

NUCLEAR POWER, TECHNOLOGICAL AUTONOMY, AND THE STATE IN MEXICO

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On 10 October 1988, President Miguel de la Madrid authorized loading of the first of two reactor units at the Laguna Verde nuclear power plant, on the Mexican gulf coast above the port of Veracruz. De la Madrid's decision to move ahead with Laguna Verde, Mexico's first foray into commercial nuclear energy production, came as no surprise. What was extraordinary was that it proved to be one of the most controversial policy actions of his *sexenio*. Culminating twenty years of planning and development, the Laguna Verde project, which had been emblematic of Mexico's technical progress and promise at its outset, had turned into a political albatross.

Mexico's decision to enter the nuclear power arena is a topic that lends itself to examining the debate over the capacity of upper-tier late-industrializing countries to sustain autonomous, technologically sophisticated development projects. This case is a useful one for several reasons: first, because the attainment of national autonomy in producing nuclear energy is considered beyond the reach of all but the most advanced industrial nations; second, because Mexico is often exemplified in the literature as an authoritarian regime managing advanced processes of dependent industrialization (O'Donnell 1978; Kaufman 1977); third, because the project's long duration allows comparison of processes of policy development over several discrete administrations; and fourth, because the nature of the project—its policy complexity and role in the Mexican energy development—lends itself to examining the capacities and limitations of the Mexican state in this issue area.

These features allow exploration of at least three interrelated questions. The first aims simply at evaluating the Mexican government's policy performance in terms of its basic objectives. Were the nuclear policy in general and the Laguna Verde project in particular intended to promote Mexico's autonomy in energy and technology? If so, can the decision to operate the plant be justified in those terms today?

The second question is, does Mexico's experience with nuclear energy support the hypothesis of structural limitations on late-indus-

trializing countries in acquiring and controlling advanced technology? This issue may be conceptualized as the problem of “external autonomy,” oriented toward examining the constraints placed on industrializing countries by the world economy.

The third question links the theoretical debate over “external state autonomy” to the issue of “internal state autonomy,” or the state’s autonomy from societal interests and constraints arising from intrastate conflict. Here the question is, how did the Mexican state’s relative internal autonomy affect its ability to implement its nuclear energy policy successfully?¹

Before considering the structuralist position on this issue, it is useful to recognize the common distinction between *dependence* and *dependency* (Caporaso 1978). The notion of dependency as such, if correctly employed, is applicable at the level of a broad social formation. Dependence, in contrast, applies to relations at a subordinate level of analysis. As Theotônio Dos Santos (1970) and Fernando Henrique Cardoso and Enzo Faletto (1979) have observed, dependency theory does not exclude the possibility that sectoral components of a socioeconomic formation may free themselves from dependent relations. But such instances of breaking with dependence at subordinate levels of analysis must be put into perspective. By themselves, these individual cases are not sufficient to sustain definitive conclusions concerning national dependency. As cases accumulate at this level, however, the evidence for or against the general dependency hypothesis may be reinforced.

The structuralist argument on technology should be set in this context. Structuralists hold that late-industrializing countries like Mexico are severely disadvantaged by the international economy in their quest to procure the advanced technology necessary to sustain autonomous development projects. They are therefore apt to remain dependent on the industrialized countries for sustained economic growth. O’Donnell, for instance, argues in the case of bureaucratic-authoritarian regimes that such regimes do not necessarily gain greater leverage over the indus-

1. Considerable debate is found in the literature about the relative autonomy of the Mexican state. Most scholars agree that the Mexican state enjoys much policy autonomy in relation to civil society due to its corporatist, limited authoritarian character (see among others Purcell 1977; Story 1986; Hamilton 1982; Grindle 1977; Cornelius and Craig 1988; Spalding 1981; Mares 1985). Analysts differ, however, in attributing varying amounts of influence in policy-making to particular interests in society. One school argues that the Mexican state is less autonomous to the degree that it has systematically favored the private sector in economic development (Hamilton 1982; Teichman 1988; Spalding 1981). Another group asserts that while private-sector influence is strong, it remains contingent on numerous other factors, including the corporate power of political elites within the state (Story 1986; Smith 1979; Camp 1980). Still others adopt a coalition-centered approach and argue that the Mexican state enjoys real latitude relative to the private sector and other social interests by dint of its administrative and political power and its strategic ability to select among various policy options in the international economy (Mares 1985).

trialized countries or enhanced control over advanced technology (O'Donnell 1977, 1978, 1988). On the contrary, such governments are likely to pursue development projects based on acquiring advanced technology from industrial countries while lacking the economic and political leverage to attain technological independence. They also remain dependent in their limited capacity to absorb advanced technology before it becomes obsolete and in their decision to adopt such technology rather than pursue alternative development paths.

Even so, most structuralist analysts allow for some exceptions. Certain countries, usually upper-tier late-industrializing countries like Mexico, are believed to have the potential to acquire technological autonomy under specific conditions. Such "potential autonomy," if actualized in certain economic sectors, may raise legitimate questions concerning a nation's overall level of dependency but does not by itself disprove the structural dependency hypothesis.

A number of scholars have criticized an extreme structural dependency approach (Bennett and Sharpe 1979; Ruggie 1983; Grieco 1984; Evans 1987; Adler 1987, 1988). Investigating advanced technology sectors in India, Brazil, and Argentina, Joseph Grieco and Emanuel Adler have identified bargaining, institutional, and ideological factors that may enable a country to attain technological autonomy. Grieco in particular carefully points out that this capacity may be characteristic of upper-tier late-industrializing countries rather than of all countries. Stephen Krasner is also sensitive to such potential outliers in an otherwise structural explanation (1985).

At the core of the debate lies the role of the state in industrializing countries, specifically its degree of autonomy vis-à-vis domestic and foreign agents.² As critics have observed, when the structural argument bears on the question of high technology transfer, it often suffers from a number of analytical and empirical problems. First, structuralists frequently treat "the state" as if it were a unitary, undifferentiated actor behaving with singleness of purpose in relation to outside interests rather than as an amalgamation of different organizations and agencies whose interests may not coincide and whose capacities are historically and

2. The notion of external autonomy as viewed here consists of two components: the autonomy of the country as a whole and such autonomy as is specific to the state as a social institution, given the possibility of encountering particularly autonomous states in less autonomous countries or less autonomous states in very autonomous countries. For example, countries like the small European nations are quite resilient and adaptable to changes in the world around them due to the organization of each country as a whole rather than the capabilities of the state as governing apparatus alone (Katzenstein 1985). Yet countries like Mexico, particularly when they depend on oil income, are less able to manage the fluctuations of world markets. At the level of analysis of the "state as a social institution," options and constraints may also result from the state's transgovernmental relations, such as military alliances or relations with foreign capital (Evans 1979).

contextually situated. Second, structuralists tend to understate the dynamic characteristics of dependency, treating external relations and state autonomy itself as static (as opposed to variable) conditions rather than as one characterized by variation and flux. Third, structuralists often do not allow for variation in state capacities in discrete policy areas. Fourth, they tend to simplify the complexities associated with relations between the state and domestic society (Adler 1988, 61).

Critics argue, in turn, that the problem of state autonomy in advanced technology development is best considered as a historically and contextually situated set of problems best understood by disaggregating the properties associated with external and internal state relations (Adler 1987, 1988; Bennett and Sharpe 1979; Evans 1979, 1987). Explaining state capacity to achieve autonomous technological development requires treating "state autonomy" as a variable and dynamic condition that is subject to change over time, contingent on specific policy arenas, institutional complexes, ideologies, or collective understandings, and influenced by the specific mix of negotiating resources available to the state vis-à-vis other interests in any policy-making encounter.

The critique of structural dependency theory that calls for "disaggregating the state" emphasizes the nature of domestic state-society relations as they affect the state's capacity to sustain autonomous development projects. This "internal autonomy" of the state may be examined along two dimensions. The state can be analyzed in terms of its relations with societal forces. The state's autonomy, however, may also be limited by intragovernmental conflicts. The wider the role of the state, the more likely it becomes that various social contradictions and external penetrations will be expressed through state agencies.

