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National Shades of Green: Comparing the Swedish and Danish Styles in Ecological Modernisation¹

ANDREW JAMISON* AND ERIK BAARK[†]

* *Department of Development and Planning
Fibigerstraede 13, Aalborg University, Dk-9220 Aalborg, Denmark*

[†] *Division of Social Sciences
Hong Kong University of Science and Technology
Clearwater Bay, Hong Kong*

ABSTRACT: Throughout Europe, science and technology policy within the environmental field is currently in a process of transformation, which has been characterised by many observers as ecological modernisation. Emphasis is being given to preventive principles and so-called cleaner technologies in the quest for a more sustainable development. Each European country has, however, adapted the new doctrines and practices in distinctive ways. The main aim of the paper is to show how contemporary policies have been shaped by history, more specifically, by institutional and cognitive traditions, and by national policy styles. By comparing 'ecological modernisation' in Sweden and Denmark, we attempt to indicate how such national cultural differences affect the ways in which science and technology policies in the environmental field are formulated and implemented.

KEYWORDS: Environmentalism, science policy, ecological modernisation, national styles

INTRODUCTION

In recent years, it has become ever more apparent that there are significant national differences in the making of public policies for the environment, as elsewhere. In the particular area of science and technology policy, which is the focus of this paper, it has, for instance, become increasingly common to refer to national 'systems of innovation' as important formative influences on policy decisions (cf. Nelson 1993; Lundvall 1992). But most analysts, for reasons of training and expertise, appear to have limited their interest to the economic, or instrumental, components of policy-making, while neglecting the broader cultural or sociological dimensions. It can be argued, however, that contemporary differences in policy making, and in politics more generally, reflect deeper and

more long-standing patterns of 'habituation', as was already indicated by Thorstein Veblen at the time of the First World War (Veblen 1915).

In the pages that follow, we show how contemporary policies in environmental science and technology have been shaped in significant ways by history, and more specifically, by institutional and cultural traditions that manifest themselves in particular ways in particular national settings (cf Hård and Jamison 1998). By comparing processes of so-called ecological modernisation in Sweden and Denmark we will attempt to indicate how national cultural differences affect the ways in which science and technology policies in the environmental field are formulated and implemented.

FROM AN ENVIRONMENTAL POLICY SECTOR TO ECOLOGICAL MODERNISATION

Throughout Europe, science and technology policy within the environmental field is currently in a process of reconstitution. On the one hand, there is the general trend towards increasing international collaboration and coordination, along with decreasing direct national state control. In this, as in other areas, there is also a growing commercialisation and privatisation of research and development (R&D). On the other hand, environmental R&D efforts are being oriented to the new tasks of 'sustainable development' and 'ecological modernisation' which often involve new combinations of both corporate, intergovernmental and non-governmental actors (cf. Jamison 1996; Hajer 1996). Emphasis in recent years has been given to preventive measures and so-called cleaner technologies, both nationally and transnationally. In this, as in other areas of science and technology policy, however, each European country has assimilated the new doctrines and practices into its own distinct national policy making style.

In a schematic form, science and technology policy in the environmental field can be seen to have gone through six main phases since the 1960s (Figure 1; cf. Jamison and Østby 1997).

Period	Emphasis
1) pre-'68: awakening	public education and debate
2) '69-'74: sectorisation	institution building/environment as R&D sector
3) '75-'80: public mobilisation	energy policy
4) '81-'86: professionalisation	environmental assessment
5) '87-'92: internationalisation	sustainable development
6) '93- : integration	ecological modernisation

FIGURE 1. Phases of postwar environmental s&t policy

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In the 1960s, a range of new environmental problems were identified, from chemical risks to automotive air pollution, which gave rise to widespread public debates and eventually to a number of policy responses. By the end of the 1960s the environmental debates had inspired both the emergence of new activist groups, as well as a process of policy reform and institution building. Most European countries established new state agencies to deal with environmental protection, and environmental research and technological development were organised in new institutional frameworks. Many national parliaments passed stronger environmental legislation and, at the United Nations Conference on the Human Environment in Stockholm in 1972, the environment was recognised as a new area of international policy concern.

From the first oil crisis until about 1980, there was a third phase of environmental science and technology policy, as environmental issues moved to the top of many national political agendas, especially in relation to nuclear energy, and several of the larger national environmental organisations turned into mini-bureaucracies. An important result of the energy debates of the 1970s was a professionalisation of environmental concern and an incorporation by the established political structures of what had originally been a somewhat delimited political issue. As a result, there was a specialisation of knowledge production.

The effect was that, when nuclear energy was removed from many national political agendas in the early 1980s, there was a range of expertise that had previously not existed. In many European countries, there were university departments and research institutes, as well as substantial state bureaucracies that had an institutional interest in environmental problems. From the mid-1980s, in large measure because of the network-building activities of these new environmental professionals, environmental science and technology policy moved into a fifth, or international, phase, in which global problems replaced local problems as the main areas of concern, and the solution to these problems came to be characterised as 'sustainable development', following the report of the World Commission on Environment and Development in 1987.

