

Ecological Modernization — Origins, Dilemmas and Future Directions

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ABSTRACT Several of the preceding contributions to this special issue have raised critical comments and questions on the concept and research agenda of ecological modernization. It is our impression that these comments not only reflect academic ingenuity, but also a broader and growing hesitation about the concept and its usefulness, as similar scepticism was also expressed by participants at the international workshop on ecological modernization in Helsinki. As the term ecological modernization has grown popular among leading politicians and policy-makers, so has the dilution of it. In this paper, we make an attempt to move away from the purely heuristic use of ecological modernization, by clarifying both its origins and meanings. For connoisseurs of the concept, our paper may be seen as a recapitulation, rather than as an innovation; our mission is not to reinvent a concept, but to clarify its origins and connected dilemmas. In essence, ecological modernization refers to a specific type of foresighted and preventive environmental policy, which is closely related to the precautionary principle and, therefore, involves long-term structural change of the patterns of production and consumption. The agenda for ecological modernization, and for an associated ecological tax reform, was promoted by scientists outside of the economics profession, but helped breathe new life into the dormant discipline of environmental economics. In recent years, much of the debate on the opportunities of ecological modernization have been 'captured' by economists, who tend to perceive it in the vein of conventional efficiency measures. In view of the serious environmental problems facing the global community in the 21st century, ecological modernization as a concept, in our opinion, only makes sense if reserved for a reference to more radical structural changes that promote ecological consistency rather than ordinary efficiency. Copyright © 2000 John Wiley & Sons, Ltd.

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Introduction

The concept of ecological modernization was developed during the 'optimistic' period of environmental policy-making in the 1980s, in response to the failures of the old pollution control policies of the 1960s and 1970s. It emerged from the German environmental debate and was closely related to the classical virtues there, such as *Vorsorge* (prevention rather than cure) and *Vorsprung durch Technik* (advancement through technology). The concept of ecological modernization managed to merge the concerns for ecology and employment into a powerful message about the assets of innovation as *'The strategy of ecological modernization aims at the same time for the improvement of ecological and economi-*

cal efficiency' (Jänicke, 1988, p. 23, our emphasis). The zero-sum game perception of environment versus economic growth was replaced by a perspective of the possible harmonization of industry with ecology.

The concept of ecological modernization implies that it is possible, through the development of new and integrated technologies, to reduce the consumption of raw materials, as well as the emissions of various pollutants, while at the same time creating innovative and competitive products. Hence, it is an optimistic message; a message that has an impact on the existing institutions, and as such, should be expected to bring about structural adjustments and changes in production and consumption. Although the conceptual debate on ecological modernization has primarily been an academic one, it has indeed had a number of policy ramifications, like environmental management systems, green accounting and cleaner technology development.

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A question raised concerns the fit between the ecological modernization strategy and the serious environmental problems facing the 21st century. Compared with global warming, overpopulation and increased entropy, the concerns of the 1980s with air pollution, sewage and waste management may seem rather trivial now. The ecological modernization strategy was fostered in a period when the limits to growth perspective had been discarded, and long before the International Panel on Climate Change (IPCC) had warned against and substantiated the risks of global warming. Therefore, the ecological modernization rhetoric has, unfortunately, at times developed into a joyful fairy tale of low-hanging £10 notes and, in terms of research, into an undue preoccupation with company innovations only at the margin of traditional production practices.

While the concept of ecological modernization was inspired, to some extent, by environmental economics (Wicke, 1982), its optimistic message has also posed formidable challenges to economists in clarifying whether the implied double dividend of a more foresighted and preventive environmental policy can be realized. In other words, as the canary was out of the cage, the neoclassical economists were prompted to capture it again. However, we argue here that the concept of ecological modernization in fact belongs to a regulatory philosophy, which is at odds with the conventional paradigm of neoclassical environmental economics. In order to analyse the validity of the concept, we find it more fruitful to move on to the results of more technology-oriented studies. We find it crucial to draw a distinction between simple neoclassical efficiency measures and a more structure-oriented modernization of industrial society on an ecological basis. Ecological modernization is not about efficiency, but rather, as Joseph Huber has argued in this Special Issue, about ecological consistency between material flows, resource use and consumption.