This article will use the Mexican experience with nuclear energy as a vehicle for examining the external and internal dimensions of the debate over the capacity of upper-tier late-industrializing countries to achieve technological autonomy. It will be argued that the Mexican case supports structuralist arguments for the sustained importance of structural constraints in limiting the capacity of these countries to acquire technology autonomy, but this case also reinforces the revisionist view that the state's internal autonomy is a crucial codeterminant of such capacity. Our review of Mexico's nuclear energy policy will examine its development during three important phases: a formative period of policy development under the administrations of Gustavo Díaz Ordaz and Luis Echeverría Alvarez, the protracted implementation phase of policy development under José López Portillo, and the crisis phase of policy implementation associated with the post-1982 recession and anti-regime mobilization on the Laguna Verde issue. The final section will assess the Mexican government's policy performance, draw out the implications of the Mexican case for the debate over the capacity of late-industrializing countries to attain technological

autonomy, and comment on the utility of structuralist and revisionist approaches for understanding the capacity of late-industrializing countries in achieving autonomy in this area.

POLICY-MAKING ON NUCLEAR ENERGY, 1955–1990

From its inception, Mexico's nuclear energy program has been one of the most complex and technologically sophisticated projects ever undertaken by the national government. Project development has had an active policy life of twenty years, longer if an earlier period of agenda building and gestation is taken into account. It may be usefully broken down into three distinct policy phases: an early phase of agenda building culminating in the decision to undertake a project of nuclear energy production, an intermediate implementation phase associated with the administrations of Echeverría and López Portillo, and a final phase consisting of the implementation crises under de la Madrid. Treatment of each phase will begin with an overview of relevant background and developments during that period, followed by a discussion of the patterns of policy-making relevant to the issues of external and internal state autonomy in making such policy.

AGENDA BUILDING, 1955–1972

The evolution of Mexico's nuclear program has varied from those in Argentina, Brazil, and India, the countries in whose league Mexico considers itself.³ As a leader in the movement to control global proliferation of nuclear weaponry and a major architect of the Tlatelolco Treaty of 1967, Mexico has taken a limited interest in peaceful applications of nuclear technology. In the mid-1950s, with the support of the U.S. program Atoms for Peace and the government's parastate *Compañía Mexicana de Luz y Fuerza Motriz*, several Mexican students were sent to the United States on scholarships to study nuclear engineering. In 1955 a study group on nuclear energy was formed that led directly to establishment of the *Comisión Nacional de Energía Nuclear* (CNEN) that same year (Ruiz 1988, 133).⁴ Juan Eibenschutz, one of the first U.S.-trained Mexican nuclear engineers who had long been involved with Mexican nuclear policy in the *Comisión Federal de Electricidad* (CFE), attests that the CNEN was estab-

3. Each of these three countries retained the nuclear weapons option. Each also initiated its nuclear sector shortly after World War II in an explicit effort to generate domestic technology. By the time they chose to go with commercial energy, all three had a large contingent of nuclear scientists and engineers. Even though all have had some outside help, they have been positioned better than Mexico to absorb technology (Potter 1990; Spector 1988; Adler 1987; Katz and Marwah 1982).

4. For the text of the law, see the *Comisión Interamericana de Energía Nuclear* (1983, 4–7).

lished “in response to the worldwide trend of creating governmental bodies that would be responsible for nuclear activities” (Eibenschutz 1982, 247).

At the outset, the CNEN was awarded primary administrative authority for activities in the nuclear sector as well as responsibility for training Mexico’s first generation of nuclear scientists and engineers (Eibenschutz 1982, 246–47). From the beginning, however, the CFE took the lead in the Mexican commercial nuclear program. Its dominance was facilitated by the fact that specialized programs in nuclear subjects were not established at the Universidad Nacional Autónoma de México (UNAM) and the Instituto Politécnico Nacional until the late 1960s. In 1966 a nuclear engineering section was created within the CFE expressly to explore the nuclear power option. The following year, the CFE joined with the Stanford Research Institute (SRI) to explore the feasibility of developing a commercial nuclear facility in Mexico (Presidencia 1988, 178; García Michel 1988, 124). This decision-analysis group consisted of three members from the CFE, one representative of PEMEX (Petróleos Mexicanos, Mexico’s national petroleum company), and SRI personnel but did not include a regular CNEN representative (Eibenschutz 1982, 247). From the outset, then, the CNEN was relegated to a consultative secondary role in Mexico’s nuclear energy program. Decisions consequently were articulated around the priorities and political capacities of a utility company rather than around those of a core of nuclear scientists or the military.

The CFE’s strategy was consciously tailored toward acquiring engineering know-how by adopting a single nuclear plant. The CFE’s pro-engineering bias was controversial nonetheless. While some scientists, particularly those at the CNEN, advocated investing in basic science before building a nuclear plant, the CFE viewed the facility as the instrument of technology transfer and sought to avoid a “turnkey” deal by building in provisions for technology transfer as part of the contract. Mexican engineers were to work in tandem with foreign contractors and consultants in plant design and construction, an arrangement planned to infuse knowledge and skills that could then be applied to future development (Eibenschutz 1982, 249).

The decision to proceed with the plant was made following a study in collaboration with the SRI of Mexico’s energy mix and prospects (Ruiz 1988, 134).⁵ During the late 1960s, the SRI’s cost-benefit estimates found nuclear power to be competitive with alternative sources (Ruiz 1988, 134–36). Yet comparative studies of nuclear and oil-fired plants suggested that when “assuming the existence of uranium at current value, the balance was slightly unfavorable for the nuclear alternative” (Eibenschutz

5. See “Mexico Will Probably Seek Bids for Its First Nuclear Power Plant,” *Nucleonics Week*, 5 Dec. 1968, p. 8.

1982, 252). But if the oil that would be used in oil-fired plants were exported instead, the balance then tilted toward nuclear plants. In short, the final comparison rested on variable costs and thus on world markets.

For all practical purposes, Mexico's commercial nuclear program was initiated during the presidency of Gustavo Díaz Ordaz. Mexico was enjoying the height of economic growth at home. Two significant trends concerned policymakers, however. Mexico's energy consumption had increased so much that imports seemed the only solution. In fact, Mexico was already importing small amounts of oil in 1970 (Williams 1979, 6). The emerging energy bottleneck thus weighed in favor of nuclear power.

Accompanying this sectoral problem was a "crisis of accumulation" (FitzGerald 1985). At the end of a successful period of import substitution, private domestic capital was not attracted by projects of deeper industrialization, while foreign capital posed a challenge to the state. Intensification of the state's role in the late 1960s and especially after Echeverría was elected may be viewed in terms of the Mexican state's role as a capital investor of "last resort" (Bennett and Sharpe 1982).

In international affairs, Mexico was increasingly being perceived as a regional force and a leader among industrializing countries. Moreover, with oil prices growing steadily in the late 1960s, nuclear power was considered the solution to the energy problem and a route to advanced and prestigious technology.

In 1970, with siting studies completed with the assistance of the International Atomic Energy Agency (IAEA), bids were tendered for a single plant with a capacity of five hundred megawatts of electricity to be located at Laguna Verde, some fifty miles north of the gulf coast city of Veracruz (García Michel 1988, 124; Presidencia 1988, 178).⁶ The bids were evaluated by an intergovernmental commission comprised of representatives of the CFE, PEMEX, the CNEN, and the ministries of Presidencia, Hacienda, and Industria y Comercio and headed by the chairman of the CFE board of directors. The final decision was forwarded for the president's approval. Because bid evaluation was not completed until the end of the sexenio, however, Díaz Ordaz deferred decision making to his successor, Luis Echeverría, who remanded the decision back to the intergovernmental advisory group (García Michel 1988, 103). The committee then proposed two units, each enlarged to 654 megawatts. In the same year, financing for the first unit was arranged from the World Bank, the U.S. Export-Import Bank, and the Japanese Export Bank (Ruiz 1988, 136). On this basis, Echeverría personally authorized proceeding with the project in December 1971 (Eibenschutz 1982, 252).⁷

6. "Around the World," *Nucleonics Week*, 21 May 1970, p. 8.

7. See "Reactor Vendor Competition for Mexico, Argentina, and Taiwan," *Nucleonics Week*, 13 Jan. 1972, p. 3.

In reflecting on policy-making during this initial phase of project development, several elements had already become evident. First, with respect to basic purposes, at least four major goals were discernible: energy diversification, comparative advantage, technology transfer, and international prestige. Of these, the most compelling was the argument favoring comparative advantage, or oil substitution.