Sustainable development has proved notoriously difficult to realise in practice, however, and, following the so-called Earth Summit in Brazil in 1992 (the UN Conference on Environment and Development), many of the relevant actors in environmental science and technology policy have come to characterise their activities in relation to a more explicitly defined environmental industrial policy, or 'ecological modernisation' strategy (Hajer 1996). A growing number of business firms have begun to adopt new methods of environmental management, including environmental auditing, recycling of waste products, and more efficient uses of resources and energy in production processes. For some, the shift is seen as a change in production paradigm, while for others it is primarily a shift in rhetoric and public relations; increasingly, however, environmental concern is being integrated into corporate planning and innovation strategies, while management schools are beginning to provide training in environmental economics as well as in the new methods of production.

In many respects, these shifts can be seen as a convergence of interests between environmental organisations, governmental agencies and business firms. The promulgation of national and international programmes to encourage 'cleaner production' in industry has led to the creation of new institutions at universities and engineering schools, and, in many European countries, new departments of environmental management, economics and engineering are being established to provide the professional experts who are to direct the greening of industry.

These shifts have manifested themselves both on a discursive level, where new principles of environmental science and technology are being formulated, as well as on a practical level, where 'networks of innovators' are serving to link universities, business and government agencies in new configurations. In between, at an intermediary institutional level, policy-makers seek to design appropriate programmes and policy measures to move environmental science and technology in more strategic directions. But what is often lacking is sufficient understanding of the relevant factors that shape and/or constrain effective policy response. It can therefore be valuable, both for practitioners and policy-makers alike, to compare national experiences in a systematic way, as well as investigate the cultural dynamics of the transformation processes. It can be suggested that culture, particularly in the form of national policy styles, or traditions, works as a kind of filtering mechanism, by which transnational processes are appropriated into particular contexts (cf. Hård and Jamison 1998).

THE NATIONAL COMPONENTS OF SWEDISH AND DANISH SCIENCE AND TECHNOLOGY

In an earlier comparison of Swedish and Danish historical experiences, it was suggested that national cultures affected technology and science in three main ways (Jamison 1982). On the one hand, there is a national metaphysic or cosmology, a particular way in which nature and natural resources are conceptualised. This 'metaphysical bias' is counterpoised to a second, more material level of cultural conditioning: the differences in resources, in geography, and subsequently in economic development, which lead to particular national scientific-technical interests. And there is a third, or mediating level of institutions and organisational forms: the historical relations that have crystallised over time between science and engineering, and, more generally, the ways in which science, technology, and production have interacted over time (see Figure 2).

In Sweden, nature was, from early on, a rather forbidding place – both in theory and practice – harsh and vast and somewhat mysterious, and the task for science and engineering was to bring it under human mastery. Not for nothing has the eighteenth century botanist Carl von Linné, or Linneaus as he is known outside of Sweden, been called the initiator of an imperialist attitude to nature

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<p>1. Metaphysical Bias Sweden: nature as machine → system Denmark: nature as workshop → experiment</p> <p>2. National Scientific/Technical Interests Sweden: mining/forestry → mechanics/chemistry Denmark: commerce/agriculture → astronomy/ecology</p> <p>3. Institutional Structures Sweden: culture vs industry, emphasis on development Denmark: early integration, emphasis on diffusion</p>
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FIGURE 2. National Styles in Science and Technology

and the instigator of a managerial approach to environmental science (cf Worster 1977). Linneaus conceived natural relationships in a mechanical, systemic way, believing that the 'Creator had designed an integrated order in nature which functioned like a single, universal, well-oiled machine' (Worster 1977: 39). Michel Foucault, in *The Order of Things*, depicted Linneaus as the archetypical observer of nature, 'who was content with seeing – with seeing a few things systematically. With seeing what, in the rather confused wealth of representation, can be analyzed, recognised by all, and thus given a name that everyone will be able to understand' (Foucault 1973: 134).

Many other Swedish scientists and engineers have shared this imperial, or mechanical attitude to nature that was so apparent in Linné. Throughout Swedish history, we find systematisers, cataloguers, system-builders, modellers, both among scientists, philosophers and engineers. In the words of Sten Lindroth, the Swedish historian of science, 'The average Swede undoubtedly has an appreciable aptitude for organisation and order, and this desire for description and classification has found purposeful expression in the natural scientists' (Lindroth 1952: 31).

The systemic, ordering bias, or mentality, was perhaps encouraged by the geography, but in any case the copper and iron mines of northern Sweden gave early impetus to the consolidation of particular national scientific-technical interests in mechanics, chemistry and metallurgy already in the seventeenth century. And it would be the further development and 'technification' of those interests that would play a major role in the country's industrialisation process. In Sweden, a number of large engineering firms emerged in the 1870s, and industrialisation was largely based on the handful of companies that grew up at

that time – Ericsson, Asea, Alfa-Laval, Nobel, Bofors – big, export oriented firms that drew on the Swedish mechanical and chemical heritage, and which derived their strength from a basic engineering competence. These large, by now transnational, corporations, have in the twentieth century come to include the automotive manufacturers, SAAB and Volvo, and they have exercised both a doctrinal and functional hegemony over Swedish research and development that is central to the ‘national system of innovation’ (cf Edquist and Lundvall 1993).

