

Chapter 1. Introduction

Clean production: oxymoron or golden chalice of 21st century manufacturing? How and where can it be accomplished? Under what circumstances and in which industries? Is it something for advanced industrial societies only, or to be shared by all? This is the story of Asia Pacific pulp firms' adoption of cleaner production technologies in the 1990s, and of local and global social activists' role in making it happen.

In the mid-1980s, prospects looked bright for pulp and paper producers in Australia, Indonesia, Malaysia and Thailand. These countries' economies were expanding, including pulp manufacturing. New or expanded pulp mills were commencing operations, significantly increasing export capacity as well as helping meet domestic demand (Ghosh 1983; Waters 1984; Hawkins 1985; Allen et al. 1986; BIS-Shrapnel Pty. Ltd. and Hawkins Wright Associates 1986a; BIS-Shrapnel Pty. Ltd. and Hawkins Wright Associates 1986b; PPI 1986; Doolan 1987; PPI 1987; Scholes 1987; Abubakar Soetikno and Sutton 1988).

Then, one after another, these industries were beset by major environment-related controversies. Proposed new export-oriented pulp mills were stopped by protest in Australia and Indonesia [Advocate, 1989 #1123; Australian Financial Review, 1989 #1203; Chapman, 1989 #1237; Jay, 1989 #1333; (PPI 1989b); Wall Street Journal, 1989 #1525; Borsuk, 1989 #84; PPI, 1989 #770]. Local farmers destroyed eucalyptus seedlings in Thailand and Indonesia (Hirsch and Lohmann 1989; *Down to Earth* 1990b; *Down to Earth* 1990a; *Down to Earth* 1990c; Ekachai 1990; Hirsch 1990; Handley 1991a; Handley 1991b; Handley 1991c; Lohmann 1991). Campaigns against pulp

industry development spread in all three countries (cf. (Scott 1990; *Down to Earth* 1989a; *Down to Earth* 1989b; *Down to Earth* 1991; WALHI and YLBH 1992; *Environesia* 1992; PER 1992; Puntasen et al. 1992); and each faced increased dependence on imports of pulp and paper products.

Dynamic change continued in these industries into the mid-1990s. Government agencies toughened environmental regulations governing pulp production. Pulp manufacturers invested millions of dollars in new, environmental pulp and paper manufacturing and waste treatment technologies, many of them "world class." These developments resulted from the combined effect of local conflicts over pulp mill development and aggressive promotion in the Asia Pacific region of new, environmental technologies developed in Europe in response to strengthened environmental activism and regulation. Social activists played critical roles in dynamics of innovation in pulp manufacturing in Europe and the Asia Pacific region.

Significance

Contemporary social theory of technology hardly mentions the importance of the environment, or of environmentalism, in shaping today's new technologies. Also, it remains bound to the experience of Europe and North America. Yet, questions involving the development and adoption of clean production technologies are no less pressing in developing countries, location of the most dynamic economic growth in the 1990s, and home to a majority of the world's people and important natural resources.

Theoretically, my research validates the following propositions:

- Social (and environmental) progress is a function of cumulative historical circumstances; complex contingencies; and multiple levels of social structures and actors;
- Technological innovation must be understood as a scientific/business process embedded in social relations and ecological contexts;
- While environmental regulatory regimes remain largely at the national and local levels, economics and politics "spill over" national boundaries all the time. This is no less true for politics and processes of innovation in environmental technology.

Depending on our point of reference, we may observe global, regional, national or local dynamics; we may discern, combine, or separate out economic, social, and environmental influences. I demonstrate the interconnectedness of these dynamics through a multi-leveled, comparative and relational analysis of technological innovation in the pulp and paper industry in four countries. An important part of why Greenpeace has had remarkable success with the pulp and paper/chlorine issue is its ability to operate on many of these levels/aspects at once. This is unusual for a popular political organization.

Social policy is ahead of social theory, however, as a growing number of programs worldwide promote "clean technology." As one of the ten largest industries in the world, and target of intense public criticism in the last decade, the experience of the pulp and paper industry has much to teach us about the prospects for, and problems of, the "greening" of industrial production.

Practically -- and of relevance to policymakers, planners, and activists -- the decreased use of elemental chlorine in pulping and bleaching by leading Asia-Pacific pulp and paper manufacturers, appears to be an important success story for industry, government, and environmentalists:

- A major industry, in an area with rapidly growing economies, has significantly improved its environmental performance;
- Government agencies have established tough environmental guidelines for new pulp mills, and have helped create conditions favorable for innovation and environmental compliance;
- Environmentalists, including Greenpeace, have had a major influence on direction and pace of technological development in the pulp and paper industry.