The conceptual origins of ecological modernization

Both Langhelle and Seippel in this Special Issue have analysed the different interpretations of

ecological modernization in the recent literature (cf Hager, 1995; Mol, 1995), but as they do not explain the origins of the concept, we will do so briefly.

The term *ökologische Modernisierung* was coined in the 1980s by two political scientists, Huber (1982, 1985) and Jänicke (1984, 1988), who used it to refer to a more foresighted and preventive type of environmental policy, in line with what was seen as necessary in the 1980s post-*Waldsterben* debate. While Huber and Jänicke introduced the term around 1982–1983, there were also other propagators of the concept. Brunowsky & Wicke (1984) outlined a comprehensive *Öko-plan*, the philosophy of which was to promote a new *Wirtschaftswunder* through a foresighted and preventive environmental policy. Although they did not explicitly speak of 'ecological modernization', the rationale for such a policy can easily be detected in their book (Brunowsky & Wicke, 1984).¹ Frequent references were made in the German debate to the spectacular Japanese experiences in air-pollution control, where taxes on SO₂ had spurred not only technological development of flue gas scrubbers, but also far-reaching changes in energy consumption and supply, something that gave Japan a competitive lead in air-pollution control (Weidner, 1986; Nishimura, 1989).² The vision that emerged was one of not only growth of a considerable environmental industry, but also far-reaching structural change in industrial society.

The concept of ecological modernization is deeply rooted in the principles of a preventive environmental policy and a social market economy. It seems to be significant that Jänicke (1988) established ecological modernization as the operational component of the *vorsorge Prinzip*, also known as the precautionary principle.

The principle of preventive and precautionary action (*Vorsorge*) was first enshrined in the 1971 FRG Environmental Action Programme, and it is defined as an approach to environmental protection that is foresighted and long-term oriented, by steering the development away from production processes that are environmentally problematic. The main tools in this process are science and technological innovation. While science is used to detect possible

dangers, technological innovation is the tool to develop alternative paths of development. The precautionary approach acknowledges that, while scientific proof can be provided only with great difficulty and delay to justify regulations against toxic or harmful emissions, reasonable doubts about the environmental effects of certain processes or products justify the search for alternative approaches to provision of the goods or services in question. This is where technological innovation and the use of science—that is, ecological modernization *per se*—becomes pertinent.

In 1984, the precautionary approach was defined officially as one in which 'damages done to the natural world (which surrounds us all) should be avoided in advance and in accordance with opportunity and possibility. The precautionary principle further means the early detection of dangers to health and environment by comprehensive, synchronised research, in particular about cause and effect relationships... it also means acting when conclusively ascertained understanding by science is not yet available. Precaution means to develop, in all sectors of the economy, technological processes that significantly reduce environmental burdens, especially those brought about by the introduction of harmful substances' (BMI, 1984; Boehmer-Christiansen, 1994).

Ecological modernization is the operational component of the precautionary principle, but seems also to imply that this development can take place in a way that is economically beneficial to society as a whole. However, the precautionary principle is in many ways at odds with the efficiency perspective of environmental economics, because reliance on scientific indications rather than scientific facts impairs the desired quantification of environmental risks and costings. The implication must, therefore, be that the harmonization of economic and ecological objectives is one that appears only in the longer term, when the precautionary approach has led to a new development path that is less environmentally destructive.

We may note that the promotion of ecological modernization relies on the well-known principles of the social market economy (cf. Ludwig Erhardt) on active government interven-

tion and state subsidies for research and development. It is a kind of green Keynesianism (Boehmer-Christiansen, 1994).³ However, the ecological modernization strategy also relies on new strategies and initiatives from within businesses. The joint emphasis on new technological paths, business responsibility and the abstention from narrow cost-benefit calculi is neatly captured in the following:

However significant a narrow cost-management may be, it is in itself not likely to be a successful strategy for the future. The key to the future is rather: innovation, technical progress and qualifications. For that purpose we need humans, who dare to do something new and who have visions for the future... Researchers and inventors must obtain more influence on the top floors of business. After the era of cost calculators and efficiency experts, we now again need a decade of technicians and engineers'. (Lafontaine, 1996)

To which extent this also corresponds with political and economic realities is, of course, quite a different story, but that is very much what ecological modernization should be about.