Organisationally, Linneaus was one of the founding members, in 1739, of the Swedish Academy of Sciences, which, perhaps more than any other institution in the country, has served as an organisational conduit for scientists to take part in state policy making. The Academy of Sciences, and later the Academy of Engineering Science (IVA), which was founded during the First World War, have provided expert advice in a wide range of policy areas. They have served to represent the academic community in what has become an increasingly formalised and comparatively well organised system of policy deliberation. In the post-war period, the role of the academies has been somewhat weakened, but their influence remains strong, and serves to accentuate the hierarchical and elitist nature of Swedish policy-making. In any case, at an early stage, an alliance, and a number of functional working relations, were established between the state bureaucracy and the academic community.

This academic-bureaucratic alliance has been extremely influential in the making of environmental science and technology policy. In the 1940s and 1950s, when the social democratic government was developing the so-called Swedish model of state intervention and active labour market policy, environmental issues were given significant public attention. In what was to become a characteristic of the Swedish approach to these matters, policy-making centred around the apparatus of ‘royal investigative commissions’ consisting of representatives of the relevant policy constituencies meeting together, in what has been termed ‘corporatist’ fashion, to deliberate on the appropriate measures to be taken. It was such a commission in the 1950s that led to the reorganisation of environmental administration. And it was an investigative commission on environmental research that led to the emergence of a particular science and technology policy sector in the environmental field in the 1970s (cf Söderqvist 1986).

The general public has historically been poorly represented in this Swedish political and administrative system. In the nineteenth century, as elsewhere in Europe, there emerged popular movements among the farmers and the industrial working class, but in Sweden these movements rather quickly became institutionalised in the form of political parties: the Centre party representing the farmers and the social democratic party representing the industrial workers. It has been primarily through the formalised parliamentary system that Swedish democracy has offered opportunities for public participation in policy-making. On the other hand, the Swedish legal framework has ensured public access to

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nature, and, for that matter, to the state bureaucracy, as a way to guarantee public acceptance and support, and as a means to legitimise the strong state role in economic affairs. The ombudsman, serving to mediate between the state and the public, is a uniquely Swedish institution, as is the tradition of *allemansrätt*, the officially sanctioned free access to nature that dates back to the early modern era. The notion of the 'people's home' that was adopted as a kind of slogan by the social democratic prime minister, Per Albin Hansson, in the 1930s, similarly rests on a long pattern of self-conscious paternalism in the state's dealings with the citizenry (cf Elzinga, Jamison, and Mithander 1998). The state bureaucracy in Sweden has sought to serve as the public's protector, first against the landed aristocracy, and, in the twentieth century, against the modern version of the aristocracy, the large corporate industrial firms.

In recent years, international market competitiveness rather than national distinctiveness – and, for that matter, a traditional interest in environmental protection – has become the main driving force behind science and technology policy. The result has been that environmental improvements have not been given in Sweden as much attention as in other countries, where firms, often in alliance with public authorities, have seen somewhat greater economic opportunities in the calls for sustainable development and ecological modernisation. The big Swedish corporations remain, in many ways, embedded in a 'techno-economic paradigm' that is characterised by an imperialist, or exploitative attitude to nature and a mechanical approach to technology.

The historical legacy is quite different in Denmark. There we find, to begin with, that the image of the workshop is a recurrent theme in the national attitude to nature. The natural environment was to be worked with in a pragmatic way, not through theory or systemic distancing, but by a kind of organic interaction, or experimentation. Already in the Middle Ages, there is a noticeably practical bent among Danish philosophers, and with it, the identification with an organic, experimental relation to nature. A good example is Tycho Brahe, who almost alone among the great men in the history of science gained his reputation for practical work, for instrument-building and precise observations rather than for theorising. Tycho was also one of the first organisers of science; on the island of Ven in the narrow strait now separating Sweden from Denmark, he constructed one of the world's first scientific communities, which lasted for twenty years, from 1577 to 1597, the practical utopia that provided inspiration for Francis Bacon and all the other theoretical utopians of the seventeenth century (cf Elzinga and Jamison 1984). In the nineteenth century, the fame of Hans Christian Ørsted again rested on a practical discovery (of electromagnetism) rather than on a theory. Ørsted was an impassioned believer in the practical value of understanding nature's secrets; almost uniquely in the Europe of his time he combined a romantic nature philosophy with a technically-oriented utilitarianism. He wrote about the spirit in nature and gave lectures to industrialists about the importance of science.

The expansion of engineering and technical education in Denmark, under Ørsted's leadership, provided a source of technical manpower which was crucial for the rapid buildup of technological capabilities and the assimilation of British technology during the 1860s. The educational system was heavily influenced by French and German institutions, and during the early part of the twentieth century was supplemented with a system of vocational training which provided the industry with a highly skilled manpower.

