Of course, industrial policy could also use alarming events as policy windows (whether anomalies, accidents, illnesses) if restrictions cannot be overcome otherwise. The best way would be to use this option as an argument during "negotiations in the shadow of hierarchy" (Scharpf 1991). A more general approach to achieve environmentally friendly structural change could be the reduction of environmentally harmful subsidies. As the OECD has shown, "the economic sectors with the largest share of global subsidies – agriculture / fisheries, transport, and energy, which account for 81 % of world's subsidies – are also those most responsible for greenhouse gas emissions, air pollution, and water pollution" (OECD-Observer 238, 2003, 39). Experience shows that even reduction of environmentally harmful subsidies requires intensive stakeholder dialogues. Structural change through industrial policy can be recommended especially in those sectors that face both ecological and economic crisis.

Box 1: Sectoral Strategies for Environment-intensive Industries

- Sectoral strategies based on environmental policy integration within government: Political leadership defining the role of the "responsible" policy sectors
- Sectoral dialogues about long-term perspectives on a broadened basis
- "Negotiation in the shadow of hierarchy" providing alternative regulatory options to negotiations
- Scientific input I: The contribution of the sector to long-term environmental problems
- Scientific input II: Long-term economic problems potentially caused by critical environmental events (e. g. Chernobyl, BSE, weather anomalies)
- Scientific input III: Alternatives, best practice (diversification, successful change management)
- Long-term investment perspective (investment cycle)
- Compensation of negative social effects of structural change (be "creative" but prevent *destruction*!)
- Change Management: Consensus conferences, network management, reporting.

The Dutch concept of "transition management" is of special interest in this context. According to Kemp and Loorbach, "transition management for sustainable development consists of deliberate attempts to work toward social, economic, and ecological objectives in a gradual, forward-looking manner in full recognition of system dynamics and windows of opportunity to effect change. Transition management is concerned with the normative orientation of socio-economic processes and seeks to overcome the conflict between long-term imperatives and short-term concerns" (Kemp/Loorbach 2003, 22).

It seems that the most important step in transition management is the common participative dialogue of sectoral stakeholders on long-term ecological risks, which at the same time cause economic risks. The confrontation of the respective sector or branch with science-based critical information about its future may be crucial. The German coal based power industry e. g. could be confronted with questions of its long-term competitiveness taken into account the probability of dramatic climate events and global pressure from countries suffering from increased poverty caused by climate change. This dialogue strategy can only be successful if stakeholders are participants of an institutionalised, well-managed, iterative process of consensus building about problems, long-term objectives and short-term steps (Joss 2000).

As mentioned before, this is no easy undertaking compared with ecological modernisation. But industrial transformation for sustainable development will often only succeed if it is "walking on two legs". In many cases, this transition does not seem "sustainable" without structural solutions in the sense of "creative destruction" (Schumpeter). But fear of destruction may at the same time be the most important obstacle to structural change. Governance of structural change should therefore be "creative", but not "destructive".

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