The economic debate

The ecological modernization concept managed to put an imprint on the European Commission White Paper on economic growth, competitiveness and employment, which gave support to the thesis of a 'double dividend' (environment and employment) from strict and advanced environmental policies, in particular by lowering taxes on income and increasing them on environment and natural resources (CEC, 1993). From this point onwards, the ecological modernization strategy moved into the political realm and gradually influenced thinking about the relationship between economic development, employment issues and pollution control across Europe. A set of new keywords were attached to the ecological modernization paradigm; apart from 'double dividend' also 'win-win' solutions and 'no-regret' measures.⁴ Ecological modernization gradually attained a degree of societal consensus, at least in countries such as Sweden, Denmark and Germany (Lundqvist, 2000). Do we need an ecological

modernization of industrial society, asked, for example, the President of the German Association of Engineers in an address to his members, and gave the answer: 'There is hardly anyone who doubts the necessity of this issue, the question only is how' (Burckhardt, 1996, p. 8).

Much of the political and economic debate has tended to focus on the virtues of an ecological tax reform as a key instrument for ecological modernization. Like the ecological modernization concept, the notion of ecotax reform was, in fact, also conceived by non-economists (Springmann, 1986; Weizsäcker, 1990; Weizsäcker & Jesinghaus, 1992). It advocated a tax shift from conventional income taxes on labour towards Pigouvian taxes on pollution and natural resources, such as fossil fuels, as part of an overall ecological tax reform. As McCoy (1997) has pointed out, economists were lagging behind in the debate on these new ideas. While policy-makers were quick to accept the idea of an ecotax shift after the White Paper (CEC, 1993), many neoclassical economists were outright sceptical.⁵

The ecological modernization imperative is essentially macro-economic in nature, whereas conventional environmental economics is a micro-economic discipline dealing with efficiency. The utilitarian approach of environmental economics requires that natural resources and environmental externalities are properly priced, so that market actors will take account of their values in their transactions. However, before the mid-1990s, little analytical work had actually been done on the macro-economic implications of ecotaxes on, for example, employment.

Goulder (1994) was among the first to express profound scepticism about double dividend. Since the bulk of eco-tax-reform proposals rely on taxation of fossil energy, in particular of their carbon emissions, Goulder speculates as to whether the reason for the focus on double dividend is the absence of a first dividend (he stipulates that unilateral carbon taxes will not bring domestic environmental benefits). Goulder (1994) rejects the notion of a double dividend, except in a rather weak form.

According to the strong double-dividend hypothesis, an exchange of distortional labour taxes with Pigouvian taxes can be carried out at

no costs, or with positive effects to the economy. Goulder contends that it is necessary to estimate the size of the environmental benefits too, in order to judge whether the overall tax shift can be carried out with a positive effect for the economy. One cannot claim that the tax shift itself is of positive value for the economy. Hence, we are back to the usual cost-benefit analysis of environmental policy.

However, the results that lead to a rejection of the strong double-dividend stem, unsurprisingly, from economic models with extremely simplified assumptions. General equilibrium models are, in principle, able to assess the dynamic effects on the economy, but the parameters of the models are often rather crude. Ekins (1997) reviews a number of economic studies that have shown more positive effects. A report commissioned by the European Commission showed a substantial employment effect from a European carbon tax, 1.1–2.2 million jobs and a contribution to GDP of about 1% (CEC, 1994, p. 53). Much work has focused on substituting distortionary taxes. Majocchi (1994) suggests that the targeting of revenue recycling to offset lower income groups could produce significant employment effects, in the magnitude of 2–3%. Barker has developed a comprehensive macro-economic model that also forecasts more positive effects (Barker & Köhler, 1998). It should be added, though, that in countries such as Sweden and the Netherlands, where government-appointed commissions have been established to model the possible dividends from environmental taxation, the results have generally not provided support for the hypothesis. These results may have as much to do with the limitations of economic models as with the potential results of ecological tax reforms or processes of ecological modernization.

