



Small Is Not Necessarily Beautiful

Coping with Dirty Microenterprises in Developing Countries

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Urban clusters of small firms in developing countries can generate enormous amounts of pollution. To control it, policymakers have a number of practical, if unconventional, strategies at their disposal.

Sizable cities in developing countries typically host thousands of small manufacturers engaged in pollution-intensive activities such as leather tanning, metalworking, ceramics, textiles, and food processing. Collectively, these firms, which are often located in poor, densely populated neighborhoods, can have devastating environmental impacts. Nevertheless, pollution control efforts in developing countries have generally focused on large industrial sources. This bias stems in part from an enduring misperception that small-scale sources are relatively unimportant. It also is a matter of practicality—small firms are difficult to regulate by conventional means. Numerous, cash-strapped, and frequently unlicensed, they are often hard for regulators to identify, much less monitor and sanction.

Yet recent RFF case studies of small-scale brick kilns and leather tanneries in Mexico demonstrate not only that cutting small manufacturers' pollution yields large benefits, but also that the barriers to pollution control are far from insurmountable. Policymakers have at their disposal a number of cost-effective and practical—if unconventional—pollution control strategies.

Brick Kilns in Ciudad Juárez

In Mexico, small-scale traditional brick kilns fired with cheap, highly polluting fuels like scrap wood, plastic refuse, and used tires are notorious sources of urban air pollution. Ciudad Juárez—a sprawling industrial city on the U.S.-Mexico border with some of the worst air pollution in North America—is home to approximately 350 such kilns clustered in eight brickyards.

A study of the benefits and costs of controlling emissions of particulate matter smaller than 10 microns (PM10)—a pollutant responsible for a large share of the noncarcinogenic adverse health impacts from air pollution—clearly demonstrates that the Ciudad Juárez's brick kilns inflict significant harm. Because these kilns do not have smokestacks, over 90% of their PM10 emissions are deposited less than a third of a mile away, a critical problem since most kilns are situated in residential neighborhoods. Thus, the kilns are partly responsible for over a dozen cases of premature mortality and hundreds of cases of respiratory illness each year in that city (see Table 1), damages that are valued at between \$20 mil-

lion and \$90 million. By contrast, the annual cost of pollution control programs that would virtually eliminate these impacts is estimated at less than \$300,000.

Although brick kilns are widely recognized to be a leading source of air pollution in Ciudad Juárez and its sister city, El Paso, Texas, a number of factors make it politically difficult to require brickmakers to bear the full costs of pollution control: brickmaking provides over 2,000 jobs, most brickmakers are impoverished (profits per kiln average \$100 per month), and most belong to a trade association or other local organization that can lobby against pollution control efforts.

Despite these obstacles, efforts to control brick kiln emissions had considerable success in the early 1990s. In 1989, the municipal environmental authority initiated a “clean technology” project aimed at substituting propane for dirty fuels. The next year, the propane initiative was handed off to the *Federación Mexicana de Asociaciones Privadas de Salud y Desarrollo Comunitario* (FEMAP), a private, nonprofit social services organization. FEMAP was able to attract considerable funding and participants from both sides of the border including local propane companies, universities, and Los Alamos National Laboratory in New Mexico.

Leaders of the propane initiative used a number of carrots and sticks to encourage participation. First, they subsidized various costs associated with adopting propane. Mexican propane companies provided most of the requisite equipment and training free of charge. To make propane more attractive, despite the fact that it was more expensive than traditional fuels, engineers at Los Alamos National Laboratories designed new energy-effi-

cient kilns. Unfortunately these kilns proved prohibitively expensive and complicated.

Second, the initiative’s leaders worked to ratchet up pressures on brickmakers to adopt propane. Most importantly, they convinced brickmaker trade unions in several brickyards to prohibit their members from using dirty fuels. Also, the city government banned the use of particularly dirty fuels and set up a telephone hotline to register complaints about brickmakers violating the ban. Enforcement teams with the power to jail and fine violators were dispatched in response to complaints.

Third, FEMAP initiated an educational campaign to raise brickmakers’ awareness of the health hazards associated with dirty fuels. Finally, project leaders tried to reduce competitive pressures for brickmakers to use cheap dirty fuels by organizing a boycott of bricks fired with dirty fuels. However, the boycott was quickly undone by rampant cheating.

By the end of 1993, over half of the Ciudad Juárez brickmakers were using propane. Unfortunately, this success proved short-lived. In the early 1990s, as part of a nationwide economic liberalization program, the federal government was phasing out long-standing propane subsidies. As propane prices continued to rise in 1994, propane users switched back to dirty fuels. By 1995, only a handful of brickmakers were still using propane. However, the propane initiative has had some lasting impacts: local organizations and city officials continue to enforce a ban on particularly dirty fuels such as tires and plastics.

