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Green Industrial Restructuring

International Case Studies and Theoretical Interpretations

With 96 Figures and 40 Tables

Springer

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Preface

This book presents the major results of two research projects carried out in the years 1995–2000. Their common subject was the decline of dirty industries in industrial countries, the driving forces of this decline, and its social management. Such a decline is one of the major challenges to any strategy of sustainable development, since reductions in energy and materials consumption almost inevitably lead to intersectoral structural changes at the cost of industries which provide materials or energy. Unfortunately, the economic, social and political costs of such changes are rarely considered in the environmental debate, let alone properly addressed in environmental policy proposals.

In the first project, financed by the German Science Foundation, the Environmental Policy Research Unit at the Free University Berlin (FFU) developed the analytical framework and the research design for case studies on declining dirty industries and analysed decreases in German steel, aluminium and chlorine production.

The second project, financed by the European Commission and conceived jointly by the FFU and the Institute for Ecological Economy Research Berlin (IÖW), sought to combine this approach with new theoretical perspectives which have gained prominence in economics in recent decades – namely evolutionary economics and theories focusing on institutions, networks and firms. In the project, working within a common research framework, researchers in Austria, Denmark, France, Germany and the Netherlands studied cases of (at least temporarily) declining dirty industries. We invited proponents of the aforementioned theories to discuss these case studies at two workshops. The first of these, in Berlin in October 1997, focused on different views of structural change, while the second, in Vienna in October 1998, focused on policy questions. With this design we hoped to set in motion an itinerate process in which empirical case studies and theoretical approaches would increasingly influence each other. As always, this interdisciplinary work proved difficult. The outcome, however, shows that such an approach is fruitful for the advance of research, as well as for the development of green policies which seek to overcome environmental problems through structural change. The major contributions to the research projects – case studies as well as theoretical considerations – went through a process of presentation and interdisciplinary discussion at the workshops and are now presented in this book.

The editors wish to thank the European Commission and the German Science Foundation for their support and all participants for their stimulating, profound

and, more often than not, underpaid input. We are also grateful to Sylvia Theodos for letting us forget the administrative side of research management. The texts were translated into English with the help of Alex Sawyer and Michael Dills. The editors nevertheless take responsibility for any remaining errors or inadequacies. Our special thanks go to Klaus Jacob and Jan Nill, who helped co-ordinate the projects and edit this book and whose ideas shaped this research to a great extent.

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Introduction

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1 The Challenge of Green Industrial Restructuring

Structural change, the rise and decline of industries, is a vital characteristic of economic development and growth. New "sunrise" industries emerge while older "sunset" industries lose their former importance. From the point of view of environmental policy and sustainable development, structural change has become an important issue: "green industrial restructuring" at the expense of "dirty industries", with their high consumption of energy and raw materials, is now seen to be necessary, but is likely to cause social and economic problems and could also be blocked by vested interests. It is therefore crucial to analyse the forces behind environmentally friendly industrial change and of the possibilities of a respective industrial policy.

There are four possible ways in which the environmental burden from production can be reduced:

1. add-on measures: reducing damage to the environment by adding technologies, generally "end-of-pipe" equipment, rather than upgrading the existing plant
2. integrated measures: changing or substituting harmful processes without changing the output
3. structural change: a change in the composition of the output without affecting its value in terms of gross domestic product ("green industrial restructuring")
4. limiting growth: reduced GDP or at least its growth

Until now, environmental benefits from industry have come mainly from *end-of-pipe measures*. These measures are attractive to private enterprise and environmental policy-makers, because they do not entail changing existing technologies, organisational structures or the division of labour. But they are of no help in solving many of the most urgent environmental problems (greenhouse effect, waste arisings, etc.), insufficient to alleviate many others (e.g. noise), and in some cases they merely shift pollutants to other media or create new problems (e.g. the creation of highly toxic filter dust) or are economically or environmentally inefficient. The introduction of *clean technologies*, the second strategy listed above, has therefore become increasingly significant. The most promising integrated technologies bring savings in energy and materials, reducing demand for the supplier sectors, causing intersectoral structural change at their expense.