The problem with most of the models is that they are hardly able to take account of technological change. And technological change is exactly what ecological modernization is about. Much of the research on the double dividend from ecological modernization takes place on the premises that no technological change is induced, and that environmental taxes are added simply to existing prices, where, not

surprisingly, they affect demand and supply and impose a burden on the existing unsustainable economy. One of the theoretical models that Goulder refers to is so simple that not even capital is represented, it includes merely labour and three commodities. Depending on the sophistication of the models, the mis-specification of the technological dimension may lead to a gross mis-specification of the potentials involved. Despite efforts to improve economic modelling, the main problem with much of the economic analysis, as pointed out very early by Zimmermann (1990), is that it does not capture the essential idea of ecological modernization well, in that it assesses the costs and benefits only in the initial period, neglecting the long-term qualitative changes in the economy that could develop under the umbrella of an eco-modernization strategy in association with a tax shift.

An ecological tax reform can be translated into economic models because it alters prices, but ecological modernization is more than a tax shift—it comprises practices, know-how and routines in a wider human, social and technical space.

Technological developments — the limits of the neoclassical efficiency perspective on ecological modernization

Which other methodologies and types of evidence, other than the economic models, do we have that explore the virtues of ecological modernization? Much of the literature is case-study oriented, depicting particular industries or companies, with primarily anecdotal and qualitative evidence. There have been no reviews of this literature, and we are not in a position that allows us to present one here. Rather, we will rely on one systematic and quantitatively-oriented study, which researched one of the more comprehensive efforts towards promoting ecological modernization across a rather broad horizon of production processes, firms and industrial sectors. Contrary to much of the case-study literature on eco-management, this study

presents quantitative evidence for a range of industrial sectors for an entire country.

The study concerns the Danish government's subsidy programme to promote the development and application of cleaner technologies, which has been a central vehicle for Danish environmental policy for about a decade (Andersen, 1994; Andersen & Jørgensen, 1995). The Danish Environmental Protection Act has the development and application of cleaner technology as one of its general targets. The Programme for Cleaner Technology was established in 1987, and allowed skilful engineers and inventors to enter into intimate cooperation with process engineers from a broad range of companies in a systematic and reflective process to develop cleaner technologies. Conceptually, cleaner technology refers to measures for pollution control, which are oriented towards control at the source, rather than end-of-pipe measures. The study of the programme was based on a review of more than 300 projects conducted over a 5-year period, and it included an assessment of the diffusion of cleaner technology and the total environmental effects. The study was conducted with full access to all documents and information, and by an independent team of researchers.

The programme has especially tried to promote cleaner technologies in industrial sectors dominated by small and medium-sized firms, such as the fish processing industry, the wood and furniture industry, the graphic industry and the electro-plating industry, but also farming practices have become subject to cleaner technologies. Projects have been financed by the Danish government under the condition of a substantial self-financing element. The programme is seen to have caused a partial change in the practice of the Environmental Protection Agency (EPA). Previously the EPA diverted many resources into the handling of complaints over discharge permits granted by local authorities, and had a legalistic going-by-the-book attitude to environmental protection. During this programme, the officials entered into a direct dialogue with companies, consultants and experts in various industrial branches on how to improve the environmental performance.

The cleaner projects ranged from good housekeeping practices to improved material and energy efficiency to substitution of products and processes with innovative and less adverse alternatives. The effects were tracked through an extensive survey of the diffusion of cleaner technologies from the supported projects to the entire industrial sectors of relevance, based on a survey of more than 600 companies, or nearly 10% of Denmark's industrial base. Six key industrial sectors were targeted in this process.