Another particularly influential component of the Danish educational system was the system of People's High Schools which sought to provide people with qualifications that went beyond pure training in literary or technical skills, namely, to endow the students with the ability to discuss major social or cultural issues and contribute to society's development through a more active humanism. The philosophy of the priest and poet N.F.S. Grundtvig became a cornerstone of the movement to create People's High Schools; his views have been characterised by a foreign observer as 'the foundation for a profound cultural synthesis that spoke eloquently to the question of nationalism and national identity' (Borish 1991: 17). The ambition was that these schools would give dignity to the life of the farmer and awaken rural people to the love of learning that would continue long after a student had finished the formal course of study. At the same time, the schools came to represent a unique expression of the social history and that national character of the Danish people, and their role in mobilising the farming community in the Danish path to modernisation should not be underestimated. Also the system of technical consultancy that was so important in the development of the dairy and food processing industries, can be said to be derived from the rural populism that Grundtvig articulated. It is at the third conditioning level in our model – the institutional – where Denmark's decentralised, rural based organisational structure linked together the artisanal attitude to technology with an agricultural economic orientation.

Attitudes to nature among Danish scientists and in the public at large were, to a certain degree, shaped by the preponderance of agriculture and the particular ecology of the Danish landscape. Few areas in Denmark have been left untouched by human intervention, and apart from the significant exception of Greenland, wilderness hardly exists. A major ecological crisis appeared during the nineteenth century, when the erosion following the disappearance of forest cover (wood was used extensively for shipbuilding and for fuel) threatened large areas of Danish agricultural land, particularly in Jutland. The efforts to combat this crisis with reforestation and by means of conservation of existing forest resources resulted in a number of institutions including the Danish Heath Society (*Det Danske Hedeselskab*) established in 1866 that mobilised state funds and the population in the fight against land erosion in Jutland.

Economic development in Denmark since the nineteenth century also represents a somewhat unique experience. Endowed with few natural resources or minerals compared to the European nations which started industrialisation at

the time, Denmark built its economic prosperity primarily on exports of agricultural or agro-industrial products (see, e.g., Senghaas 1982). Probably the most well-known example of this is the successful establishment of a dairy industry based on the cooperative movement, which in turn proved important for a whole system of technological innovation (Edquist and Lundvall, 1993; Lundvall 1992). As late as the late 1950s, almost two-thirds of Danish commodity exports derived from agriculture or food-processing industries. For this reason, the interests of producers in agriculture or the agro-industrial sector have had a major say in Danish politics, including an established relation to the Liberal Party (*Venstre*) which has continued to be one of the largest political parties in the Danish parliament.

Denmark's industrialisation subsequently took the form of a process that relied on a large number of small or medium-sized enterprises with a highly skilled work force, and which grew on the basis of rapid diffusion and adaptation of technology, mostly imported from countries with major research and development activities. Danish industry includes very few large firms and for more than a century, the Danish state has followed a laissez-faire policy with regard to industrial development, leaving the initiative primarily to private industry and minimising the role of public enterprises. Consequently, industry and business has tended to constitute a relatively autonomous body of interests and, in spite of the link which exists between the Federation of Danish Industries and the Conservative Party (*Konservative Folkeparti*), these interests have seldom been allowed to occupy a strong power base in the Danish political landscape.

Democratic traditions have had a long period of formation in Danish history, and Denmark was one of the few countries in Europe that accomplished a peaceful transition to the parliamentary system. The mobilisation of farmers by the Liberal Party (*Venstre*) in the late nineteenth century created a viable opposition to the political dominance of the landowner's Right Party (*Høire*), which increasingly came to represent the new class of industrialists based in Copenhagen. The strength of the liberals and, during the early part of the twentieth century, of the Social Democrats led to a distinct tradition for delegation of administrative tasks to regional or local government. Combined with the cooperative movement that relied on local entrepreneurship and the educational institutions associated with the People's High Schools, which aimed to enhance both the practical skills of young people in the countryside and their ability to understand and participate in debates over major political issues, the Danish tradition for decentralised administration has occupied a core position in setting the stage for public debates and policy-making related to environmental science and technology.

Given the position of Denmark at the midpoint of maritime trade in the Baltic and the North Sea, and with the significance of agricultural exports, the Danish economy has continued to be strongly integrated in the international market. The open economy has also been accompanied by a receptivity toward the cultural

and social influence of the country's large European neighbours, e.g., France, Germany and later Britain. In many ways, borrowing from such European cultures became an important element of the way in which the Danish culture became a hybrid of Scandinavian traditions and the new stimuli which came to Denmark from other areas in Europe. Many institutions in Denmark relied on access to international sources of knowledge and skills; for example, universities encouraged students to study abroad and for long periods the certification of a master carpenter would require that the apprentice had obtained a journeyman's certificate after working outside the country.