In an era when environmental "success stories" are too far and few between, pulp and paper firms' growing use of environmental technologies could serve as an important model for other industries, including in Asia. It is important, then, to document the extent to which environmental technologies are being used, and to understand the circumstances in which this use has come about.

Before getting to the details of my story, it will be useful to review the history of development in cleaner production technology now underway in the pulp and paper industry, and to introduce my case studies.

Development of new technologies

Development of the new, cleaner pulping and bleaching technologies in which I am interested began in the 1970s, in Sweden and Finland, in response to environmental activism and regulation in Europe and North America. Nordic

government agencies encouraged technology firms to take the slower route of reengineering basic industrial processes, rather than the quick-fix "end-of-pipe" solution favored by industry in North America (Gullichsen 1990)(Gullichsen 1990; see also (Johansson 1992). The prescience of this policy was validated in the 1980s when controversy broke out on several fronts regarding dioxin¹ and chlorine.

Chlorine/dioxin controversy

Dioxin was first linked to the pulp industry by the USA EPA in 1985; this link was not made public, however, until publicized by Greenpeace in 1987 (Kroesa 1990; Brown and May 1991). In 1988, dioxin was discovered in milk, having leached from containers made from paper (Science News 1988). This followed immediately on the heels of controversy concerning health effects of Agent Orange, a defoliant related to dioxin used by the USA in the Viet Nam War; and another involving a major chemical plant explosion in Seveso, Italy. The latter showered hundreds of people with dioxin, with severe health impacts (JAMA 1988).

Greenpeace's global campaign against use of chlorine in the pulp and paper industry evolved out of another campaign against ocean incineration.² Greenpeace's pulp and paper campaign was active on at least three continents -- Europe, North America, and Australia -- by the late 1980s (see (PPI 1989a; Gladwell 1990; Kroesa 1991; Thornton 1991).

With the presence of dioxin documented not only in milk cartons, but also toweling, sanitary and other paper products [(*Advertiser* 1989); Ardill, 1989

¹2,3,7,8 tetrachlorodibenzo dioxin, also known as 2,3,7,8 TCDD, and related substances.

²Interview, Ms. Lisa Bunin, former anti-toxics campaigner, Greenpeace International, Santa Cruz, California, September 1993.

#2017; Costello, 1989 #2010; FDA Consumer, 1989 #188; Henderson, 1989 #235; Science News, 1989 #496; Science News, 1989 #497; Science News, 1989 #494; Science News, 1989 #495; (WEN 1989)], it was not long before people living downstream from paper manufacturing attempted to link their cancers with dioxin. Cancer victims and their families in the USA litigated against paper manufacturers for damages. At first, the pulp and paper industry was defensive, refusing to acknowledge a problem, and fighting in court.

In Europe and North America, governments regulated against the presence of dioxin in pulp mill effluent, and public and private research on new, reduced chlorine and chlorine-free pulping and bleaching technologies were placed on the fast track. The race was on by technology supply firms and pulp manufacturers for the "green" markets, especially in Europe, where environmentalists had greater political strength, including sitting as Green members of parliaments.

The new technologies

Few times in history has an industry devoted as many resources or moved so quickly to develop new technologies as did the pulp industry and the technology firms supplying that industry. The industry devoted millions of dollars to research, testing, and implementation of new technologies, and to improving environmental operating conditions (API 1992; Porter and Linde 1995).

Not only chemical, but also biological processes were investigated (Aldwell 1988; Eriksson 1988; Jurasek and Paice 1988; Eriksson 1990; Trotter 1990; Downs 1991; Eriksson 1991; Kirkpatrick 1991; McDonough 1991; Mehta and Gupta 1991; Patrick 1991; Pulliam 1991a; Pulliam 1991b). By 1991, leading

industry trade journals had declared that elemental chlorine -- principal source of dioxin in the pulp industry-- was 'dead' as an ingredient for papermaking in Europe and North America (Pearson 1991)(Pearson 1991; see also (Capps 1990). The first mills to use the new, chlorine-free processes developed in Sweden and Finland went on-line in the early 1990s in Europe and North America (cf. (*New York Times* 1992). By 1994, technology firms claimed to be ready to build "closed process" ("totally effluent free" or TEF) pulp mills, promising to improve environmental performance even further, and remove political and locational constraints from further pulp mill development (Edstrom 1994; Silander 1994).

In this dissertation, I examine how these new processes have been made in "far off" and newly industrializing countries as well as in Europe and North America. Challenges and problems remain, including in the Asia Pacific region, with regard to adapting the new technologies to unique local conditions and raw materials. But the progress has been remarkable. How did it happen?