Nonetheless, this indirect form of *green industrial restructuring* might not prove sufficient from an environmental point of view. In addition, sectoral crises in the energy and materials supplier sectors are forcing businesses to seek new markets for their products – sometimes with success. If the crises take them by surprise, sunk costs in existing factories and machinery might make it sensible for them to start selling at below production costs. Since these basic sectors are themselves resource and pollution intensive, contributing a great deal not only to overall materials and energy consumption but also to emissions, solid waste production, transport volumes etc., reducing the activities of these "dirty industries" would benefit the environment in any case. For this reason, green industrial restructuring must be placed on the political agenda. It should be noted that a decline in basic industries in the industrialised world will not in itself guarantee sustainability, if these industries are simply relocated to less developed countries. Although research in this respect has not in fact been able to identify this tendency in many countries, and certainly not in industrialised countries as a whole, this potential should not be ignored.

Converting natural resources into products, solid waste and emissions across the globe must be considered a critical issue for the long-term health of the environment. Postulates that a *"dematerialization"* could take place, at least in highly developed countries, have become an important component of environmental policy. The focus of this research project has not been on dematerialization in general, but on the specific consequences of dematerialization for certain sectors of the economy and therefore on sectoral change there. As mentioned above, such a development could bring severe *social and economic consequences* in its wake and might be blocked by the potential loser branches. Dirty industries often play a rather important role as employers and political pressure groups, at least regionally. This is a problem not just for green industrial restructuring but for structural change as a whole. From the point of view of environmental policy, the problem has been highlighted in the debate on CO_2 taxes.

The issue of green industrial restructuring is intimately connected with *"autonomous" structural change*, its determining factors and the opportunities for influencing them. And a relative – in some cases absolute – decline in production by some environmentally intensive industries has indeed been taking place in industrialised countries since the 1970s. This has to some extent been due to economic factors such as energy price rises and market saturation.

But some important factors are not directly related to market forces – industrial restructuring is frequently influenced by *industrial policy*, which is in turn influenced by the aforementioned vested interests. The resulting policy is often defensive and structurally conservative (as for coal and steel, for example). Since the 1970s, however, environmental and energy supply problems have also led to government intervention at the expense of dirty industries. One example is the "anything but oil" strategy which – in conjunction with the explosion in oil prices – has led to a decline in mineral oil production in several OECD countries. In Japan, primary aluminium production, among other things, has even been curbed by law

(1978). Generally, however, several "dirty" industries still benefit a great deal more from the current industrial policies of the European Union and its member states than sunrise industries do, especially with regard to subsidies and state protectionism. Finally, environmental policy could itself be a determinant of industrial restructuring, and move towards a "green" industrial policy.

Due to the serious economic and social consequences, an inefficient industrial policy may even put obstacles in the way of innovation or restructuring which favours new industries. Thus, before there is any structural change, "green" or other, these obstacles may have to be eliminated first. And if "automatic" green industrial restructuring is insufficient, policy may need to challenge the might of economically successful industries.

The key question is therefore: what conditions bring about a more or less painless decline of dirty industries on the one hand, and support for the development of cleaner "sunrise" industries on the other? And what part, if any, could green industrial policy play in this restructuring process?

Unfortunately, there is a serious *lack of research* in this area. Economists have not been especially interested in the non-economic aspects of structural change, nor in most aspects of sectoral decline in general. There are very few detailed theories of structural change which can also account for decline. Until recently, they have been limited to a rather general, top-down analysis, with scant reference to the evolution of technologies, companies and institutions across sectors. Nevertheless, the crucial importance of these factors has been suggested, and is now increasingly being acknowledged.

The same is true for the political aspects. The traditional industrial policy debate focuses on the question of whether and how a shift from sunset to sunrise industries should be supported, in order to promote economic development and the competitiveness of national economies. This neglects the older basic industries: if some industries are growing or are expected to grow, others are shrinking or must shrink, at least in relative terms. Recent analytical approaches, however, are shedding a somewhat different light on the political implications.

Environmental economists have usually ignored the role of economic structural change in environmental policy, focusing instead on environmental modernisation and economic instruments, leaving out the structural implications. We do not therefore know much about the management of industrial restructuring from an environmental perspective, and very little indeed from the perspective of potential loser branches.