These different historical legacies have provided the basis for an approach to environmental science and technology policy that has been unique in some respects, but also similar to international experience in other respects. Probably the combination of romantic and still pragmatic knowledge interests of the Danish scientific community with an economic and political system mobilising the local communities in the development of the country proved very useful in exploiting existing technology under new organisational patterns. During the first half of the twentieth century, a new element of 'dialogue' was added to this structure, as a framework for conflict resolution grew out of the labour struggles that culminated around the turn of the century. Since the Social Democrats succeeded in marshalling all the major political parties, the labour movement and the employers' organisation in an effort to weather the economic crisis of the 1930s, the basis of a corporatist relationship was established that came to define much of the political context of the welfare state in the post-war period.

NATIONAL STYLES OF ENVIRONMENTALISM

These national components, or styles, of science and technology remain evident today both in the different approaches to science and technology policy as well as in the different ways in which environmentalism has developed in the two countries. In Sweden, the emphasis in technology policy has long been on supporting basic technological research, and on using technology policy as a way to improve the international competitiveness of the big Swedish engineering firms. There has been little attempt by the state authorities to steer or redirect technology, or, for that matter, to assess the social and environmental consequences of technological projects. Mechanisation, rationalisation – and now information technology – are seen as the main determinants of social change, and the emphasis in Sweden is to follow and support the systemic logic that further technological development requires.

The environmental movement, for its part, has been primarily a reactive force, focusing on large-scale technologies, from cars to nuclear reactors, and proposing alternative 'systems' of ecological planning and now, more recently, sustainable development, rather than conducting piecemeal, small-scale experiments as has been characteristic of the environmental movement in other

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countries, perhaps especially in Denmark (cf Jamison et al. 1990). In this respect, the Swedish political culture and national style of science and technology has left a strong imprint on the way in which environmentalism has developed. In particular, the hegemony of the Swedish social democratic party has been decisive. Although environmentalism has been a very important political force in Sweden, the almost immediate incorporation of environmental consciousness into the established political culture has made it difficult for an autonomous environmental movement to develop.

During the 1970s, the environmental debate in Sweden was dominated by the issue of nuclear energy, and the transformation of the environmental movement into an anti-nuclear opposition was in characteristically Swedish fashion incorporated into the established political culture. Nowhere else in Europe was anti-nuclear sentiment so deeply 'parliamentarised' as it was in Sweden. In particular, the Centre Party's identification with an environmental and anti-nuclear position meant that anti-nuclear protest in Sweden, almost from its beginning, was a parliamentary affair. The environmental movement, as a result of internal splits and external pressures, fragmented during this period of anti-nuclear opposition. In the 1980s, as in other countries, a new cluster of transnational non-governmental organisations – from Greenpeace to the World Wildlife Fund – entered the scene, and there emerged a parliamentary Green party. Most significant, however, was the renovation of the older conservation society, which has become a key actor in many of the programmes of sustainable development and ecological modernisation. In recent years, the society's expert staff has played a central role in a number of new activities, from eco-labelling to sustainable transport policy making. In relation to local Agenda 21 activities, the society has served as a national coordinating body, filling in when decreased funding has kept the state Environmental Protection Agency from playing an active role (cf Ring 1997).

In Denmark, the environmental movement has been much more characterised by local experiments, and a booming wind energy industry is one of the most visible results. There environmental issues lay dormant much longer than in Sweden, and became more directly associated with the alternative political ideologies that grew out of the youth rebellion and the student movement of the late 1960s. The most important organisation in this connection was NOAH, started in 1969 by biology and architecture students in Copenhagen, which soon developed into a national organisation of environmental activism. NOAH utilised scientific information and cooperated with scientists who themselves sympathised with the effort to act as 'counter-experts' particularly in relation to the media. In this way, the first efforts at creating public awareness of the environmental problems in Denmark were carried out by an alliance between students and the media that was highly critical of the 'establishment'.

The activist approach of NOAH drew on the Danish tradition of participatory democracy associated with the cooperative movement and the People's High Schools, and the rural populism of the nineteenth century. The new social

movements like NOAH that emerged in the 1960s contributed to a new civic policy culture for environmental science and technology that was to grow stronger over the following decade. In Denmark, the public debate on environmental issues was not so easily incorporated as in Sweden. In contrast to other countries, the 'grass roots' dimension became even more important as environmentalists took part in the struggle against nuclear energy and the search for alternative means of energy supply. The opposition to nuclear energy was coordinated by an independent Organisation for Information about Nuclear Power (OOA), which so effectively mobilised public resistance and pressure that the Danish government abandoned its nuclear plans in the late 1970s. In addition, the popular debate on alternative energy sources and various public awareness and information campaigns, encouraged social movements to generate local debate and practical initiatives which gradually became an established mode of public participation in Danish political decision-making (Læssøe 1995: 39-40).