Politics of consumption

Some of the "global" answers to this question involve Greenpeace's successful consumer-oriented campaigns aimed at changing individual, corporate, and institutional demand for paper products in Europe and North America. "Green consumption" campaigns encourage the adoption of innovations in environmental technology through increasing acceptance of the paper products bleached without use of chlorine. Some dimensions of "green" consumer activism with regard to pulp and paper products include:

Environmentalists, notably again Greenpeace, have successfully lobbied major publishers to change to chlorine-free paper. A key event was Greenpeace's widespread distribution in Germany of a simulated edition of the weekly

newsmagazine, *Der Spiegel*, printed on chlorine-free paper from a mill in Sweden. This success was followed up by a similar agreement with *Time*, in the USA. Through actions like this, activists demonstrated strong consumer acceptance of the slightly less bright, chlorine-free paper.

Women consumer activists have demanded chlorine-free tissue and personal hygiene paper products (cf. (Armstrong and Scott 1992; WEN 1989; Costello et al. 1989)). Their efforts have been bolstered by the availability of chlorine-free sanitary paper products (again from Sweden) and evidence that such products reduce women's and children's risk of exposure to dioxin. Manufacturers in the highly competitive tissue segment of the paper industry (see below) thus have had a particularly strong incentive to adopt chlorine-free pulping and bleaching technologies.

International environmental organizations and consumer activists also have focused on the development of national and international eco-labeling standards.³ For paper, such standards might include certification that raw materials were sourced from "sustainably managed" forests or timber plantations, that elemental chlorine was not used for pulping and bleaching, that all liquid and airborne wastes received secondary treatment, etc. (cf. (Pulp and Paper Information Centre n.d.; Webb 1994)). Pulp mills which are able to obtain environmental certification for their operations have been able to obtain premium prices for their products, and gain access to "green" markets. The eco-labeling standards-setting process is a very politicized one, with sharp disagreements between industry, environmental and other representatives on the international commissions charged with developing such standards.

³Interview, Ms. Amanda Cornwall, consumer member, international eco-labeling advisory panel, and staff attorney, Consumer Law Centre Victoria, Melbourne, Australia, May 1994.

Another focus of green consumer activists has been on the establishment of environmentally preferred governmental purchasing policies.⁴ Under such policies, a governmental body would be required to purchase environmentally-certified paper products over other comparable, but uncertified, products. This may be required, even with an unfavorable price differential between the two types of products.

Impact on different segments of the pulp industry

Various segments of the pulp industry have been affected differentially by environmentalist and consumer pressure. Manufacturers concentrated in some product/process/market segments have benefited from new, environmental technologies more than others; also, some are able to convert to chlorine-free processing more easily and economically than others.

Tissue and sanitary papers manufacturers are subject to pressure from individual consumers. This segment of the industry tends to be concentrated in a few producers of well-known name brands; highly competitive; and vulnerable to consumer anxieties. Consumers are concerned about paper products which come into intimate contact with their and family-members' bodies. Fears about dioxin residuals in women's sanitary products, paper diapers (nappies), toilet tissue, paper napkins (serviettes), paper toweling, and facial tissues have an immediate market impact. Brightness, whiteness, and expectations of strength for such products are relatively forgiving, however, and technology changes eliminating chlorine use can be made relatively inexpensively.

Fine printing and writing papers manufacturers, especially those using kraft pulping techniques, have a more difficult time. Business and institutional

⁴For an aborted attempt to establish such a policy in the USA, see (Wall Street Journal 1993).

customers often require specified whiteness, brightness, and strength -- all enhanced by chlorine -- and are sensitive to price. Retrofitting kraft pulping and bleaching technologies to completely eliminate elemental chlorine use is a major undertaking and quite costly. Nevertheless, leading kraft pulp mill operators are steadily reducing chlorine use through minor process modifications (see Chapter 4).

Newsprint and unbleached kraft papers (e.g. packaging, linerboard) manufacturers have been less effected by debates over chlorine use. They, too, however, may use elemental chlorine in the pulping process, e.g. because the wood's hardness or resin content.

Case studies

Southeast Asia

The development of today's large-scale, wood-based pulp industries in Southeast Asia can be traced to UN/FAO initiatives in the 1960s to develop resource-based primary industries in Asia (see (United Nations. Economic Commission for Asia and the Far East 1962; FAO 1966; *PPI* 1967; Hass 1980; FAO 1980). Current Asian pulp industry development is very close to what development advocates, national officials, technicians, and others wanted to happen, and have worked to make happen, since then.