On the environmental side, the interesting finding was that most of the good housekeeping and efficiency measures, despite impressive rates of diffusion, had been offset by increases in production. For example, despite substantial per unit reductions in organic pollution in various food-processing industries, the end-result was that water consumption and organic pollution was unchanged; only the fish-processing industry had achieved a modest reduction in CO₂ emissions, although it had been a major target of the subsidy programme.

By contrast, more promising and lasting results were attained where more radical substitutions and technology innovations had taken place. For example, in the wood and furniture industry, volatile organic compound (VOC) emissions were eliminated, thanks to the development of complete substitutes to conventional production technology. The modernization of production that followed with the innovative machinery also improved the work environment. In addition, it provided an additional dividend to the manufacturers due to enhanced labour productivity. The improved labour productivity was created through a revolution in the entire work process, based on a world patent on lacquering that was soon to be adopted by the leading international manufacturers in this sector. A similar, although less spectacular, pattern was found in other industries, such as the graphic industry, where water-based inks replaced the conventional types.

There is some disagreement in the literature on ecological modernization as to whether it, by definition, involves structural changes. However, the results of the Danish programme lead us to suggest (along with other contributions to this Special Issue) that a simple efficiency revo-

lution, in the neoclassical sense, falls short of the imperatives of ecological modernization. If improved environmental practices merely promote increased efficiency in the use of materials, and energy in order to diminish unwanted outputs and residuals, it is likely to become efficient only at the margins of already established production process practices. Although some of the early publications on ecological modernization could lead one to equate it with such an efficiency revolution, these interpretations underscore how intimately the concept is linked to approaches of prevention and precaution in environmental policy—that is, the long-term oriented effort to promote other paths of development. The significance of structural change becomes perhaps even more clear when we consider some of the more serious environmental problems facing the world, such as the enhanced greenhouse effect.

From simple to serious problems

The neoclassical efficiency perspective on natural and environmental resources tends to neglect the wider systemic limits to economic growth. Recent innovative contributions to environmental economics, for instance, from ecological economists and of a more interdisciplinary nature, have served to highlight these limits. The concept of ecological utilization space, as developed by Opschoor & Weterings (1994), underlines the delicate interplay between the present use of the environment and the possible resulting decrease in future consumption and utility opportunities. In particular, the use of non-renewable resources exhausts the resource base and demands careful consideration over the possible transformation into other and more lasting types of capital (Pearce *et al.*, 1989). Population growth (from 6 to 11 billion in the 21st century according to UN forecasts) is another crucial factor that affects the scarcity and pressure on environmental and natural resources.

Consider, for example, the emissions of greenhouse gases, particularly CO₂. Present carbon emissions are estimated to be in the magnitude of 6–7 giga-tons per year, while the

assimilative capacity of the natural environment is in the magnitude of just 3 giga-tons per year (Houghton, 1997). As a result, a build-up of CO₂ takes place in the atmosphere. Its concentration has increased from 270 ppm in pre-industrial times to about 360 ppm at the present. According to the projections of the World Energy Council, annual CO₂ emissions will, as a result of economic and population growth and in a business-as-usual scenario, more than double before the end of the 21st century, corresponding to a CO₂ concentration of about 650 ppm. The IPCC warns that as a result of such a concentration, the global mean temperature can be expected to increase by 1.2–4.5 degrees centigrade before the end of the century (*ibid.*, p. 92). Although many uncertainties still envelop the issue of climate change with the speed of global warming and its specific consequences, the basics referred to here remain fairly well understood.

The accumulation of CO₂ is primarily a consequence of unprecedented burning of fossil fuels. Even business-as-usual scenarios assume a certain annual level of energy efficiency improvement (Houghton, 1997, p. 193). Clearly, efficiency at an improved level is only a necessary, but far from sufficient, measure to cut CO₂ emissions to a sustainable level. The climate change problem is a particularly difficult problem, not only because of its global nature, but also owing to its intricate connection with the dynamics of population growth and because of the timelags involved. The inherent dynamics of economic and population growth imply that most energy-efficiency gains are likely to be offset by growth and population-breeding factors. At the same time, there is time pressure owing to the gradual accumulation of excess emissions in the atmosphere as time passes without sufficient action being taken.