Leather Tanneries in León

The city of León in north-central Mexico produces about two-

Table 1: Estimated annual health effects of PM10 emissions from traditional brick kilns in Ciudad Juárez (number of cases above baseline = zero kiln emissions; mean values and 95% confidence intervals)

Health endpoint (number of cases)	Ciudad Juárez			El Paso		
	Low	Mean	High	Low	Mean	High
Mortality	2.5	14.1	31.0	0.5	2.6	5.8
Respiratory hospital admissions	0	262	770	0	37	107
Emergency room visits	0	607	1,719	0	85	240
Work loss days	0	3,216	8,500	0	448	1,185
Adult respiratory symptom days	91,610	376,600	794,000	14,430	59,300	125,000
Adult restricted activity days	2,704	138,000	349,100	377	19,240	48,670
Asthma attacks	180	42,680	108,600	25	5,950	15,130
Children's chronic bronchitis	0	1,637	4,416	0	184	497
Children's chronic cough	0	1,878	5,017	0	211	564
Adult chronic bronchitis	0	93	242	0	15	38

(Source: Blackman, Newbold, Shih, and Cook 2000)

thirds of the country's leather. Of the 1,200 tanneries in the city, about half employ fewer than 20 workers. Virtually all of León's tanneries dump untreated toxic effluents directly into municipal sewers where they flow untreated into the Turbio River. The resulting pollution has contaminated ground water, destroyed irrigated agricultural land, and caused serious health problems. Regulations governing water pollution have been on the books for decades, but most are simply not enforced. By all accounts, the main reason is that, as one of the city's principal employers, tanners have considerable political power.

Concerted efforts to control pollution from tanneries in León began in 1986. Tannery representatives signed a *convenio* (voluntary agreement) with regulators in which they agreed to comply with written regulations within four years. But when it became apparent in 1990 that the tanners had not taken any action, they were given a second four-year grace period. At the end of this second grace period, tanneries still had made no progress, so they were granted yet another grace period. This cycle has continued until today.

In addition to the succession of *convenios*, there has also been an attempt to control pollution by relocating the tanneries. In the early 1990s, the city built the infrastructure for a tannery industrial park with a common wastewater treatment facility. Tanners were required to purchase land and build new facilities in the park. In consideration, they were to be provided with subsidized loans and tax credits. However, tanners ultimately refused to foot these costs, and today the industrial park stands empty.

Perhaps the most successful means of controlling tannery emissions in León has been the largely voluntary adoption of clean tanning technologies, including sedimentation tanks, that allow particulate matter to settle out of waste streams; low-chemical tanning recipes; enzymes that substitute for sulfur compounds used to rid hides of hair; recycling tanning baths; and chrome recovery. Estimates of the percentage of tanneries using these technologies range from 90% for sedimentation tanks, which are required by law (this law appears to be enforced), to less than 5% for chrome recovery.

In view of the proven political and economic constraints on relocation and conventional regulation, clean technologies currently represent the best hope for controlling tannery pollution. To assess the barriers to and incentives for adoption of clean technologies, a team of researchers from RFF and the University of Guanajuato in Mexico recently administered a detailed



Typical traditional Mexican brick kiln.

survey to the owners and managers of about 170 tanneries. Preliminary analysis of the survey data suggests that for most technologies, firm size is not determinative: small tanneries are just as likely to adopt cleaner methods as large ones. Rather, access to information about the technology as well as the education of tannery managers appears to be critical. Many clean technologies are simply not well known or well understood by tanners. Surprisingly, key sources of information and assistance are private sector entities, including chemical supply companies, fellow tanners, and the tannery trade associations.

Another finding is that adopters of certain technologies tend to be spatially clustered, suggesting that demonstration effects are important. In the case of one technology—sedimentation



Brickmaker throws a tire into a kiln.

tanks—laws requiring installation are clearly driving adoption. Finally, even though most of these technologies lower materials costs (and sometimes labor costs), several entail significant set-up costs that act as a significant barrier to adoption.