The experience of the 1970s left a significant legacy of environmental awareness and concern among all the major political parties. When an initiative was taken to form a Green Party in 1983, this legacy made it difficult for the new party to gain a sufficient following in parliamentary elections. Other parties such as the People's Socialist Party (*Socialistisk Folkeparti*) and the Social Liberals (*Radikale Venstre*) have developed an explicit profile regarding environmental policies, and there has been a gradual 'greening' of nearly all the political parties during the 1980s (Andersen 1997: 12)

In general terms, it can be argued that environmental movements in the 1970s integrated an ecological world-view or philosophy with an anti-elitist organisational form, and, in some countries, like Denmark, actually developed alternative technologies as part of a movement *cognitive praxis* (Eyerman and Jamison 1991). These 'knowledge interests' were an important part of the collective identity of the environmental movement. The movements provided a new public space for knowledge production, and for the working out of new technological projects and criteria. In Denmark, OVE, the Organization for Renewable Energy, developed a national network of renewable energy workshops, often located at folk high schools, and there were a number of alternative farmers who settled in the countryside in production collectives to experiment with new, ecological ways of living and growing food. The movement thus provided a temporary space for experimentation with new 'modes' of knowledge production, that had both cosmological, technological and organisational dimensions. But the way that mode developed differed from country to country; in Sweden, the movement identity was largely channelled into more established structures, while in Denmark the movement was part of an emergent alternative political culture.

In the mid-1980s, however, the environmental movements had begun to change character in both Sweden and Denmark. New kinds of professional organisations had emerged, such as Greenpeace, and the activism that had been

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so widespread in the 1970s began to fade into the collective memory. There were also Green political parties that started to take part in the more formalised political arenas, and, most importantly, there were new kinds of activities in national and international politics, that were slowly being grouped together under the paradigmatic slogan of sustainable development. In Sweden, the state and the established political culture largely incorporated the ideas of environmentalism into 'business as usual', while in Denmark there was a broader government policy interest in technology assessment and social experiments that would eventually lead to major programs in 'cleaner technologies'.

In both countries, the integrative cognitive praxis of the environmental movement fragmented into a disparate cluster of activities carried out by a wide range of organisations and individuals. The 'knowledge interests' of the environmental movement were transformed into various kinds of professional expertise, which made it possible to incorporate parts of the movement into the established political order, and shift at least some of the members of the movement from 'outsider' to 'insider' status. But this transformation was strongly conditioned by the national styles of science and technology and the broader political culture. In Denmark, where some of the alternative technical projects – in biological agriculture and wind energy – proved commercially viable, professionalisation led to new companies and economic branches, while in Sweden, where the parliament had served as the main arena for debate and protest, a new generation of professional politicians emerged out of the environmental movement.

The doctrines of ecological modernisation can be seen as a result of this transformation of environmentalism from a loosely organised, activist movement in the 1970s to an ever more integrated programme of industrial and technological policy in the 1990s. But obviously, the actual implementation of ecological modernisation differs dramatically from country to country. In Sweden, there has emerged a new rhetoric of 'environmental adaptation' and sustainable development with little impact on the 'national system of innovation', while in Denmark there seems to have been greater success in infusing cleaner production processes and environmental management systems into industry. There, the problem has rather been to infuse an environmental consciousness into the important agro-industrial corporations. The final section of this paper briefly presents some preliminary notes on the Swedish and Danish styles of ecological modernisation.

SWEDISH AND DANISH STYLES OF ECOLOGICAL
MODERNISATION

In Sweden, the main responsibility for environmental research and development has shifted, over the past ten years, from the public to the private sector. Although Swedish industry was comparatively late to take up the new ideas about pollution

prevention and cleaner technology that have been widely propagated in most other European countries, much of the new R&D effort in recent years has been devoted to environmental improvements in industry. In 1993, a new Foundation for Strategic Environmental Research was created to support large-scale projects involving collaboration between universities and industry in the area of 'sustainable development'. At the same time, several other foundations were established, with money taken by the then conservative government from the controversial wage-earner funds, that the social democrats had created in the 1980s. These foundations are charged with funding strategic industrial research and technological competence building and are run as private foundations, with decisions taken primarily by representatives of industrial firms and the engineering, or technological sciences. One small foundation supports the newly-established International Institute for Industrial Environmental Economics at the Technical University in Lund. At the other technical universities and business schools a range of projects and courses are being instituted in environmental management and economics, many with the support of the new foundations.

Compared to many other European countries, however, these new initiatives have come relatively late and have had trouble being integrated into established disciplines and institutions. The example of the institute in Lund, which lies outside of the traditional disciplinary structure and has its own outside funding, is all too typical of the Swedish reconstitution process. The lion's share of environmental research and development work continues to be channelled through the Environmental Protection Board and the other sectoral agencies – in energy, transportation, waste treatment, occupational health, regional planning, construction, etc. – which were created in the 1970s. There is a need for greater coordination among the myriad agencies and committees, particularly between the older state bodies and the newer private foundations. There is also a need for greater integration of the various efforts, both old and new, into the 'non-environmental' sectors. As things stand now, the environmental science and technology system remains a sector that, while growing, still has relatively little impact on the main priorities of Swedish science and technology policy, which, as in most other countries, are focused around the so-called advanced technologies: information technology, biotechnology, industrial materials.