Second, with respect to Mexican external autonomy in this policy area, it is evident that Mexico was at the outset depending heavily on foreign technology and expertise to develop its nuclear energy program. Foreign consultants played a significant role as advocates of the nuclear option. U.S. state and nonstate institutions also actively promoted the development of nuclear energy.⁸ Further, while domestic advocates were careful to avoid a “turnkey” project, their basic strategy for achieving technology transfer was fragile. Only partial transfer of technology would be achieved by the Laguna Verde project, mainly in the areas of design and construction. Very modest levels of manufacturing and product development were entailed. Moreover, only a few participants in the project would receive the technology, and little technological redundancy (backup knowledge) was built into the acquisition process. Finally, the technology acquired was largely monopolized within the CFE and was not diffused to other scientific and industrial sectors, not even to the CNEN. Thus the potential for technology diffusion and development was inherently limited.

Third, on the question of domestic policy development and the character of the state’s internal autonomy, policy-making was tightly confined to a few engineers and *técnicos* at the CFE who consulted with other federal agencies having energy responsibilities and foreign technical experts. Virtually no one outside these groups was involved, neither from the ruling Partido Revolucionario Institucional (PRI) and its sectors nor from private industry. There was no apparent political opposition.

In sum, the policy-making process conformed closely to what Roger Cobb, Jennie Ross, and Marc Ross have labeled as an “inside access” mode of agenda building (1976). Both the idea and its refinement were limited to government insiders, who were dominated by *técnicos* in one agency, the CFE. Its predominance, which overrode even the formal authority of the CNEN to coordinate nuclear policy, suggests that, short of presidential decision, the CFE acted with considerable autonomy from other state interests and the private sector.

THE POLITICS OF POLICY IMPLEMENTATION, 1972–1982

Mexico’s decision to proceed with its nuclear program coincided with major policy shifts in several spheres. In domestic policy, Echeverría

8. For a thorough discussion of this point, see Costa (1979, 316–19).

set forth a broadly populist and distributive policy agenda, orchestrated around the theme of "shared development." It was aimed at broadening the domestic market, increasing national consumption, strengthening domestic production through the elaboration of import-substitution policies, and stimulating export growth (Mares 1985, 694). In foreign affairs, Echeverría worked aggressively to establish Mexico as a regional and Third World leader by playing major roles in the Law of the Sea Conference, negotiations on global restructuring, and other efforts to shape the international North-South axis. Echeverría's domestic and international policies also stimulated projects emphasizing international prestige and technological autonomy, such as Laguna Verde. Further, the Arab oil embargo in 1973 sharply boosted world oil prices, strengthening the argument for oil substitution. Events thus augured well for sustained executive commitment to the nuclear program and to Laguna Verde in particular.

Implementation of the Laguna Verde project was nevertheless marred by a number of obstacles. Administrative changes in Mexican leadership every six years normally entail considerable turnover in public administration, which affected the nuclear program at the CFE. Delays associated with the presidential transition also required a second tender of bids, in line with the recommendations of the committee appointed by Echeverría.⁹ In the fall of 1972, General Electric was awarded the contract to complete the first reactor in 1976. Participants on the Mexican side were the CFE and the Instituto Nacional de Investigaciones Nucleares (INEN, the reorganized CNEN).¹⁰ In August 1973, Wells Fargo Bank and the U.S. Export-Import Bank signed an agreement to lend Mexico fifty-four million of the sixty million dollars needed to finance the first plant. On 22 December 1973, General Electric received an order for the second reactor.¹¹ Contracts for the turbines went to Mitsubishi. Both reactors were to be boiling-water reactors.¹²

During 1973, however, the new CFE director appointed a new subdirector of the nuclear program, and he immediately ordered a re-evaluation of the project in response to various allegations of flaws in the design, logistics, construction process, reactor type, and site of the project as well as in the expertise of project personnel already working

9. "Reactor Vendor Competition," *Nucleonics Week*, 13 Jan. 1972.

10. "GE Gets Mexican Contract," *Wall Street Journal*, 7 Sept. 1972, p. 8.

11. "2 Reactor Orders Received by GE," *New York Times*, 22 Dec. 1973, p. 34.

12. Evidence that became public in the mid-1980s suggests that General Electric had information from the mid-1970s indicating that the particular type of reactor sold to Mexico exhibited various design and safety problems. Some of the delays on Laguna Verde were traceable to those difficulties. The anti-nuclear opposition focused on these problems after 1986. See Armando Ibarra Sepúlveda, "El reactor de Laguna Verde, de los más inseguros," *Excélsior*, 18 July 1987, p. A-1; and "Obligan a General Electric a publicar el Reporte Reed; aquí se exalta su reactor," *Proceso*, 3 Aug. 1987, p. 24.

(Presidencia 1988, 178).¹³ Complaints were emanating from sources both inside and outside the Laguna Verde CFE group, including scientists at the INEN. This review process led to lengthy delays and eventual reorganization (Eibenschutz 1982, 253–54).

Meanwhile, buoyed by rising petroleum prices, the Echeverría administration accelerated uranium exploration, increasing known reserves of uranium from 750 to 4000 tons. Based on these new projections, in 1974 the Mexican Comisión Nacional de Energéticos (CNE), the INEN, and the CFE announced joint plans for a second nuclear plant to be located somewhere in northwestern Mexico. Plans were also unveiled for a new uranium mill to service the Laguna Verde station and a new Mexican-designed pilot plant for refining uranium concentrates. The pilot facility would be designed by the INEN with the ultimate goal of manufacturing fuel by 1979.¹⁴ As the situation developed, proposals for a second plant became the vehicle for a more “nationalist” pro-nuclear wing that united elements of the Mexican state with various political forces (García Michel 1988, 116).

Undergirding these expansionist plans, a major boost for the nuclear program came from the CNE’s decision to make energy diversification top priority regardless of the extent of uranium reserves. Nuclear power was expected to play a major role in this process. A plan to build twelve to fifteen nuclear plants in the thousand-megawatt range by the mid-1990s was tentatively advanced by the CFE in 1975. It was not endorsed officially, however, because of economic difficulties, extant problems at Laguna Verde, and revelations of new hydrocarbon potential along the coast of the Gulf of Mexico (Ruiz 1984).

While López Portillo abandoned Echeverría’s distributive populism at home, he attempted to balance it with a new initiative for political liberalization by enhancing opportunities for opposition parties. He also continued to pursue regional leadership abroad by building on Mexico’s newfound oil wealth (Grayson 1988).

The change in administrations when López Portillo assumed the presidency in 1976 again disrupted progress at the Laguna Verde site. In December 1976, the New York-based Ebasco corporation was awarded the lead role in engineering design (Reichle 1979). Because the previous firm had taken all the work to the United States, construction came to a standstill, underscoring the limitations of Mexican involvement (Reichle 1979, 261). Subsequent reorganization occurred amidst a major devaluation crisis and wholesale rethinking of Mexico’s energy strategy in view of newly discovered petroleum reserves.

13. “Laguna Verde, un fracaso económico y potencial catástrofe,” *Proceso*, 25 Aug. 1986, pp. 23–26.

14. “Mexico Now Plans a Second Nuclear Station and Major Expansion of Its Uranium Industry,” *Nucleonics Week*, 17 Jan. 1974, p. 8.

López Portillo's decision to accentuate oil development and expand oil exports nevertheless carried with it a renewed commitment to the nuclear program.¹⁵ Oil prices in 1978–79 reached all-time highs, bolstering the case for oil substitution and energy diversification. New long-range energy plans drew on the 1975 CNE and CFE studies to project a major role for nuclear power in Mexico's domestic energy mix (Ruiz 1984).