In the early 1970s, a worldwide paper shortage (Hass 1980) left many developing countries, including in Asia, with severe paper shortages, causing disruption of government, schools, and news media. European and North American paper manufacturers exhausted paper stocks fulfilling domestic orders, leaving their farther away customers without. Officials from import-dependent countries, including Australia and Southeast Asian countries, took

these events as further encouragement for increasing domestic pulp and paper production capacity.

to develop their resource-based industry to end their dependence to foreign suppliers.

Asia Pacific pulp and paper industries have been expanding rapidly, from the mid-1980s to present; factors include:

Availability of capital. An ideal-typical (Indonesian) startup pulp mill might be capitalized on the basis of a relatively small initial capital outlay on the part of a domestic business group; "in-kind" participation on the part of forest concession-holders -- whether the state itself, an army officer, close friend or family member of the president, etc.; foreign direct investment from an overseas partner, possibly in-kind (used equipment); or in cash; loans from private and state-owned domestic banks; loans or joint venture participation from capital equipment manufacturers, and their country's overseas development assistance and/or trade agencies. After the mill has been operating successfully for a few years, additional capital may be raised on international corporate bond markets. Some investment may be derived from agroindustry and logging profits.

Availability of inexpensive equipment. Leading Asia-Pacific pulp and paper firms have been able to take advantage of a number of factors leading them to be able to purchase manufacturing equipment at relatively low costs.

Liquidation of natural capital. In Malaysia and Indonesia, mill startup costs have been minimized through state granting of timber concessions; through profits from logging primary/secondary forest on those concessions; and

through ready utilization of "logging residue" or "wastewood" from those concessions.

Control of land and forests. Pulp mill development in Southeast Asia is often a vehicle for final consolidation of corporate control of land and forests. In Indonesia, for example, industrial timber plantation (HTI) concessions, allow the holder to clear whatever is on the land to plant fast-growing industrial trees; whereas logging concessions are more restrictive in logging and restoration practices. Rural communities which were able to coexist with logging operations are divorced from traditional livelihoods with the establishment of timber plantations. Some survive by providing wage labor to timber estates. If they are fortunate to be in the concession of a "good company," they may receive further benefits, such as health services. Corporate management is the big winner, however, having gained virtually complete control over land and forest resources.

Consumption factors. Consumption factors are also important in Asia Pacific pulp and paper industries' expansion in the 1980s and '90s. Regional and domestic consumption is growing rapidly, insulating the industries somewhat from recessions affecting the industry in other parts of the world.

Indonesia has a rapidly expanding export goods sector; and is also promoting increased education among its population of 190 million people. Despite the country's export-substitution orientation, Indonesia's pulp and paper industry finds itself producing increasingly for the domestic market.

[insert Figure 1 here]

Thailand's paper industry is oriented towards providing intermediate capital goods for a booming export-oriented manufacturing sector. Export goods need packaging. Thailand is also aggressively expanding the literacy of its population and uses large quantities of paper for publication of newspapers and books. (See Figure 1.)

The cases compared

The countries of my study offer interesting similarities, differences, and linkages, with relation to the adoption of elementally chlorine-free (ECF) pulping and bleaching technologies. Key factors include timing of industry expansion; and strength of environmentalist forces (both public and private) vis a vis corporate or business forces. (See Figure 2.)

		<i>Timing of Expansion</i>	
		EARLY	LATE
<i>Environmentalists' Strength</i>	WEAK	Old tech., mill built (Malaysia, Indonesia, Thailand)	ECF (Indonesia, Thailand)
	STRONG	Project blocked (Australia)	TCF TEF (???)

Figure 2. Influence of timing of expansion and strength of environmentalism on adoption of environmental technologies in Asia Pacific pulp and paper industries.

In Australia, a new pulp mill was proposed in 1988, after the chlorine/dioxin issue had developed in North America and Europe, but before chlorine-free pulping technology was widely available. The proposal quickly roused strong opposition among local farmers and fishermen, and urban environmentalists. Greenpeace brought information and contacts from its pulp mill campaigns in Europe and North America. The environmental coalition prevailed, preventing construction of an "old-technology" mill, promulgating new regulations affecting existing, as well as new, pulp mills, and catalyzing a five-year, government-sponsored pulp mill research program.

Indonesia's pulp industry boomed during the period studied. New mills built in the first part of this period used "old technology," some with used equipment. Sharp conflicts developed around community and environmental impacts of new mills in Sumatra; and have simmered for a decade, sometimes leading to involvement by the army. In the aftermath of an explosion at one of the troubled mills in November 1993, Indonesia's Minister of Environmental Planning and Management declared that all new mills built in Indonesia would have to be "ECF or better." New mills coming on-line in Indonesia in the last couple of years have, are utilizing ECF technology. Environmental and community activists in Indonesia have had limited success getting government agencies to police the environmental practices of operating mills.

