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Lead Markets for Environmental Innovations



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Preface

Some countries are earlier than others in the development and introduction of environmental innovations. If other countries follow their examples and adopt their innovation design as well, these countries can be analysed as lead markets. In this book, contributions from innovation economics, environmental economics, and policy sciences are reviewed to explain the leadership of such countries. In case studies on environmental innovations such as photovoltaic cells, fuel cells, chlorine-free paper bleaching, diesel particulate filters, social responsible investments and others the lead markets are identified and factors that determine their advance are analysed. Often, the leadership in technological development is accompanied by a leadership in environmental policy. There is a parallel diffusion of environmental technologies and policies. Based on the theoretical considerations and the case studies, policy recommendations for R&D policies, environmental and industrial policies are derived to support the development of lead markets for environmental innovations.

This book is the result of a joint research project under the title “Policy Framework for the Development of International Markets for Innovations of a Sustainable Economy – from Pilot Markets to Lead Markets (LEAD)”. The authors are grateful for the funding provided by the German Federal Ministry of Research and Education (grant number 07RIW1A).

Table of Contents

1	Introduction	1
1.1	The Notion of Lead Markets	1
1.2	Studying Lead Markets	6
2	Theoretical Approaches	11
2.1	Lessons from Innovation Economics	11
2.2	Lessons from Policy Analysis	14
2.3	Pioneering Policy from the Perspective of Environmental Economics	22
2.4	Companies and Strategic Management	26
3	Towards an Integrated Model of the Lead Market for Environmental Innovations	29
4	Case Studies of Lead Markets from Literature Studies	33
4.1	Fuel-Efficient Passenger Cars	33
4.2	Wind Energy	36
4.3	Substitutes for CFCs in Domestic Refrigerators	40
4.4	Chlorine-Reduced Pulp Production	43
4.5	Introduction of the Catalytic Converter for Cars	47
4.6	Substitutes for Phosphates in Detergents	50
4.7	Interim Conclusions	55
5	The International Adoption of Photovoltaic Energy Conversion	59
5.1	Introduction	59
5.2	The Diffusion of Photovoltaic Energy Conversion	60
5.2.1	PV History	60
5.2.2	The Diffusion Pattern	62
5.2.3	Competing PV Designs and Policy Instruments	65
5.2.4	Domestic Markets and the Success of Manufacturers	68
5.3	Factors of International Diffusion	70
5.3.1	Explaining the Adoption of Solar Energy	70
5.3.2	Price and Cost	72
5.3.3	Demand Trends	74
5.3.4	Transfer and Policy Diffusion	74
5.3.5	Competition	76

5.3.6	Export.....	77
5.4	Conclusions.....	79
6	Fuel Cells in Stationary Applications	81
6.1	Innovation Designs.....	81
6.1.1	Phosphoric Acid Fuel Cell (PAFC).....	84
6.1.2	Proton-Electrolyte-Membrane Fuel Cells (PEFC, PEM)	85
6.1.3	Molton Carbonate Fuel Cells (MCFC).....	86
6.1.4	Solid Oxide Fuel Cells (SOFC).....	87
6.1.5	Comparison of the Fuel Cell Types.....	89
6.1.6	Cost Comparison with Conventional Energy Technologies.....	90
6.1.7	Comparison of Environmental Impacts.....	91
6.1.8	Market for CHP Installations	92
6.2	Political Instruments.....	93
6.3	Comparison of Fuel Cell Policies.....	94
6.3.1	USA.....	94
6.3.2	Japan.....	96
6.3.3	Germany.....	98
6.3.4	European Union	100
6.3.5	Canada.....	100
6.3.6	Other Countries and International Activities.....	101
6.3.7	Comparison of the Research Activities	101
6.3.8	Comparison of Energy Prices.....	103
6.4	Summarised Assessment.....	105
7	Fuel Cells for Mobile Applications.....	109
7.1	Introduction.....	109
7.2	Lead Markets in the Automobile Industry.....	110
7.3	Fuel Cells and Alternative Innovation Designs.....	113
7.3.1	Fuel Cells	113
7.3.2	Battery Electric Vehicles.....	114
7.3.3	Hybrid Electric Vehicles (HEVs).....	114
7.3.4	Conventional Fuel Efficient Vehicles	115
7.4	Regulations.....	116
7.4.1	USA.....	116
7.4.2	Japan.....	116
7.4.3	Europe	117
7.5	The International Diffusion of Engine Designs.....	118
7.6	Conclusions.....	120
8	Technologies to Reduce Harmful Emissions in Diesel Vehicles.....	123
8.1	Introduction.....	123
8.2	Emissions Regulation in the Automobile Industry.....	125
8.2.1	Auto Oil I.....	126
8.2.2	Strategies Pursued by the Automobile Industry as Part of Auto Oil I.....	127