Until 1977 the Laguna Verde project had proceeded in-house, encountering little political opposition. The project enjoyed support from the civilian-dominated pro-nuclear lobby within the government and also from professional associations of nuclear scientists and energy engineers. Once construction began, however, the Mexican public became more aware of the project. Rising international concern over nuclear power found advocates in Mexico, who focused their critique on Laguna Verde. University faculty and students in the Veracruz region raised environmental objections, but their numbers were few and they were dismissed by the plant's defenders.¹⁶

More serious criticism began to emanate from the growing nationalist constituencies in the nuclear sector outside the direct administrative orbit of the CFE, namely the parastate Uranios Mexicanos (URAMEX) and the Sindicato Unico de Trabajadores de la Industria Nuclear (SUTIN) (García Michel 1988, 114–16).¹⁷ A highly nationalist, leftist union associated with the Echeverría administration, SUTIN championed technological autonomy in nuclear power and aligned its membership more closely with the advocates of domestic nuclear development at the INEN than with the engineers at the CFE.¹⁸ In 1977, during congressional hearings on reorganizing the Laguna Verde operation, SUTIN director Arturo Whaley accused the Mexican government of abandoning its goal of technological autonomy. Noting a trend toward denationalization, Whaley observed that virtually all construction activities at Laguna Verde had been placed under the supervision of foreign (mainly U.S.) technicians.¹⁹

Reorganization of the Mexican nuclear establishment became official in late 1978 and took effect in January 1979 (Comisión Interamericana de Energía Nuclear 1983, 20–31). Regardless of the López Portillo admin-

15. "López Portillo's Travels May Boost North-South Dialogue," *Latin American Weekly Report*, 13 June 1980, p. 5.

16. "Mexico Aims at World Role as Leading Uranium Producer," *Latin American Weekly Report*, 21 Nov. 1980, p. 7.

17. In 1978 a new law replaced the INEN with three new organizations. It established the Instituto Nacional de Investigaciones Nucleares (ININ), the Comisión Nacional de Seguridad y Salvaguardas (CNSNS), and URAMEX, the Mexican uranium company created to carry out uranium exploration and exploitation. See *Nuclear Law Bulletin* (1978, 18).

18. "La pelea por un industria nuclear nacional," *Proceso*, 9 Jan. 1978, pp. 21–22.

19. See "Energéticos: reorganización en la energía nuclear," *Proceso*, 26 Dec. 1977, p. 26; "Impugnaciones sindicales a la legislación nuclear," *Proceso*, 2 Jan. 1978, p. 9; and Guillermo García, "Es inversión de 2,300 millones de dólares," *Excélsior*, 31 July 1988, p. A-1.

istration's intentions, the more "nationalist" wing of the nuclear forces represented by SUTIN, the ININ (Instituto Nacional de Investigaciones Nucleares), and URAMEX established itself as a major player in nuclear politics, ensuring that uranium would remain nationalized and that these groups would play a large role in nuclear planning (Eibenschutz 1982, 255; García Michel 1988, 114–18).²⁰

The growth of URAMEX also introduced greater complexity and potential points of disagreement into the administrative milieu surrounding the Mexican nuclear program. By 1981 URAMEX's exploration and development activities had identified nine thousand tons of known extractable uranium reserves. Its staff had tripled from nine hundred in 1977 to more than two thousand in 1981.²¹ While strongly supporting the nuclear program, the leaders of URAMEX as well as SUTIN were critical of the CFE's approach to Laguna Verde and willing to consider alternative technologies for future nuclear energy facilities.²²

In 1980 the López Portillo administration introduced its new national energy plan that set forth six basic objectives: to satisfy national energy necessities, to diversify sources of primary energy, to integrate the energy sector into development of the Mexican economy, to fortify Mexico's scientific and technical infrastructure, to make the production and use of energy rational, and to quantify precisely Mexico's energy resources (Ruiz 1984, 433). The Programa Nucleoeléctrico Nacional (PNN) was introduced as a subcomponent of the national energy plan. It contemplated the ambitious objective of thirty nuclear plants of twenty-thousand-kilowatt capacity by the turn of the century (Ruiz 1984).²³ The new plan was vague, however, on which technology was to guide Mexico's nuclear energy program, calling for several technologies in order to diminish Mexico's potential dependence on any single approach. In response, critics, including SUTIN and the former director of the Laguna Verde project, hastened to point out that such diversification would greatly hinder Mexico's efforts to achieve technological autonomy (Ruiz 1984).²⁴

The PNN clearly reflected the lack of consensus within the Mexican nuclear establishment as to the role of nuclear power in Mexico's energy

20. "Energéticos," *Proceso*, 26 Dec. 1977; and *Nuclear Engineering International* (1978, 14).

21. Estimates of Mexico's recoverable uranium potential varied widely. In 1978 URAMEX director Francisco Vizcaino Murray estimated potential reserves at more than six hundred thousand metric tons. More prudent estimates cited seventy-eight thousand tons of recoverable uranium (*Nuclear Engineering International* 1978, 14). By 1984 estimates had been scaled down to about ten thousand tons of proven reserves (*Business Mexico* 1985, 46).

22. "Mexico Aims at World Role," *Latin American Weekly Report*, 21 Nov. 1980; and García, "Es inversión de 2,300 millones," *Excelsior*, 31 July 1988.

23. "Green Light for the Energy Program," *Latin American Weekly Report*, 23 Jan. 1981, p. 4.

24. "Sin capacidad para hacer una nucleocéntrica, se programan 30 más," *Proceso*, 27 Apr. 1981, pp. 10–12.

program and what direction Mexico should take to attain technological autonomy. While advocates of technological autonomy at the ININ, URAMEX, and SUTIN argued for alternatives deemed more conducive to that goal within the national energy plan, the CFE técnicos were moving in the opposite direction.²⁵ In 1981 the CFE tendered bids for plants of twenty-four hundred megawatts that were decidedly more “turnkey” in nature than Laguna Verde.²⁶

The national energy plan's projections must be viewed in the context of the debate over PEMEX's role in Mexican industrial development. Under the direction of Jorge Díaz Serrano, PEMEX was pursuing a strategy of rapid extraction and export, plowing profits back into the oil sector. Opponents, who centered around the Secretaría de Patrimonio y Fomento Industrial (SEPAFIN) argued for “sowing the oil” nationally and against pegging production and export to extractive capacity. Political competition between PEMEX and SEPAFIN led the latter to ally with Laguna Verde supporters at the CFE.²⁷

The SEPAFIN-CFE alliance was in turn opposed by more “nationalist” supporters of nuclear development, such as ININ Director Dalmau Costa, SEPAFIN Energy Director Adrian Lajous, Jaime Corredor E. (one of López Portillo's economic advisors), and SUTIN leaders (Escalante 1988, 534). These individuals favored further study of nuclear technology alternatives and considered the Canadian natural uranium reactor design (CANDU) to be a more promising vehicle for attaining Mexican self-sufficiency in nuclear energy.²⁸

Although scheduled for completion in 1982, work on the Laguna Verde facility faltered due to the need for design modifications on the GE Mark II reactors in 1978–79 and complications in installing the reactor vessel on Unit One in 1980.²⁹ By mid-1981, the downturn in world oil prices and subsequent budgetary rescheduling in the nuclear program were delaying project implementation further and reinforcing domestic opposition.³⁰ Frustrated CFE officials, who had taken over project man-

25. “Cracks in the Green Lagoon Point to Flaws in the Nuclear Programme,” *Latin American Weekly Report*, 8 May 1981, p. 5.

26. “Domestic Participation (Technology Transfer) Key to Mexican Bid Specs,” *Nucleonics Week*, 30 Apr. 1981, p. 1.

27. Fernando Hiriart, Undersecretary of Energy and Mining, CFE Director Alberto Escofet, and CFE Planning Coordinator Juan Eibenschutz have been the major supporters of Laguna Verde and of importing U.S. technology (Escalante 1988, 534). See also “Hiriart y Eibenschutz, promotores de importación de equipo: Jacinto Viqueira,” *Proceso*, 11 May 1987, p. 32.

28. See “Mexico Aims at World Role,” *Latin American Weekly Report*, 21 Nov. 1980; “Sin capacidad para hacer una nucleoelectrica,” *Proceso*, 27 Apr. 1981; and “All Roads Lead to Mexico City,” *Latin American Weekly Report*, 16 Jan. 1981, pp. 3–4.

29. García, “Es inversión de 2,300 millones,” *Excélsior*, 31 July 1988, A-1; and “Cracks in the Green Lagoon,” *Latin American Weekly Report*, 8 May 1981.