The empirical basis for analysing environmental aspects of industrial change is somewhat thin on the ground, too. In fact, the study of global environmental change in terms of industrial change still lacks a comprehensive research strategy. We do not even know exactly what is happening in many areas. Many people believe for example that "dirty industries" are being relocated to the developing countries, something flatly contradicted by the existing – albeit few – empirical studies.

Another popular view is the hypothesis of an end to the "era of materials", which suggests saturation in the demand for most basic materials in highly developed countries. If this were the case, it would give reason to hope for an environmental "Kuznets curve", i.e. a trend where, once a certain threshold value is passed, further economic growth no longer aggravates the state of the environment but tends rather to improve it. However, the available statistics are far from sufficient to support such an optimistic view.

2 A Brief Outline

Given this unsatisfactory state of affairs, we have developed a broad approach to the question of green industrial restructuring, by tackling empirical as well as theoretical aspects and by approaching the political aspects based on a broad analysis of structural change. On the theoretical side, we have evaluated and drawn upon different approaches, exploiting their insights for the analysis of industrial restructuring and its implications for policy, while on the empirical side we have conducted case studies. We focused on certain basic industries in Europe where at least a temporary decline in physical and economic production has been observed since the beginning of the 1970s. The results of these studies were then interpreted by experts, using approaches which explicitly consider the (usually neglected) roles of technology and economic actors, in these cases the affected companies and their networks. These interpretations are divided into some which focus on restructuring, whilst others highlight the political dimension.

We therefore not only stress the importance of the environmental dimension in current scientific and political debates on structural change and industrial policy, but also explore some new and widely neglected aspects of the discussion.

The report starts with an introduction to the case studies by *Binder*. These case studies focus on products of strategic importance to industries with above-average environmental problems, e.g. through high intensities of resource consumption, emissions, solid waste, transport, or through the risk of accidents. In the cases chosen, the output of these products declined in the country studied, at least temporarily. Since the decline in production took place against a backdrop of overall economic growth, this suggests green industrial restructuring as defined above (a change in the composition of national output to the detriment of dirty industries).

The cases were analysed by researchers in the corresponding countries:

- chlorine in Germany by *Jacob*
- fertilisers in Austria by *Payer*
- coal and steel in Germany and Luxembourg by *Binder and Schucht*
- aluminium in Germany by *Schucht*
- cement in Austria by *Hüttler*
- cement in Denmark by *Klemmensen*
- petroleum products in France by *Allal, Amorsi, Faucheux and Haake*
- petroleum products in the Netherlands by *Van der Straaten*

After the termination of the project, *Annette Piening* added a case study about nuclear energy in Germany, which is not included in the summary and could not be discussed by the other contributors to this book.

The full case studies form the final part of the report. Research started with a common questionnaire on the main features of the respective markets, the patterns of structural change, the forces driving the developments, the political and decision-making processes, and the possibilities for environmental intervention. Statistics are provided of international developments and profiles of change affecting materials or sectors.

The engines of decline in the use of specific materials, and consequently in the corresponding industries themselves, are many and varied. No general laws governing these changes can be discerned at present. The forces behind reduced material consumption, such as increased process efficiency, market saturation and substitution, have been important for green industrial restructuring; in our case studies this is especially true for cement and steel. In some cases, energy policy (the mineral oil industry) and environmental policy intervention (fertilisers in Austria, chlorine in Germany) have had some effect, although its role was typically a minor one. Other driving forces, such as loss of competitiveness or relocation to other industrialised countries were sometimes active, but can only explain changes in terms of production itself, whereas change in the actual demand for materials is crucial from the point of view of the global environment.