Outlook and future prospects for ecological modernization

The concept of ecological modernization was formed well before problems of climate change were conceptualized and well after the alert of

the Club of Rome had ended. We think that the time has come to rearticulate and clarify the meaning of ecological modernization. Several of the contributions to this Special Issue venture into such clarification. There has been an unfortunate ambiguity in much of the existing literature, which has made it commonplace to consider ecological modernization simply as a form of production rationalization. Although the contributions here do not end the discussion, we think that the emphasis on structural change and consistency is pertinent.

Once such an emphasis is accepted as the proper starting point for ecological modernization, it becomes necessary to reflect more carefully on the role of the state. Much of the literature on ecological modernization seems to suggest that there are win–win solutions and low-hanging £10 notes, which will make businesses and industries venture on an ecological modernization path of their own. Although several such examples have indeed been provided, we are reluctant to accept the premise that a far-reaching eco-modernization will come about merely as a result of new insights in business board rooms. One does not have to subscribe to neoclassical views to contend that the gains of environmental management fall short of the imperatives of the challenges of the more serious environmental problems.

In this paper, we have tried to underline the inherent conceptual linkage between ecological modernization and the precautionary principle, and the latter principle suggests, in fact, that the state has a rather significant role to play for establishing the pathways towards ecological modernization. A truly precautionary approach requires the identification of different and innovative technologies, that substitute materials and processes in unprecedented ways. Unfortunately, the role of the state so far has been more or less neglected in the ecological modernization literature, although, implicitly, the need for intervention has long been recognized. For example, the use of price signals—that is, by means of ecotax reform—with the purpose of promoting a new path of development, requires state intervention. Also, implementation of the precautionary principle relies heavily on science and technological development; and even

though the state is not the only relevant actor, it is hard to see how the necessary promotion and support can be established without a role played by the public authorities.

The acknowledgement that an eco-modernist rationalization is unlikely to come about on its own, but will follow only if nurtured through a deliberate and far-sighted intervention policy, seems to suggest the need to confront some of the neo-liberal rhetoric inherent in the ecological modernization literature. 'Win-win solutions' and 'getting the prices right' do not follow on from *laissez-faire*, but require intervention of a scope and quality that is likely to strain the capacity of many a regulatory state. In our view, the ecological modernization debate should, therefore, end the subscription to efficiency rhetoric, because it needs to begin to address issues of governance capacity much more explicitly, consciously and cautiously.

Notes

1. It is interesting to note that a parallel concept of 'ecodevelopment' appeared even earlier in France, where the Polish social scientist Sachs summarized his ideas in a book entitled *Stratégies de l'écodéveloppement* (Sachs, 1980). The theory of ecodevelopment does not call for a dismantling of 'capitalism' altogether, but focuses rather on the search for changes that are more palatable culturally in lifestyles, as well as in production and consumption patterns, social policies, systems of political decision-making, and in international cooperation. The concept of ecodevelopment apparently did not overcome the French language barrier (cf. Vaillancourt, 1995), or development research in which Sachs has been involved. On the other hand, Sachs is reported to have been a guest researcher at the International Institute for Environment and Development in Berlin in the 1980s.
2. The first scrubbers installed in Germany in the early 1980s were imported from Japan, via the trans-Siberian railway.
3. Unfortunately, the analysis of environmental issues has largely been separated from the contemporary discussion on the future of the welfare state, which conventionally focuses on the 'big five' (social security, housing, education, health and social services, as well as the required resource transfers).
4. Although the strategy indeed was derived from several different sources (such as the Brundtland report), Delors and members of his think-tank, *Cellule de Prospective*, have, in interviews, quoted certain German intellectuals as their main source of inspiration for the environmental chapter in their White Paper (Klok, 1999).
5. Neoclassical environmental economists refer to ecological modernization as the Porter hypothesis, after an article by Porter and the Swiss economist Van der Linde, who stipulated employment and competition advantages from environmental regulations (Porter & Van der Linde, 1995).

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