30. “Doubts Swirling around Proposed Mexican Nuclear Program,” *Nucleonics Week*, 23 July 1981, p. 1.

agement from Ebasco in 1981, virtually gave up on trying to specify completion dates.³¹ In May 1982, the CFE announced a complete policy freeze pending the change of presidents in December of that year (Luddemann 1983, 403).

The policy process during this period reveals several dynamics at work. The goal structure established in the earlier period remained intact and was solidified over the decade. Energy diversification became the most prominent objective, supplemented by the logic of comparative advantage. The goal of technological autonomy, while acquiring important constituencies outside the CFE, was effectively undermined by inter-agency disagreements and CFE decisions favoring procurement of proven foreign technologies and foreign management.

Mexico's inability to deal with the fluctuations of the world oil market revealed strong evidence of the country's external limitations. Proximity to the United States and its increasing pressure for Mexican oil, coupled with the prospects of great wealth, proved overwhelming. Mexico's energy infrastructure proved unable to overcome strong technological dependence in either the postextractive stages of the oil industry or the nuclear alternative.

The state's capacity to negotiate these problems remained weak. Although ambitious goals for technological autonomy had been articulated in the national energy plan, they called for acquiring multiple finished technologies, thus greatly compounding the task of achieving technological autonomy. This strategy indicates the tension between reliance on world energy markets and attempts at limiting the degree of dependence on any one country. Such tension is further evident in the controversy over the degree of domestic technology participation that intensified again in 1980 and 1981.³² The bids tendered by the CFE for new plants relaxed provisions for technology transfer. And Mexico's increased financial dependency during the López Portillo administration placed the whole program at risk when the 1981–82 economic crisis escalated.

As for internal autonomy, it is clear that policy implementation on Laguna Verde continued to be dominated by the CFE throughout both administrations. Its domination was based substantially on tactical alliances with SEPAFIN, which did not share the same development strategy in other areas and stressed domestic sufficiency in technology instead. The alliance owed much to PEMEX's overwhelming economic presence.

31. Even so, in October 1981, the CFE proceeded to tender bids for the new plants. See "Mexico Going Ahead with Bidding Plans for New Nuclear Plants," *Nucleonics Week*, 1 Oct. 1981, p. 1. The bids went unopened, however, as Mexico's building economic crisis provoked sharp revisions in major capital projects in the spring of 1982.

32. "Domestic Participation," *Nucleonics Week*, 30 Apr. 1981; and "Cracks in the Green Lagoon," *Latin American Weekly Report*, 8 May 1981.

Moreover, during the López Portillo administration, the growing strength of other agencies in the nuclear sector presented challenges. This trend was particularly clear in the broader, long-term nuclear-power agenda. Opposition to the CFE strategy was now coming from the more “nationalistic” elements within the state and the parastatal agencies, reflecting the overall divisions in Mexican policy-making during that period.

At the level of the Laguna Verde project, administrative delays and technical complications drew criticism from inside and outside the nuclear sector. While these administrative power contenders were unsuccessful in wresting control over the nuclear program from the CFE, their varying perspectives on the role of nuclear energy in Mexico’s development process and their criticism of the CFE’s approach prevented maturation of consensus on nuclear policy and diminished the influence of the nuclear lobby on energy decisions as a whole. Outside the government, budding opposition to the nuclear option—and Laguna Verde in particular—was beginning to take root. In general, then, policy-making remained state-dominated, although it increasingly manifested problems associated with bureaucratic fragmentation in the developing nuclear sector.

LAGUNA VERDE IN CRISIS, 1982–1990

The Miguel de la Madrid administration took office on 1 December 1982, amidst the worst Mexican economic crisis since the great depression. The collapse of world oil prices forced Mexico to seek relief from the International Monetary Fund in order to solve the balance of payments crisis that resulted. Sharp curbs on government spending and foreign exchange flows promptly followed. De la Madrid’s policy agenda stressed fiscal austerity and economic restructuring, seeking to reduce the Mexican state’s profile in the economy while liberalizing trade relations. Recovery was premised on the expansion of exports. In the political sphere, liberalization was proffered as a partial response to the domestic inflationary spiral, rising unemployment, and plummeting standards of living.

At Laguna Verde, construction again ground to a halt. The López Portillo administration briefly considered eliminating Mexico’s nuclear energy program entirely in May 1982 but settled instead for abandoning additional nuclear facilities.³³ In early 1983, the new de la Madrid team placed the nuclear power program under review. A strongly critical evaluation of the nuclear project and Laguna Verde came in a report by the German Kraftwerk Union.³⁴ The Kraftwerk report, whose details the government tried to withhold, pointed out the immense sunk costs at-

33. “Nuclear Programme Hits the Road,” *Latin American Weekly Report*, 1 Mar. 1985, p. 4; and *Latin American Weekly Report Special Report*, Apr.–June 1985, p. 5.

34. “New Programme, Old Criticism,” *Latin American Weekly Report*, 28 Sept. 1984, p. 2.

tached to Laguna Verde, the inadequacy of uranium reserves, the failure of URAMEX, and the lack of direction in terms of type of technology, remaining design decisions, and cost problems. These difficulties were exacerbated by disputes between URAMEX and the ININ and between the ININ and SUTIN.³⁵ Nevertheless, in the spring of 1983, some construction resumed on the Laguna Verde facility and a revised target of 1987 was set for final operation (Luddemann 1983, 403).³⁶ But despite the Mexican government's renewed commitment to the Laguna Verde project, the economic, administrative, and political environment affecting its completion was shifting by 1984. The downturn in world petroleum prices undercut the project's main rationale, as the real cost of nuclear power from Laguna Verde increased relative to oil and hydropower.

Administratively, the de la Madrid administration chose to downgrade the role of nuclear power in its revised Programa Nacional de Energéticos (PNE) for 1984–1988, placing the entire program in limbo. While calling nuclear power “inevitable” in tacit admission of the sunk costs invested in Laguna Verde, the new plan projected that uranium would supply merely 4 percent of Mexico's energy needs by the year 2000, a significant reduction from the ambitious 40 percent projected in 1980.³⁷ A new cabinet-level ministry, the Secretaría de Energía, Minas e Industria Paraestatal (SEMIP), was created to regulate parastate giants like PEMEX and the CFE and to preside over divestment and reorganization of the parastate sector.

The nuclear sector was among the first to feel the brunt of de la Madrid's reforms. Shortly after the de la Madrid administration took office, SUTIN militants virtually shut down URAMEX, protesting wage freezes and budgetary revisions in the nuclear program.³⁸ Highlighting the politicization of the nuclear sector, SUTIN's action was followed in late 1983 by Mexico's first major radiation accident: the Cobalt 60 contamination of workers and steel products in Ciudad Juárez arising from improper handling of x-ray equipment (*Science* 1984, 1152–54).³⁹ In 1984 the government introduced legislation abolishing the Comisión Nacional de Energía Atómica (CNEA) and transferring its functions for nuclear energy oversight to SEMIP. The legislation dissolved URAMEX as well (*Nuclear Law Bulletin* 1985, 17; Millán 1986, 35). The nuclear sector nevertheless re-

35. “Por castigar al SUTIN, Escofet reniega de su proyecto nuclear,” *Proceso*, 4 July 1983, pp. 20–25; and “New Programme, Old Criticism,” *Latin American Weekly Report*, 28 Sept. 1984, p. 2.

36. “Nuclear Program Hits the Road,” *Latin American Weekly Report*, 1 Mar. 1985.

37. *Ibid.*; and *Latin American Weekly Report Special Report*, Apr.–June 1985.

38. “New Programme, Old Criticism,” *Latin American Weekly Report*, 28 Sept. 1984; and “Por castigar al SUTIN,” *Proceso*, 4 July 1983.