Lessons Learned

Political constraints. In both Ciudad Juárez and León, city regulatory authorities have been able to enforce regulations that impose minimal costs on polluters. For example in León, they have compelled tanneries to install sedimentation tanks. But they have not been able to consistently enforce more burdensome regulations. A key reason is that brickmakers in Ciudad Juárez and tanners in León are numerous and well-organized and, as

a result, have the power to block enforcement. In general, when dealing with severe pollution problems created by small firms, political considerations are likely to be quite important, if not paramount. Severe pollution problems arise when small polluters are numerous, and when polluters are numerous, they are bound to have political power. Consequently, unless the victims of small manufacturers' pollution can be galvanized into action, successful policies will need to accommodate polluters' concerns about the costs of pollution control.

Informal regulation. The case studies suggest that so-called “informal” regulation—pressure generated by private sector actors that have day-to-day contact with polluters—is probably the most important ingredient of a successful pollution control program for small firms. In Ciudad Juárez, brickmakers trade unions played a critical role in promoting propane by enforcing prohibitions on the use of traditional fuels in some brickyards. Also, citizen complaints facilitated enforcement of a municipal ban on dirty fuels. In León, pollution control efforts have been stymied by the absence of such private sector pressure.

There are a number of explanations for the lack of informal regulation in León. Most households in the city depend on the leather industry for their livelihood so it is difficult to generate public support for measures that raise tanners' production costs. Also, tannery emissions are less noticeable than those of brick kilns, and their health and environmental impacts are less immediate. Hence, informal regulation would seem to be easier to generate when polluters are not the mainstay of the local economy and when emissions are easy to detect and have immediate adverse health impacts.

Clean technological change. Given the barriers to regulating small firms by conventional means, clean technological change represents a particularly promising pollution control strategy. In both cities, technical assistance spurred clean technology adoption, and in Ciudad Juárez, a campaign to educate brickmakers about the health impacts of dirty fuels also appears to have had some impact. Surprisingly, both case studies suggest that private-sector organizations, such as equipment suppliers and trade associations, can be the principal purveyors of technical information, an encouraging prospect given chronic constraints on resources available for public sector initiatives.

The Ciudad Juárez case study also demonstrates that clean technologies need not be “win-win” propositions; that is, they need not reduce production costs as well as polluting emissions. The majority of brickmakers adopted propane and continued

to use it for over a year even though it significantly increased production costs. Part of the explanation may have to do with the interplay between competition and informal regulation. The market for bricks is highly competitive, and as a result, brickmakers that use high-cost clean fuels are liable to be undercut by competitors using dirty fuels. Thus, competition in the market for bricks discouraged adoption initially. But once diffusion has progressed past a certain stage, competition appears to have worked *in favor* of adoption because those who had adopted have an incentive to ensure that their competitors adopt as well. Moreover, adopters generally had some leverage over competitors who were neighbors and/or fellow union members. As a result, once an initial cadre of brickmakers adopted, neighbors and fellow union members quickly followed suit. This suggests that if a critical mass of small firms can be convinced by hook or by crook to adopt a cost-increasing clean technology, eventually diffusion can become self-perpetuating.

Finally, the failure of efforts to successfully diffuse costly, complicated energy-efficient kilns in Ciudad Juárez demonstrates the well-established principle that in developing countries, new technologies must be appropriate, that is, both affordable and consistent with existing levels of technology.

The promise of private-sector-led environmental initiatives. The relatively successful Ciudad Juárez experience suggests that private-sector-led initiatives hold considerable promise as a means of addressing small-firm pollution problems. These initiatives would seem to enjoy a number of advantages over state-run programs. First, the willingness of the majority of the Ciudad Juárez brickmakers to cooperate with the project suggests that private-sector-led initiatives may be best suited to engage unlicensed firms that, by their nature, are bound to be wary of sustained contact with regulatory authorities. Second, the public enthusiasm that the propane initiative generated suggests that private-sector-led projects may be able to draw more freely on public sympathy for environmentalism than top-down bureaucratic initiatives. And finally, the projects' success at consensus

building among a diverse set of stakeholders suggests that private-sector-led initiatives may be better able to sidestep the politics and bureaucracy that often plague public-sector-led initiatives.

By contrast, the León efforts to establish *convenios* have been rife with such problems. The qualified success of the propane initiative, however, does not imply that small-scale pollution problems are best left to private sector organizers. In all likelihood, the propane initiative would not have had as much success without unusually strong public sector support.

Boycotts. In Ciudad Juárez, the attempt to organize a boycott of the brickmakers still using dirty fuels was an utter failure. Buyers simply continued to buy bricks from whoever was selling at the best price. This experience suggests that in most cases, contravening market forces—especially in informal or lightly regulated markets—simply does not work. Monitoring is too difficult and cheating is too easy.

Allen Blackman is a fellow in RFF's Quality of the Environment Division. Funding for this research was provided by the Tinker Foundation.

Further Reading

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