Jänicke assesses the plausibility of an end to the "era of materials", that is a decline in the basic industries of developed countries. A number of long-term developments may be contributing to this alleged trend, such as:

- the shift towards a "post-industrial", service-based society
- the rise of "post-materialism" which, among other things, may favour consumer behaviour which is more oriented around "non-material" criteria
- the increasing material productivity of manufacturing industry, due to input-saving modernisation and the shift towards more flexible and specialised forms of production
- the lower material intensity of basic industries brought about by improvements in product quality, e.g. the strength of steel

Nonetheless, a general dematerialization hypothesis can explain current trends in developed countries only to a limited extent: market forces, as well as political factors, are often working against this decline. Influences such as the rise in the costs of oil and other raw materials have had only temporary significance. The intensity of materials use in terms of GDP has generally fallen in advanced OECD countries such as the USA, Japan, Germany, the Netherlands and Austria. But the rate of the fall in specific materials consumption has not generally exceeded growth in GDP. An absolute fall in the total material input to production processes has not occurred anywhere. The curve described by total material input in highly developed countries is not a broad inverse U curve, but more often a sort of an N curve. Consumption of some of the materials covered in this volume, as well as

the total materials requirement of countries like the USA or Japan, exhibit this kind of up-down-up trend. The decline started with the oil crisis, but materials use increased again in the mid-1980s as economic growth picked up and the fall in materials intensity slowed down or halted altogether.

Following on from this, the present report assesses some economic theories of industrial restructuring. The contribution by *Zundel* offers an overview of traditional economic theories of structural change and their contribution to explaining green industrial restructuring. In order to do so, the complex relationship between economic and environmental structural change mentioned above is first unravelled and a number of caveats are made. Traditional economic theories of structural change, inasmuch as they exist at all, generally consider relative change between industries. To oversimplify for a moment, if these theories are applied to absolute declines, phenomena which they were never conceived to deal with, they give cause to hope for some kind of autonomous green industrial restructuring, predicting either a shift towards manufacturing and services or a relocation of old basic industries to developing countries. But their ability to account for the facts is very limited, mainly because they often operate at too high a level and completely ignore "political" forces, actors, and institutions.

There are some recent theoretical developments which are more open to these factors, and which could be helpful in analysing structural change and its political implications. These approaches are in some respects rooted in conventional economic theory, but their scope extends well beyond, borrowing from related disciplines, especially political science and business approaches. These theoretical developments and their possible applications to industrial restructuring are presented and evaluated in the contribution by *Nill and Petschow*, which covers evolutionary economics, neo-institutional economics, network theory and company-based approaches. At the same time, it places the interpretations of the case studies in a broader theoretical context.

Given its emphasis on change, evolutionary economics seems an appropriate approach to industrial restructuring, in particular when seen as a discontinuous process. Structural regularity and structural change are considered specific to countries or technologies. The application of this perspective to industrial restructuring seems promising.

From a neo-institutional perspective, institutions restrict the behaviour of agents, but are themselves influenced by actors and organisations. Public choice theory highlights the fact that collective action, e.g. by powerful interest groups, reduces flexibility and slows down industrial restructuring. A more dynamic view, along the lines of North, emphasises the interaction between technical progress and the institutional environment.

Network theories point out that networks and similar forms of coordination are very important to the course of economic and political processes. These include both innovation and diffusion networks, as well as networks which resist change, and they all determine to some extent the course of industrial restructuring.

The behaviour of firms can be viewed as the micro level of the observable phenomenon of industrial restructuring. The strategies and rationales of companies and their determinants are important, because they provide a sizeable part of the impetus towards structural change. In this interpretation, the major role of multinational enterprises must be emphasised.

Some generalisations are possible, particularly because these approaches can complement one another, for example the evolutionary and institutional or company and network perspectives. In these terms, industrial restructuring can be understood as the interaction between factor markets, technologies and institutions, and it should be stressed that "history matters", and will therefore have a significant influence on future trajectories.

Typically, the resulting structural change will be unpredictable. However, further research is both necessary and desirable. The potential inherent in many recent approaches to analysing industrial restructuring and industrial decline or stagnation has yet to be fully exploited. However, the above approaches do provide a means including such questions in an analysis. Three of these approaches – evolutionary, network and company-focused analysis – are demonstrated practically in three interpretations of the cases studies, by Jöst, Kenis and Ruigrok respectively.