39. “A la intemperie, la varilla radiactiva contamina a más personas,” *Proceso*, 1 Oct. 1984, pp. 18–21.

mained one of the strategic areas reserved exclusively for the state.⁴⁰ Dissolving URAMEX directly weakened the nationalist nuclear advocates, however, and political disagreements within SUTIN further undermined the ministry's effectiveness.⁴¹

Adding to these administrative setbacks, Laguna Verde and Mexico's entire nuclear program came under intense political scrutiny. After the Three Mile Island accident in the United States in 1979, Mexico's budding anti-nuclear movement began to gain public visibility. The fledgling anti-nuclear and ecology movement also benefited from de la Madrid's decision to profile environmental problems. Creation of a new cabinet-level environmental ministry, the Secretaría de Desarrollo Urbano y Ecología (SEDUE), was accompanied by a nationwide campaign to mobilize public awareness of environmental problems. This campaign inadvertently helped legitimize anti-nuclear protest and drew much media attention to Laguna Verde's problems (Mumme, Bath, and Assetto 1988). The Cobalt 60 affair in December 1983 also dramatized Mexico's problems with nuclear safety.

The real catalyst of a backlash against Laguna Verde and the Mexican nuclear program, however, was the Chernobyl disaster in the USSR in April 1986 (Montaño, Lund, and Bollinger 1988; García Michel 1988, 167). In the aftermath of the Soviet catastrophe, Mexico's anti-nuclear movement rapidly mobilized public opinion against Laguna Verde. Armed with extensive documentation of technical difficulties, mismanagement, and corruption, anti-nuclear groups sought to shut the plant down or convert it to an alternate fuel source. With Laguna Verde still not operational but due to open in mid-1987, the project became a test of strength for the increasingly popular environmental movement.

The level of protest against Laguna Verde was unprecedented in Mexican history. It was the first nationwide mobilization against the government on what could be properly classified as an environmental issue. Moreover, it was the first nationwide protest against a major infrastructural development project in a country where electrical power had been historically sacrosanct, viewed as an essential engine of national development. Laguna Verde took on the dimensions of not only a poorly conceived and trouble-plagued project but one symbolic of the government's competency and legitimacy. In the environmentalists' hands, it became a referendum on the Mexican government itself.

The coalition of anti-nuclear and environmentalist groups opposing the Laguna Verde project was diverse, bridging social classes, regions, and even pro-government and opposition groups.⁴² Although the

40. "Investment: Petrochemicals and Others Opening Up," *Latin American Weekly Report*, 14 Mar. 1986, p. 5.

41. "Por castigar al SUTIN," *Proceso*, 4 July 1983.

42. For an account of the Mexican anti-nuclear movement, see García Michel (1988, 229–57).

protest movement centered regionally in Veracruz and Mexico City, more than one hundred different groups from every Mexican state condemned the project. After Chernobyl, the movement received a major boost with the formation of the Grupo de Cien, an informal alliance of many of Mexico's leading artists, intellectuals, and scientists in opposition to the nuclear program. The prestigious group, which included Octavio Paz, Carlos Fuentes, and Miguel Wionczek, actively supported the movement with editorials, public appearances, and pressure on government officials.

By mid-1987, the anti-nuclear movement had thoroughly embarrassed the Mexican government. Major newspapers, including *Excelsior*, *Unomásuno*, *El Día*, and *La Jornada*, were condemning the Laguna Verde project, as were many regional presses.⁴³ Influential policy journals also opposed it.⁴⁴ The public's loss of faith in the government on this issue was revealed in a national poll conducted by the Instituto Mexicano de Opinión Pública in July 1987. It found 70 percent of the Mexican public opposed to building nuclear power plants to produce electricity. Fully a quarter of those interviewed said they were willing to protest publicly against nuclear energy.⁴⁵

Because the Laguna Verde issue threatened to expand beyond being a political embarrassment into a volatile controversy in the upcoming presidential campaign, the government went on the counteroffensive in August 1987. Postponing the firing of Laguna Verde's now completed Unit I reactor until 1988, officials of the International Atomic Energy Agency (IAEA) were invited to conduct a thorough safety inspection of Laguna Verde to assuage public concern.⁴⁶ Meanwhile, a major media campaign was launched by the CFE to promote the idea that nuclear energy was safe.⁴⁷ CFE Director Fernando Hiriart and other officials from the nuclear sector testified before Mexican congressional committees that Laguna Verde should be permitted to operate.⁴⁸

Despite these attempts at damage control, government officials failed to prevent the Laguna Verde issue from tainting the 1988 presidential contest. This campaign was more intensively contested than any

43. Sepúlveda Ibarra, "El Reactor de Laguna Verde," *Excelsior*, 18 July 1987.

44. "Obligan a General Electric a publicar el Reporte Reed," *Proceso*, 3 Aug. 1987; and "Contra Laguna Verde el poder judicial no se atreve," *Proceso*, 19 Oct. 1987, p. 22.

45. See Juan Ochoa Vidal, "En lugar de insistir en la planta de Laguna Verde debería combatirse el desempleo: IMOP," *Excelsior*, 18 Aug. 1987, p. A-4; and *Interamerican Public Opinion Report* (1987, 1-3).

46. "Los veracruzanos rechazan la revisión de la OIEA a Laguna Verde, por parcial," *Proceso*, 13 July 1987, p. 27.

47. "La SEMIP llevó a Corripio a bendecir Laguna Verde, pero no disipa el temor," *Proceso*, 10 Aug. 1987, p. 29.

48. Carlos A. Medina, "No funcionara Laguna Verde hasta comprobar que es segura," *Excelsior*, 29 Oct. 1987, A-18; and "Entró en su fase final el proceso de operación de Laguna Verde, indicó Alcudia," *Excelsior*, 18 Nov. 1987, p. A-39.

election in fifty years. In the fall of 1987, almost all of the Mexican opposition parties came out against the operation of Laguna Verde, including both the Frente Democrático Nacional of Cuauhtémoc Cárdenas and the conservative Partido de Acción Nacional (PAN). The PRI's Carlos Salinas de Gortari found himself on the defensive on this issue.⁴⁹ The government was sufficiently concerned about public opposition to delay the decision to inaugurate Laguna Verde until the municipal elections had also been held in the state of Veracruz in October 1988. Several aspects of the campaign against Laguna Verde from 1986 to 1988 warrant mention.

As noted, opposition to Laguna Verde found broad support among various sectors of the Mexican public.⁵⁰ The movement drew on anti-government political opposition but also embraced a wide range of middle-class PRI supporters as well. By 1987–88, several leading técnicos associated with development of the nuclear program had joined the opposition, most prominently former officials at SUTIN and URAMEX.⁵¹ While these PRI supporters had their own political axes to grind, their presence dramatized policy divisions within the Mexican government on this issue.

Second, by 1987–88 the project had lost almost all popular support outside the professional circles and labor unions directly benefiting from the project. The only groups publicly supporting Laguna Verde were several professional engineering associations, the electrical workers' Sindicato Unico de Trabajadores Electricistas de la República Mexicana (SUTERM), unions affiliated with SUTIN representing employees at Laguna Verde, and the Partido Popular Socialista.⁵² Support was fragile even within the government. For instance, during the 1987 congressional hearings, the only officials speaking in favor of Laguna Verde were CFE

49. In an unprecedented measure, Salinas assigned one of his close advisors, Patricio Chirinos, to manage the Laguna Verde issue. See Antonio Garza, Armando Sepúlveda Ibarra, and Juan Ochoa Vidal, "Decidirá la Sociedad Veracruzana sobre Laguna Verde," *Excélsior*, 8 Mar. 1988, p. A-1. Chirinos was subsequently appointed to head SEDUE, the environmental ministry.

50. The opposition was very effective in dramatizing the issue. In 1987–88, they staged numerous traffic blockades on major Veracruz highways as well as mass demonstrations in Veracruz and Mexico City. Another strategy was to use the courts to publicize opposition. By April 1988, more than twenty-five thousand writs of *amparo* had been filed against the government by the anti-nuclear opposition. Although they were subsequently dismissed, such actions drew considerable press attention. See Rogelio Hernández, "Son ya 25,000 amparos contra la nucleoelectrícula Laguna Verde," *Excélsior*, 26 Apr. 1988, p. A-5.

51. Among the plant's most effective critics were Jorge Young Larrañaga and Jacinto Vaqueira, both former planning directors at the CFE. See "Laguna Verde, un fracaso económico y potencial catástrofe," *Proceso*, 25 Aug. 1986, pp. 23–26; and José Antonio Román, "Sobre Laguna Verde sólo se consulta a pronucleares," *La Jornada*, 16 July 1987, p. 3. Former SUTIN leader Arturo Whaley also joined the opposition to Laguna Verde. See "Forum Highlights Nuclear Concerns," *Latin American Weekly Report*, 26 Mar. 1987, p. 5.