Recently, the Swedish government has launched a number of initiatives to give a concrete form to the 'ecological adaptation' that Göran Persson called for when he became the new prime minister. The government has created a state delegation, or committee, for an 'ecologically sustainable development' and another for the 'stimulation of environmentally adapted technology'. The delegation for sustainable development, led by the (former) Minister of Environment Anna Lindh, has as its task to 'formulate a platform for the government policy for an ecologically sustainable society and to create a broad and long-term investment program'. The government has expressed the intention, as spelled out by Persson in his government policy statement, to modernise housing, construction, energy production and distribution, industrial production,

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transportation, and water and sewage systems to become 'ecologically sustainable'. Conservative politicians and economists have compared the plans to the social engineering that was so prominent in the 1940s and 1950s, when the Swedish government put into place plans for suburbs and modern infrastructure through strong centralised planning that has since gone out of fashion. That kind of planning, it is argued, can no longer function in a society that is so strongly integrated into the international market (cf Berggren 1997).

The government has not managed to convince Swedish industry with its proposals to rebuild the country. While the issue of nuclear energy has probably to a large extent contributed to the lack of consensus about sustainable development, different opinions regarding economic policy seem to underlie the conflict between government and industry. According to critics, the social-democratic policy – with large-scale state measures and an expansive short-term employment policy – lacks a comprehensive long-term strategy. Current strategy marks simply a return to the good old days of the Swedish model, when the state supported massive infrastructural projects of 'social engineering' in construction, housing, transportation and energy. The argument is that such approaches are no longer relevant, and that the new plans will not be successfully implemented.

The comparatively high degree of political polarisation around environmental issues, and especially around nuclear energy, has affected the development of environmental science and technology policy in Sweden. Somewhat more than in other countries, 'green' concerns and ideas have been given an anti-modernist connotation, and there has been a kind of anti-environmentalist backlash from economists and business leaders. Such development has been somewhat less noticeable in other European countries.

In Denmark, there has been a gradual and much more deep-seated realisation that end-of-pipe solutions are not sufficient, and that new approaches stressing a change in productive technology are required. This awareness came also with the experience of energy-saving experiments and pro-active policies that had become an integral component of Danish energy and environmental policy and administration in the 1970s.

Given the perceived limitations of supply of energy sources – further reinforced by the decision to abandon nuclear power as a result of the intense public debate of the 1970s – the Danish government has emphasised the need to resolve the energy crisis by saving energy and encouraging the transition to renewable energy sources. This led, on the one hand, to the establishment and rapid growth of the Danish wind turbine industry and, on the other hand, to a diversified regulatory framework in the energy sector encouraging more efficient technologies. The attention gradually shifted towards identification of solutions that could be integrated earlier on in the cycles of production and consumption. The relative effectiveness of economic incentives in improving the technological and organisational capacity for saving energy has inspired similar initiatives in the environmental field: a move from end-of-pipe solutions

to a model that emphasises preventive solutions including the development and diffusion of cleaner technology.

Beginning in 1986, the Danish government launched a series of major support programmes in cleaner technology. Compared to most other European countries, the Danish efforts have been substantial and have spread the various preventive technical approaches to environmental problems throughout Danish industry (Remmen 1995).

In the first phase, from 1986-1989, the effort was concentrated primarily on investigating the potential for cleaner technologies in different branches of the economy and in conducting demonstration projects in particular firms. The general approach followed similar 'national programmes' in technology development that had taken place in the 1980s, in relation to information technology and biotechnology, and were based on the long-standing Danish emphasis in technology policy on demonstration projects. The second phase of the cleaner technology programme, from 1990-92 involved a more active broadening of focus, as well as increased competence-building and information dissemination. Courses were held at engineering colleges and associations, handbooks were written, and special branch consulting schemes in cleaner technology were established in four particular branches: furniture-making, meat processing, fish production, and metal-working. At the same time, environmental management systems were instituted in a number of small and medium-sized companies with governmental support, and major efforts were taken to document the experiences with cleaner technology through a number of technology assessment projects at the technical universities. From 1993, the efforts have expanded further as the environmental administration has adopted a more flexible, interactive approach that seeks to pass responsibility and policy initiative from the public to the private sector (Remmen 1998).

The new attempts to alleviate the problems of environmental degradation were, to a significant extent, based on a dialogue between public and private interests that has characterised Danish approaches from the beginning, and a new ideology of commercialisation and the use of market forces in regulation. In the political atmosphere that prevailed in Denmark during the 1980s, when the government was usually based on a combination of parties from the centre to the right of the political spectrum under the leadership of the Conservative Party, there was a strong leaning towards liberal economic policies and indirect instruments of regulation, i.e., small government. Even in areas where the government was unable to secure a majority of votes in the Parliament for its policies – as was the case for much of the environmental legislation supported by the so-called 'green majority' (social liberals, social democrats and two left-wing parties) – the subsequent implementation of policies tended to be framed in the manner of indirect regulation.