8.2.3	Outcome of Auto Oil I.....	128
8.2.4	Outlook on Future Emissions Standards for Diesel Vehicles in the EU.....	129
8.2.5	Tax Incentives	130
8.2.6	Assessing the Process from the Perspective of Technological Potential: Technology Forcing?.....	130
8.3	The Spread of Diesel Vehicles and Their Markets	132
8.4	Market Development for Diesel Passenger Cars	133
8.5	Technologies Designed to Reduce Hazardous Emissions	135
8.5.1	Engine Modification.....	135
8.5.1.1	Exhaust Gas Recirculation	136
8.5.1.2	Direct Injection Systems.....	136
8.5.1.3	Homogeneous Combustion	137
8.5.2	Exhaust Treatment.....	137
8.5.2.1	Particulate Filters.....	137
8.5.2.2	Catalytic Converters for the Reduction of Nitrogen Oxides.....	138
8.6	Carmakers' Technological Development Strategy	138
8.6.1	Peugeot Introduces the Particulate Filter.....	139
8.6.2	Long-Term Testing by ADAC and the Federal Environmental Agency	141
8.6.3	Automobile Manufacturers' Current Technological Strategies... ..	142
8.7	Strategies by Components Suppliers	145
8.7.1	The Companies.....	146
8.7.2	Research & Development.....	147
8.7.3	Assessment from a Supplier Perspective	147
8.8	Outlook and Discussion.....	148
9	Lead Markets for VOC-Reduced Paints	153
9.1	Markets for Paint and Lacquer	154
9.1.1	The Economic Salience of Paint and Solvent.....	154
9.1.2	Consumption	158
9.1.3	Costs of Low Solvent Paints.....	160
9.2	VOC Regulations	161
9.2.1	Comparison of Most Important Regulative Measures.....	161
9.2.2	Summarised Evaluation of Policy Measures	167
9.3	Effects of Regulations	168
9.4	Solvent-Based Paints and the Reformulation of the European Chemical Policy	171
10	Potentials for Substituting Paper by Electronic Media.....	179
10.1	Introduction	179
10.2	Potentials for Substituting Graphical Papers Through Electronic Media	180
10.3	Technologies and Applications and Their Diffusion.....	182
10.3.1	Cross-Section Technologies and Applications	183