52. See Andrea Becerril, "No hay retraso en Laguna Verde; se busca seguridad para que funcione," *La Jornada*, 21 July 1987, p. 7.

personnel and representatives of the nuclear sector. Other agencies in the energy and environmental sectors were conspicuously absent.

In sum, de la Madrid's decision to activate Laguna Verde in October of 1988 became a defensive gesture designed to demonstrate the government's resolve, defend its authority, and recover some of the sunk costs from its operation. The original goals associated with the project had been discredited, and the ambitious plans for expanding the Mexican nuclear program had been abandoned. The nuclear sector was now in political and administrative disarray, and Laguna Verde had become a symbol of policy failure.⁵³

It is clear too that Mexico's strategy of enhancing its energy autonomy through the transfer of nuclear technology had failed. Although some new technology had been transferred, by 1990 Mexico was still depending heavily on foreign technology and administrative skills for its nuclear program.⁵⁴ Nor had the Mexican government resolved the most rudimentary questions concerning development goals and strategy for technology transfer. Its decision to pursue nuclear energy development on the basis of the comparative advantage of trading nuclear energy for oil combined with the nuclear program's dependence on oil-financed capital together proved to be structural weaknesses that undermined policy stability in this issue area (Gutiérrez 1990, 276).

With respect to the state's internal autonomy, the de la Madrid sexenio demonstrated the government's ability to advance the project in the face of substantial domestic policy opposition. This course, however, underscored the administration's weaknesses more than its strengths. By 1987–88, the nuclear lobby associated with the CFE and the professional and occupational groups directly associated with the nuclear program stood virtually alone in supporting the project. This outcome resulted from bureaucratic fragmentation, administrative disruption, mismanagement, the politicization of interest groups directly linked to project implementation, and the lack of presidential involvement in coordinating policy in this important issue area.

Moreover, the decision to pursue Laguna Verde was costly. The government's delaying Laguna Verde for more than a year on strictly political grounds, at a cost conservatively estimated to exceed sixty-five million dollars, indicates just how seriously its political predicament was viewed on the basis of this single issue. Thus the de la Madrid years exposed critical structural weaknesses in the government's nuclear program and its capacity to implement its original policy objectives successfully.

53. By 1988 the Laguna Verde project had experienced four presidents, seven CFE directors, five project directors with their individual staffs, and roughly 150 different contractors and subcontractors (Presidencia 1988, 179).

54. *Latin American Weekly Report Special Report*, Apr.–June 1985, p. 5.

Since its authorization, Laguna Verde has been plagued by technical problems and political challenges.⁵⁵ By the summer of 1990, it still had not been connected to the national electricity grid. Initially, the plant was to produce electricity within five months of the loading order in October 1988, but early in 1990, the new operational target was postponed to September 1990.⁵⁶

On the political level, a thorough audit promised by Salinas has yet to materialize. In fact, the CFE director and a key supporter of Laguna Verde, Fernando Hiriart, was appointed as Secretary of SEMIP.⁵⁷ Since that time, SEMIP has argued that sunk costs in Laguna Verde weigh against canceling the project.⁵⁸ The Salinas administration has given no indication, however, that it supports construction of additional nuclear plants.⁵⁹

MEXICAN NUCLEAR ENERGY AND STATE AUTONOMY

Returning to the three questions posed at the outset of this case study, what does Mexico's experience with nuclear energy reveal about the government's policy performance? Also, what does Mexico's attempt to acquire nuclear technology contribute to the general debate over structuralist explanations of technology development in industrializing countries?

The question of goal attainment can be answered easily in this

55. Allegations of an accident between 16 and 18 November, around the time that operating tests were first planned, were at first dismissed as part of an emergency drill. See Manuel Viguera, "La generación de electricidad por medios nucleares es la mejor alternativa: ININ," *Excelsior*, 23 Nov. 1988, p. A-37; and "Negó el director datos básicos a los diputados investigadores," *Proceso*, 5 Dec. 1988, p. 30. Since that time, it has become evident that accidents have occurred and that serious security problems exist (Miramontes 1989a, 1989b; Nadal 1989; Fretz 1989). See also "Desde junio de 1988 el expediente negro de Laguna Verde," *Proceso*, 5 Feb. 1990, pp. 22–24. According to this article, in April 1989, the plant's operation was criticized by Ebasco evaluator John K. Wilmhurst for lax procedures with already contaminated water. Moreover, General Electric threatened to cancel a guarantee of fuel if the use of commercial rather than nuclear quality parts continued. If these points are accurate, they lend plausibility to the allegations of the Instituto de Investigaciones Ecológicas (associated with the Grupo de Cien) that the second reactor is being stripped to maintain the first one. See "Laguna Verde: High Maintenance Costs," *U.S.-Mexico Report* 9, no. 3 (Mar. 1990): 20. This article first appeared in Spanish in *El Heraldo*, 2 Feb. 1990.

56. "Despite Protests, More Nuclear Power," *Latin American Weekly Report*, 10 Nov. 1988, p. 3; William Branigin, "The Prospect of Nuclear Power—and the Protest," *Washington Post*, weekly edition, 14–20 Nov. 1988, p. 19; and "Desde junio de 1988," *Proceso*, 5 Feb. 1990, p. 22.

57. "Salinas Concedes on Cabinet Posts," *Latin American Weekly Report*, 15 Dec. 1988, p. 8.

58. "Conversion at Laguna Verde," *U.S.-Mexico Report* 9, no. 3:14.

59. In the fall of 1988, the project director suggested that four more plants similar to the one at Laguna Verde were planned, but such projects have received no high-level confirmation. See "Despite Protests, More Nuclear Power," *Latin American Weekly Report*, 10 Nov. 1988; and Branigin, "The Prospect of Nuclear Power," *Washington Post*, 14–20 Nov. 1988.

case. Plainly, Mexico has fallen short of its ambitious objective of achieving national technological autonomy in nuclear energy production. Virtually the entire original rationale for the project had been abandoned or discredited by the end of the de la Madrid administration. The arguments for cost effectiveness and comparative advantage as well as energy diversification were severely impaired by the collapse in world oil prices. Although technological autonomy continues to be a formal policy objective, it remains far beyond Mexico's grasp in 1991 because the country still depends substantially on foreign sources of technology in almost every component of the nuclear fuel cycle. Moreover, the government's prestige has been diminished rather than enhanced by its poor performance in implementing Laguna Verde. While técnicos at the CFE remain committed to a less expansionary goal of at least four more nuclear plants, little evidence can be found of official support for nuclear energy at the highest levels. Renewed confidence in nuclear energy hinges on Laguna Verde's operational success and future developments in the international nuclear energy sector.

Mexico's experience with Laguna Verde does lend support to structural arguments concerning the dependence and vulnerability of industrializing countries in their quest to achieve autonomous control of technology. After twenty years of experience in implementing policy in the nuclear sector, Mexico has made no significant strides toward developing an autonomous nuclear energy program, Laguna Verde's completion notwithstanding. Among the external impediments to technology autonomy in this issue area have been Mexico's dependence on foreign sources, its dependence on external capital, and fluctuations in the world oil market for developing this capital-intensive industry.

It is nevertheless important to recognize that the Mexican state was not utterly limited in its quest to acquire nuclear energy technology. At the time Mexico entered the market, suppliers were eager to sell nuclear technology and the country possessed the means to purchase that technology. Mexico also had the industrial infrastructure for supplying at least some of the basic products prerequisite to fabricating a nuclear energy facility. And the government successfully negotiated contracts that stipulated some transfer of technology in this area. Thus Mexico's policy failure in this issue area was at least as contingent on internal conditions as on the country's external dependence.

In retrospect, it is difficult to argue that this policy failure was predetermined. Despite critical structural variables like the international market price of oil, accidents like Chernobyl, and the shifting course of public opinion toward nuclear power, the basic strategy pursued by the Mexican government and its administrative weaknesses were fundamental impediments to effective policy implementation.