The concrete administration of policies related to environmental science and technology were typical of an economic policy culture and paid more attention

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to ensuring the cooperation of business interests, or even the promotion of such interests, for instance, in connection with the growth of the environmental engineering consulting firms and the establishment of a competitive industry for the production and exports of wind turbines. In fact, the case of the wind turbine industry in Denmark illustrates the extent to which a combination of innovative policies, local industrial entrepreneurship, and a set of priorities evolving from the political pressure of public debate contributed to the shaping of new technologies (Jørgensen and Karnøe 1995).

This shift in awareness and attention to a wider economic perspective was also reinforced by initiatives that sought to integrate technology assessment more directly into policy-making procedures. In many ways, a particular Danish style of technology assessment found its application in the policy debates related to areas such as biotechnology and cleaner technology .

One of the most important aspects of Danish environmental science and technology policy in the 1990s has been the effort to move beyond the sectoral perception of environmental problems and to ensure that areas such as energy, transport, agriculture, and industry would integrate environmental concerns into their activity. The actual policy making and administration is still split up according to sectoral responsibilities of ministries, but the Ministry of the Environment and Energy is attempting to provide overall coordination of the activities in each sector. The problem, however, is that the influential agricultural and agro-industrial interests still remain somewhat outside of the emerging consensus.

The process of policy integration and cooperation among major actors is particularly evident in the efforts to promote cleaner technology. On the one hand, the government initiated a programme of support for cleaner technologies, attempting to reduce the costs of complying with existing emission standards and achieving future standards for emission of, for example heavy metals. On the other hand, the EPA has become increasingly forthcoming in entering into active dialogues with individual firms to find solutions to their problems. In many cases, the new approach to interaction between business and public authorities has also been associated with the methodology of Life Cycle Analysis (LCA) or 'cradle-to-grave' analysis for products. In the case of LCA, for instance, business firms have sought to develop a better environmental image for their products by examining the 'environmental load' of each of the components that enters into the production process. Frequently industrial managers have discovered that there are substantial cost savings associated with 'greener' production methods and naturally this has created a substantial amount of good-will among business interests. The problem for Denmark, however, is that the world outside remains stubbornly anti-ecological and, to compete in an international marketplace, Danish companies cannot move too quickly. There is thus, particularly in agriculture and the food-processing industries, a resistance to many of the new ideas and programmes that might grow more serious in coming years.

CONCLUSIONS

In both Denmark and Sweden, the effects of the new policies and institutional readjustments are not yet clear. What is striking is how different the experiences have so far been in the two countries.

In many respects, the efforts to transform Sweden in more sustainable directions have been constrained by the legacy of the past (cf Lundqvist 1996). The first wave of environmental science and technology policy brought into being a system of 'end-of-pipe' competence integrated into Swedish industry that has tended to dominate both the theory and practice of environmental engineering ever since. Similarly, the major efforts in the 1970s devoted to energy research and development and energy systems analysis meant that the new ideas about environmental management, accounting, and assessment have been primarily appropriated to the energy 'sector'. The sector-specific competence has been difficult to transform into a more general expertise in pollution prevention, cleaner technologies, or sustainable development. The fragmented orientation of Swedish (environmental) science and technology policy has meant that environmental issues have had difficulty leaving their sectoral isolation and entering into broader discourses about industrial and economic development. But, of course, the problem also has to do with the structure and emphases of Swedish industry. The large corporations that were built up in the late nineteenth century were based, to a large extent, on the exploitation of natural resources in the mines and the forests, and environmental consequences and impacts were evaluated accordingly. It has proved difficult to restructure Swedish industry and to incorporate an environmental concern into the characteristic forms of economic activity. But, after some delay, there are nonetheless indications that the systematic Swedes are beginning to consider a broader environmentally-oriented transformation process. In late 1998, a new social democratic government, governing with the support of the Green Party, formulated the notion of a 'Green People's Home', mobilising the rhetoric that had been so much a part of the earlier Swedish model (cf Elzinga, Jamison, and Mithander 1998).

Denmark, on the other hand, has become one of the most active countries in Europe in pursuing the new ideas of pollution prevention and cleaner production. Indeed, the environmental minister Svend Auken has recently proposed that Denmark should seek to provide an example for other countries to follow. As in the nineteenth century, when traditions of popular participation were mobilised in the industrialisation process and during the war, when resistance to the Nazis also drew on national cultural traditions, Auken argues that the strength of Danish democratic institutions and not least grass-roots movements is an important factor in explaining the relative success of Danish environmental policy.

It is, however, somewhat premature to compare the effectiveness of the two countries' efforts in ecological modernisation. While there can be no denying

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that the Danish environmental movement struck especially deep chords in the society in the 1970s, and played an important role in keeping the parliament from approving the development of nuclear energy, it can be questioned how firmly the new ideas of sustainable development have actually ingrained themselves in the Danish political culture. In 1998, a political scientist mounted a widely reported media attack on environmentalism and many of the ecological modernisers have been thrown on the defensive. In Sweden, on the other hand, the election in September brought about a 'red-green' alliance between the social democrats and the green party, which might well provide a more fertile parliamentary base for environmental measures of various kinds. It thus remains too early to assess the comparative strengths and weaknesses of the two neighbouring countries' somewhat different approaches to ecological modernisation.

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