10.3.1.1	Information and Communication Technologies.....	183
10.3.1.2	The Internet.....	183
10.3.2	Business-Related Technologies and Applications.....	187
10.3.2.1	Electronic Document and Form Management	187
10.3.2.2	Document Management Systems.....	187
10.3.2.3	Electronic Signatures	189
10.3.2.4	Electronic Services	190
10.3.3	Consumer-Oriented Technologies and Applications.....	191
10.3.3.1	E-Books	191
10.3.3.2	Electronic Paper.....	192
10.3.3.3	Printing on Demand.....	193
10.4	Policy Framework	194
10.4.1	Public Policies.....	194
10.4.1.1	IT Strategies and Action Plans.....	194
10.4.1.2	The US Government Paperwork Elimination Act	197
10.4.1.3	E-Government Initiatives.....	198
10.4.2	Industry and Stakeholder Activities	199
10.5	Diffusion Factors.....	200
10.6	Summary and Conclusions.....	202
11	Technologies for Paper Recycling	205
11.1	The Development of the Utilisation of Recovered Waste Paper in Germany and in the International Context	205
11.2	Environmental Impacts	209
11.3	Technologies	210
11.3.1	Collection of Waste Paper.....	210
11.3.2	Treatment of Waste Paper	211
11.4	Policy Measures and Regulatory Approaches	213
12	Regulations Promoting Socially Responsible Investment	217
12.1	Introduction	217
12.2	Design of SRI Products	218
12.3	Regulations Promoting SRI.....	219
12.3.1	Existing Types.....	219
12.3.2	International Diffusion of SRI Regulations.....	220
12.3.3	Effectiveness of SRI Regulations.....	222
12.3.4	Window of Opportunities to Introduce Regulations.....	222
12.4	Market Development.....	223
12.4.1	International Development of SRI Investment Funds	223
12.4.2	Structure of the SRI Market in the UK.....	226
12.4.3	Further Development.....	227
13	Comparison of In-Depth Case Studies.....	229
13.1	Introduction.....	229
13.2	Frequency Distribution.....	229
13.3	Analysis of Factor Subgroups	232

13.4	Early Hypotheses in the Light of the Findings from In-Depth Studies	236
13.5	Conclusions	238
14	Policy Patterns to Develop International Markets of Innovations for Sustainability	239
15	Policies for Lead Markets	245
15.1	Policies to Stimulate the Emergence of Environmental Innovations	245
15.2	R&D Policies.....	249
15.3	Environmental Policies for the International Diffusion of Environmental Innovations	250
15.4	Economic Policies	251
	List of Figures.....	253
	List of Tables	255
	References	257

1 Introduction

1.1 The Notion of Lead Markets

There are considerable differences in the rate of adaptation of environmental innovations among the different countries. Some countries are earlier in adopting innovation, and the penetration of markets is more encompassing than in others. If these innovations are adopted subsequently without great changes in other countries, the countries where the first market introduction took place, can be viewed as *lead markets*. The concept of lead markets has been developed and fruitfully applied for any type of technological innovations. Examples for lead markets for non-environmental innovations are the mobile phones that were introduced in Finland, the fax in Japan or the internet in the USA (Beise, 2001). The lead market is not necessarily the country where the technology was actually invented. These markets have the characteristic that product or process innovations that are designed to meet local demand preferences and conditions can be introduced in other geographic markets as well and successfully commercialised without many modifications. A lead market is the core of the world market where local users are early adopters of an innovation on international scale (Beise, 1999). This definition focuses on two characteristics of lead markets. Firstly, they are pioneering countries in the development and – more important – the marketing of innovations. Secondly, innovations that arise in these markets subsequently diffuse worldwide. Both phenomena call for analysis and explanation.

At first glance, lead markets are countries with the following features (Meyer-Krahmer, 1999):

- High per capita income,
- Demanding, innovative buyers and high quality standards,
- Problems creating pressure for change and innovation,
- Flexible regulation and innovation-friendly basic conditions for producers and users,
- Product standards acknowledged in other countries.