Malaysia's one, formerly state-owned pulp mill, in the East Malaysian state of Sabah, was built in the mid-1980s, before the pulp industry's use of chlorine became an international issue, and before ECF technology was widely available. Malaysia's national environmental authorities were relatively strong in their regulatory enforcement of this mill, perhaps related to the conflictual

relationship between the national government and the opposition party-controlled state government. This enforcement, combined with an energetic staff of young engineers, resulted in a steady stream of environmental improvements, including reduced use of elemental chlorine, at least until the state's financial resources began to run out. (The mill has since been privatized.)

Thailand's pulp industry, smaller and more natural-resource constrained⁵ than Indonesia's, has also grown rapidly in the last decade. Local activists and environmentalists succeeded in having the national government shut down one large, relatively new pulp mill in northeastern Thailand, due to its impact on a nearby river and on downstream users. The mill was an easy target due to its foreign ownership and largely non-Thai management. Strong activist and regulatory pressures on this mill have had important spill-over effects on the entire industry in Thailand. A new pulp line in operation at that same mill, and another at a pulp mill under construction, utilize ECF technology. The Thai government has shown its willingness to shut down polluting mills.

No chemical pulp mills utilizing "totally chlorine free" (TCF) or "totally effluent free" (TEF) technologies have been built yet in the countries studied, although TCF technology is commercially available, and capital equipment companies say they can build a TEF mill. If a new chemical pulp mill ever is built in Australia, it may have to utilize such technologies. In Southeast Asia, where mills *are* being built, environmentalists have not been strong enough to

⁵The little forest remaining in Thailand is unavailable to the pulp industry. Seventy percent of the raw material used by Thailand's pulp industry is waste paper imported from Hong Kong and the USA. Pulp companies' attempts to establish eucalyptus plantations in Thailand have been sharply opposed, though such planting programs continue to be carried out in the name of "reforestation."

force the use (and additional purchase and operating costs) of TCF/TEF technologies. Particularly sensitive downstream ecological or social circumstances, or increased demand (and thus higher prices) for chlorine-free pulp and paper products could mitigate towards use of such technologies in the future, however.

Asia-Pacific pulp and paper industries' rapid expansion in the 1980s was supported by those who stood to benefit directly from it -- mill owners, capital equipment supply firms, consulting engineers, local governments, local workers, contractors for the supply of raw materials. At the same time, industry expansion provoked strong negative reactions by communities affected by radical changes in natural resource use and land/forest tenure. Local communities were joined and supported by city-based, "middle-class" national and international environmental activists.

Key conflicts in Australia, Indonesia, and Thailand combined with national politics, leading to: protracted anti-pulp mill campaigns; blocked and modified project proposals; tightened environmental regulation; and local innovation. Greenpeace provided assistance to local campaigns, contributing to an increased demand for engineering services and capital equipment from Europe and North America.

In the countries studied, pulp firms became national "landmark" cases not only because of their practices, but also because of their political vulnerability as minority- or foreign-owned businesses, and because of sharp conflicts with local communities of other minority groups (see below). Minority mill ownership tended to strengthen local activists' and government officials' hands. Opposition to pulp mill expansion and operation was built on top of long histories of local

resistance to colonial and/or central development efforts. These cases' cultural roots did not stop them from setting precedents affecting more advantageously situated manufacturers.

Ecologically sensitive waterways, multiple downstream users and drought conditions have left Asia Pacific pulp mills, huge users of water resources (see Appendix C), vulnerable to impacts, regulation, and change.

Asia Pacific pulp and paper industries use raw materials different than in those countries where industry technology is developed: mixed tropical hardwoods in Indonesia and Malaysia; bagasse (fibrous residue from processing sugar cane) in Indonesia and Thailand; bamboo and kenaf in Thailand; old-growth and different varieties of eucalyptus in Australia. National and international research institutions, organizations, and networks, and international aid agencies have stepped in to help provide new technology for mills using non-wood fiber sources, as well as older mills -- markets viewed as less profitable by capital equipment manufacturers.

Organization of dissertation

In the pages that follow, I review academic literature on environmental technology (Chapter 2); summarize my research methods (Chapter 3); present the studies of the adoption of cleaner production technologies in the pulp and paper industries of Australia, Indonesia, and Thailand (Chapters 4-6); discuss Finland's and Sweden's role in this adoption (Chapter 7); and discuss my findings in comparative context (Chapter 8). I have included graphs, tables, and select photographs throughout. Further detailed documentation is included in appendices and the bibliography.