An assessment of the environmental aspects of these approaches is not as straightforward as it might seem. They do not point to a kind of automatic decline, stressing instead restrictions but also opportunities for environmentally beneficial structural change. Hence, any permanent industrial decline must be organised, and at least some basic industries do or will need a *green* industrial policy. The need for environmental policy to act in this way is emphasised by Lehner.

In analysing the processes and actors involved in structural change, and in partially integrating the "political" determinants, some of the new approaches already go some way towards building a bridge between analysis and its political implications, especially in terms of the scope of industrial policy (see Nill and Petschow). At any rate, they acknowledge the need to include the institutional setting in any analysis, and to identify any specific characteristics, actor constellations and the regimes which are at work. Green industrial policy needs to take into account a multitude of factors and restrictions. From an analytical point of view, it should start from the dynamic interaction between markets, actors, networks and technologies, and therefore the political implications are further explored. Subsequently, Kolk and Kemp use a company-based and an evolutionary technology approach to the political aspects of the case studies.

Jöst presents a rather special evolutionary framework, integrating the theory of joint production and neo-Austrian capital theory. Industrial restructuring is brought about by innovation. The description of the development of economies using concepts from evolutionary economics shows that some elements of structural change are not predictable without analysis of past developments. He identifies two essential factors determining structural change in the case studies: on the one hand, scarcity of resources and environmental problems, to which companies

and societies responded with a change in production techniques and environmental regulation, and on the other hand, the two oil crises at the beginning of the 1970s and 1980s, which provided a strong incentive for changing technologies in order to reduce energy consumption. However, as his theoretical analysis shows, structural change does not automatically, i.e. for purely economic reasons, lead to a reduction in environmental pollution.

Kenis takes a sectoral network perspective on industrial restructuring. The existence of sectoral networks, of which he identifies several examples, affects the course of restructuring, as is found in the case studies. In the absence of sectoral networks, structural change is leading to faster and more radical decline in employment levels and production capacity in the aluminium industry, for example. The presence of sectoral networks has a far more ambivalent effect. The outcome is contingent on the type of structural change produced by the existing sectoral network. Structural change with sectoral networks can lead to outcomes which better safeguard production capacities and thus also often employment, because sectoral networks are often effective devices for internalising or externalising contingencies or uncertainties. This phenomenon of atypical decline due to the presence of sectoral networks can be observed in the cases of the French oil refineries and German coal-mining. Thirdly, sectoral networks need not necessarily concentrate on conserving existing production facilities and employment levels, but may develop collective strategies which help facilitate a minimisation of the economic and social consequences of structural change, especially if the sector is relatively "open".

Ruigrok combines a company-based approach with network theory. In his analysis of international industrial restructuring, he points to the importance of "industrial complexes", which develop around large core enterprises and imply different concepts of control. They constitute a kind of hierarchical network. The strategies of these complexes are shown to be decisive for industrial restructuring. On the one hand, industrial complexes may act comprehensively across sectors while, on the other hand, competing complexes may exist within a single sector. Different intersectoral strategies are a possible, albeit not inevitable, result of the activities of industrial complexes. The driving forces behind industrial restructuring do not therefore necessarily emerge from a single sectoral level.

None of these approaches assume any longer that autonomous market forces alone can explain or predict structural change. They clarify some of the conditions which any environmental strategy or "green" industrial policy must take into consideration: it must address not only the technical and organisational situation but also contradictory, to some extent endogenous, political intervention. The possibilities and limitations of such a green industrial policy are further explored in the subsequent articles.

Kolk focuses on the role of multinational enterprises (MNEs) in environmentally beneficial structural change and their interaction with governments. Core companies may have a heavy impact on regulatory authorities and other companies. Kolk takes a strategic environmental management approach, differentiating

between outside-in, inside-in and inside-out perspectives. She highlights the importance of MNEs in most of the cases, noting that they choose different environmental strategies. Referring extensively to the cases of petroleum and cement, the often restrictive impact of MNEs on environmental policies is demonstrated. Nevertheless, different regulatory traditions also partly explain the diversity of the cases. Given the importance of core businesses, the explicit promotion of strategic environmental management within these firms is seen as a way to further green industrial restructuring.