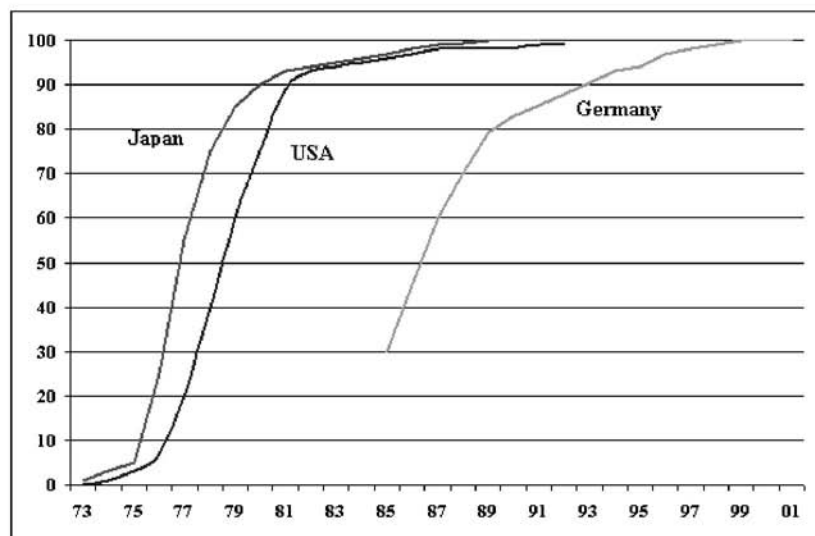
These factors hint to the fact that there are many different economic and policy factors that contribute to the emergence of such markets. Our study systematises the different factors that can be found in different streams of literature. Our approach is largely explorative, since no encompassing explanation has been developed for the emergence of lead markets for environmental innovations so far. Based on this study we develop recommendations for policy strategies that are able to stimulate the emergence of lead markets.

Our studies are dealing with lead markets for environmental innovations. It can be expected that the above mentioned factors are characteristic of lead markets for *environmental* technologies as well, but that there are also additional factors at work here, arising from the particular context in which environmental innovations are developed, both at the national and international level.

The history of environmental protection is rich in examples for lead markets: It encompasses the legally enforced introduction of catalytic converters for automobiles in the United States, desulphurization technologies in Japan, the Danish support for wind energy or the CFC free refrigerator in Germany. Another impressive example is the global diffusion of chlorine-free paper, from the political activities by Greenpeace and the EPA in the United States, by way of the introduction of chlorine-free paper whitener in Scandinavian countries and various Greenpeace campaigns in Germany and Austria, right through to effective political market intervention in Southeast Asian countries like Thailand (Mol and Sonnenfeld, 2000, see chapter 4.4 for a more detailed analysis). The latter case shows that political action that stimulates internationally successful innovations is not limited to governmental agencies only, but that this function at least regarding the process of setting environmental objectives may also be taken over by environmentalists.

Lead markets can be represented by the rate of market penetration in the different countries. The diffusion starts earlier and the market penetration is typically more complete than in other countries. An example is the catalytic converter for cars (see for more detailed discussion: chapter 4.5):

Fig. 1. Share of passenger cars equipped with catalytic converter in %



California became the pacesetter for air quality and automobile emission standards from the 1960s on. U.S. congress took over these far-reaching standards in

1970 that were not to be met with existing technologies. That was for the first time a purposeful technology forcing. However, the short period of time to meet the standards did not allow the development of a new engine design. Therefore, the catalytic converter became the dominant technical strategy to reduce emissions. The U.S. regulations were adopted by several countries with automobile industry. In particular Japan adopted early the US regulations, in order to adapt its own car industry to global markets and to enhance its competitiveness.

While the U.S. standards were postponed and lowered due to successful lobbying of the U.S. car industry, the Japanese government maintained the earlier objectives. In Europe, the regulations favouring a catalytic converter had been adopted in 1985, and among the European countries Germany took over the leading role, mainly due to its export oriented automobile industry.

What are the determinants that cause the differences in the introduction of innovations? What are the characteristics of the leading countries? Is there room for manoeuvre for a purposeful establishment of lead markets for environmental innovations?

From our case studies as well as previous studies we can infer that technical *environmental* innovations have to be largely ascribed to governmental (or NGO) activities. Environmental innovations are not only stimulated by the higher environmental standards of consumers in a country as compared with those in other countries, but also by special promotional measures, or by political intervention in the market (Klemmer et al., 1999; Jänicke et al., 2000). If the technologies cause additional costs without improving the benefits for the users as for the case of end of pipe measures, regulatory interventions are even indispensable for innovation and diffusion. But also in cases of integrated technologies, with additional advantages in efficiency, policy measures are often necessary to stimulate innovations and to support their diffusion. The underinvestment in environmental innovation can be explained by the double externality of R&D efforts made in environmental technologies: Alongside the spillover effects that can be observed for any R&D activities, efforts in *environmental* technologies do result in improvements of the environment which again is a public good. Therefore an underinvestment in environmental innovations can be expected (Rennings, 2000).

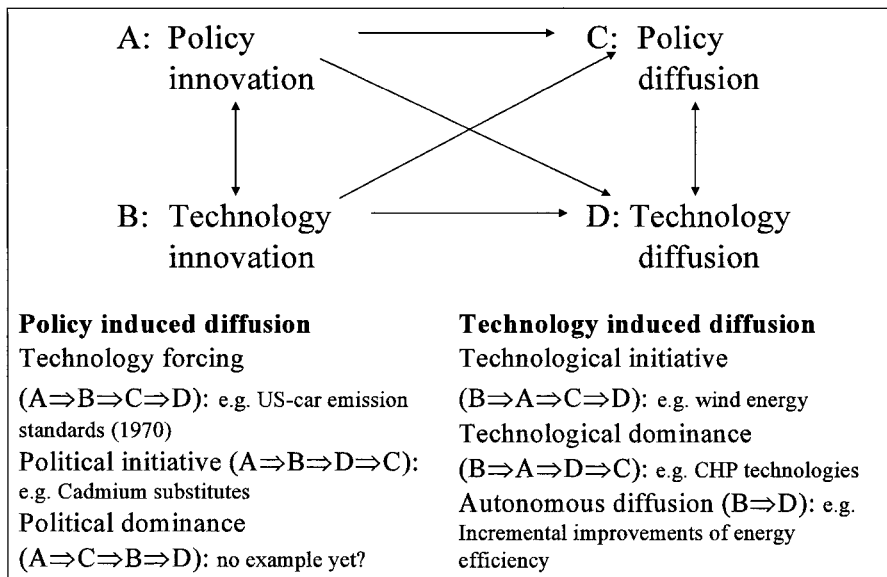
Environmental innovations do have another characteristic that is in favour of their international diffusion: They provide marketable solutions to environmental problems that are usually encountered worldwide, or at least in many countries. Thus, technological solutions to environmental problems inherently lend themselves to adoption in international or global markets.

The regional differences in adoption and diffusion of innovations cannot be explained with the specifics of environmental innovations. For this purpose, the framework conditions and political strategies in the leading countries have to be analysed. The dependence of environmental technologies on regulatory measures leads to the question to what extent national environmental policies to stimulate lead markets remain possible and effective in the context of globalisation. Our theoretical and empirical investigations, however, reveal that there is considerable room for manoeuvre for national actors. Typically, policy innovations arise in a national framework rather than being imposed by an international regime. Innova-

tive policies do diffuse very much like technological innovations. The process of diffusion is determined by the capacities of the innovating countries to develop environmental policies, by the type of innovation and the underlying problem, and by activities of international actors that often look for best practices on the national level and stimulate their diffusion (Tews et al., 2003, see chapter 2.2 for a more detailed discussion).

There is a close inter-linkage in the innovation and diffusion of environmental policies on the one hand and the innovation and diffusion of technologies on the other hand. The interplay between the diffusion of environmental policy measures and environmental technology can take a wide variety of possible sequences as depicted in the following graph.

Fig. 2. Stage model of the diffusion of environmental innovation



Source: Jänicke (2000).

Theoretically, it is possible to distinguish between the following diffusion scenarios, depending on the factors leading to the political and technological innovations:

- *Technology forcing* (A⇒B⇒C⇒D): A national environmental policy innovation in one country forces a technological innovation which diffuses if the policy innovation also diffuses (e.g.: catalytic converter technology in cars).
- *Technological initiative* (B⇒A⇒C⇒D): An existing environmental technology induces a political innovation the diffusion of which in turn encourages the diffusion of the technology (e.g.: wind energy in Denmark).
- *Political initiative* (A⇒B⇒D⇒C): A national environmental policy leads to technological innovations the diffusion of which in turn encourages diffusion of the policy innovation (e.g.: cadmium substitute).