Kemp explores the challenges of eco-restructuring from the political side, using insights from technology studies and evolutionary system approaches. He states that little experience has been gained from policies aiming at "creative destruction" or system renewal. Starting from the production chain, Kemp shows that the window of opportunity for making integrated process change is limited. This is due not only to the influence of economic, policy and innovation networks, but also to the technological trajectories which make radical change difficult. Thus it is not surprising that the case studies show few examples of major product and process change, and it is hard for policy to make industry adopt environmental measures that entail financial loss. Kemp proposes and explores strategic niche management as a probe-and-learn method for exploring the potential for environmentally friendly innovation and managing the introduction process by providing a mixture out of initial protection and selective market pressure. Government acts mainly as a facilitator of new approaches.

The starting point of the contribution by *Lehner* is the current lack of competitiveness of the European economy. He points out that the problems of unemployment and weak growth rates have their main causes in a late structural shift towards knowledge intensive economies. He states that delayed structural change is also a major reason for current environmental problems and that a radical environmental policy could be a key force for innovation and structural change towards a knowledge-based and service-oriented economy. According to his analysis, the case studies show that there are rather large similarities within Europe, in that environmental policy has had no effect on structural change. It is a type of policy which is integrated into the dominant industrial structures and fits in with incremental innovation and change, the dominant pattern in most European industry. As a result, he concludes that there is a need for a more radical environmental policy, as an innovation policy to overcome existing structures and structural deficits in the European economy.

3 Conclusion: Towards a Green Industrial Policy?

The interpretations offer some advice on strategies for coping with the difficulties a green industrial policy will encounter. For a long time, mainstream economics did not consider the influence of government action on the structure of the economy. "Outsiders", however, have always pointed to the possible benefits to be

gained from political action. Recent developments in traditional economic theory are now also suggesting that interventionist industrial policy could in fact promote economic development. While the classic debate on the justification for industrial policy remains, a *green* industrial policy brings a new dimension into the discussion. It does not primarily aim at growth and (short-term) competitiveness, but does integrate the negative "externalities" of such an orientation. With respect to "picking winners" – the specific support of new industries and technologies –, this implies a need to screen these industries environmentally. Green arguments not only point to further disadvantages from strategies to conserve heavily polluting industries such as coal, steel etc.: a green industrial policy should aim at a decline of (parts of) particularly dirty industries ("picking losers").

Such an approach is quite new and research is only at an early stage. The potential difficulties arising from restructuring are often neglected in traditional policy concepts. Political management of structural change is a complex task for regulators. Green industrial policy must consider a range of different influences and restrictions, such as the sectoral or regional conditions and the interaction between actors, technologies and institutions. Screening the cases under this aspect points up some important aspects of green industrial policy.

No common pattern of political influence caused structural change in our case studies. Only in two cases did environmental policy operate partly as a green industrial policy. The example of chlorine in Germany shows that agenda setting by environmental policy actors can contribute to industrial restructuring in the long term. The demonstrability of the environmental consequences of some chlorine uses and a broad discussion of possible regulation encouraged the development of technical alternatives. Doubts about a key process and the threat of regulation led to a restructuring of the sector and a fall in chlorine production at the end of the 1980s, before regulations actually came into effect.

The example also points to limitations: a more far-reaching green industrial policy, as lobbied for by environmental groups, has been successfully blocked by a close political network of the industrial association, the union and the industry ministry. Only an internal restructuring of the industry, with limited effects on employment and the region was feasible.

Environmental policy played a part in the decline of Austrian fertiliser production, too, but not a decisive one. Between 1986 and 1994 a fertiliser tax, and later a limit on the use of fertiliser in agriculture, contributed to falling demand. The industry, which is essentially shared between two oligopolies, could partially compensate for declining demand with increased exports. At the end of the 1980s, the profitability of reinvestments by one of the two firms was only assured by a state subsidy from environmental funds. Environmental pressure groups, the ministry of the environment and some economists were loath to pay this subsidy, but the company and the ministry of industry won through, and investment was subsidised, even though the effects on employment were minor.

Other cases also demonstrate the limitations of far-reaching environmental policies. In the Danish cement industry, the Danish-English monopolist used ex-