The strategy for technology transfer, based as it was on the premise

that technology could be rapidly acquired by stipulating Mexican participation in the design and construction process, was vulnerable to various problems. Such a strategy is based on an instrumentalist view of technology and does not account for the social dimensions of technology transfer and acquisition. A socially based approach to technology transfer would take into consideration the appropriateness of the technology for the goals at hand as well as the depth of expertise in relation to the goals and impacts of such transfers (Hveem 1983; Sardar 1988). Mexico in particular lacked the kind of experience with nuclear energy that India, Argentina, or the People's Republic of China had before engaging in commercial activities (Sotomayor Torres and Rudig 1983; Katz and Marwah 1982).⁶⁰ At best, a commercial plant would teach the operators the skills needed to operate a complicated facility but not one on the cutting edge of technology.

Moreover, little real consensus existed from the outset on key questions related to development goals, the role of nuclear energy in Mexico's energy mix, the type of technology that should be sought, and the priority that should attend its development. Nor did effective policy centralization and coordination develop on this question. On the contrary, the fragmentation of administrative functions and the competing agendas of the various agencies in the nuclear sector were fundamental problems that diminished efficiency and consistency in pursuing goals for technology transfer.

Complicating matters further were problems associated with the political and administrative system. The change of administrations every six years predictably disrupted administrative continuity on Laguna Verde. Every new administration found cause to review and modify the Laguna Verde project, and turnover in project management became a major impediment to completing the project.

The administrative problems that dogged implementation of Laguna Verde and the nuclear program generally suggest that the obstacles to policy implementation in this case are as much related to the internal dimension of state autonomy as to the external dimension. Policy development and policy implementation on nuclear energy were dominated by the Mexican state, which enjoyed a monopoly on policy in this issue area. No evidence suggests that the Mexican private sector had any real influence in this policy decision, although it might be argued that Mexican energy policy benefited this sector most directly. Decisions were dominated by a small nuclear lobby consisting entirely of interests internal to agencies in the energy and nuclear sectors. Organized interests outside the government agencies had little direct influence on policy-making,

60. See *Latin American Weekly Report Special Report* (1985).

despite the fact that as the nuclear sector grew in the 1970s, new occupational groups associated with Laguna Verde and the nuclear sector as well as professional associations of engineers benefited directly from investment in the nuclear program and became strong constituencies favoring it. In short, the Mexican state clearly enjoyed potential policy autonomy in this issue area.

Despite the state's potential autonomy, nuclear advocates failed to connect their preference to a "privileged" developmental or national goal and to "capture" a particular state institution to a degree that would guarantee stable, long-term continuity and insulation from partisan or institutional conflicts.⁶¹ As the debates that led to the 1981 national nuclear program demonstrate, the nuclear lobby within the CFE had to engage in political alliances while its own nuclear strategy was being challenged by competing nuclear agencies. The internal autonomy of the state as a whole was much diminished by fragmentation of the state's authority in this issue area. It is evident that the Mexican state cannot be viewed as a unitary actor in this area. Our findings support Judith Teichman's characterization of the Mexican state as a "weak state" unable to translate its potential autonomy into real autonomy due to internal administrative and societal constraints (Teichman 1988, 143).

Further diminishing the actual autonomy of the Mexican state in this policy area were vulnerabilities arising from the dynamics of political liberalization and the electoral process. Although outside groups had little influence in basic policy development and the implementation of Laguna Verde, the anti-nuclear mobilization following the Chernobyl accident managed to prejudice the project's implementation and to exact significant political and economic costs. Anti-nuclear mobilization benefited from the political reforms instituted under the López Portillo and de la Madrid administrations, especially the environmental mobilization undertaken by the Mexican regime itself. Thus it is fair to say that the Mexican state, in attempting to co-opt the environmental movement after 1984, actually helped delegitimize itself on Laguna Verde. Moreover, the timing of the anti-nuclear mobilization could not have been worse for the Mexican state. Coming onstage the eve of a transfer of political power and during one of the most contested elections in Mexican history, anti-nuclear activists were able to wield significant leverage on the project's implementation.

In summary, this case study provides some useful insights into the three general questions posed at the outset. With respect to Mexico's

61. Adler (1988) argues persuasively that the ability of Argentina's nuclear energy sector and Brazil's computer industry to connect their preferences to such a privileged development objective and to capture certain state institutions was critical to the attainment of technology autonomy.

nuclear policy in general and the Laguna Verde plant, the evidence demonstrates that the capacities of the Mexican state were seriously stretched. Several factors conspired against the success of Mexico's ambitious nuclear energy program: its weak technical and research infrastructure (Wionczek 1981), linkage of the nuclear energy program to oil development, and political and administrative weaknesses.

Mexico's failure to develop a viable and independent nuclear energy program is a function of both external and internal constraints. With respect to external constraints on policy autonomy, persuasive evidence supports the pessimistic assessments of structuralist arguments on the capacity of upper-tier late-industrializing countries to achieve technological autonomy, at least in this issue area. Mexico continues to be sensitive to fluctuations in the world economy, particularly oil markets and the availability of external financing. The Mexican state remains dependent on outside sources of financing because of its historic role as investor of last resort. These structural variables, which are evident in this case, restrict the external autonomy of the Mexican state.

Although structural variables are necessary components in explaining policy failure in the case of Mexico's nuclear energy program, they are insufficient to account for the many difficulties encountered in program implementation. Despite the structural constraints, Mexico had policy options, as Mares (1985) has argued. To put it another way, Mexico had potential external autonomy in certain bargaining opportunities with respect to acquiring and controlling technology and in its choice of strategies for developing the nuclear energy sector. The fact that Mexico was unable to realize its potential was contingent in no small way on the internal dimension of constraints on the autonomy of state policy.

What, then, does the case of Mexican nuclear energy policy contribute to the larger debate over the prospects for upper-tier late-industrializing countries for acquiring high technology? Although a single case cannot substantiate theoretical propositions, the evidence presented here strongly suggests that neither simple structuralist nor anti-structuralist explanations of the process of acquiring technology in upper-tier late-industrializing countries are adequate in themselves. The Mexican case certainly illustrates the importance of structural constraints, or the external dimension of state autonomy, in determining policy outcome. Even so, Mexico's restricted external autonomy is a necessary but insufficient condition for understanding policy failure. In this case, the most compelling obstacles to policy success were associated with constraints on the internal autonomy of the state. The present study thus supports the movement to disaggregate the state in structuralist explanations of policy outcomes involving the efforts of late-industrializing countries to procure technological autonomy as part of their development strategy.

REFERENCES

ADLER, EMANUEL

1987 *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil*. Berkeley and Los Angeles: University of California Press.

1988 "State Institutions, Ideology, and Autonomous Technological Development: Computers and Nuclear Energy in Argentina and Brazil." *LARR* 23, no. 2:59–90.

BENNETT, DOUGLAS, AND KENNETH SHARPE

1979 "Agenda Setting and Bargaining Power: The Mexican State v. Transnational Automobile Corporations." *World Politics* 32, no. 1 (Jan.):57–89.

1982 "The State as Banker and Entrepreneur: The Last Resort Character of the Mexican State's Economic Intervention, 1917–1970." In *Brazil and Mexico: Patterns in Late Development*, edited by Sylvia A. Hewlett and Richard S. Weinart, 169–211. Philadelphia, Pa.: Institute for the Study of Human Issues.

BUSINESS MEXICO

1985 "The Energy Situation in Mexico." *Business Mexico* 3, no. 1 (Nov.):34–47.

CAMP, RODERIC A.

1980 *Mexico's Leaders: Their Education and Recruitment*. Tucson: University of Arizona Press.

CAPORASO, JAMES A.

1978 "Dependence, Dependency, and Power in the Global System: A Structural and Behavioral Analysis." *International Organization* 32, no. 1 (Winter):13–43.

CARDOSO, FERNANDO HENRIQUE, AND ENZO FALETTO

1979 *Dependence and Development in Latin America*. Berkeley and Los Angeles: University of California Press.

COBB, ROGER, JENNIE K. ROSS, AND MARC HOWARD ROSS

1976 "Agenda Building as a Comparative Political Process." *American Political Science Review* 70, no. 1 (Mar.):126–38.

COMISION INTERAMERICANA DE ENERGIA NUCLEAR

1983 *Legislación sobre energía nuclear en los Estados Americanos*. 3d ed. Washington D.C.: Secretaría General, Organization of American States.

CORNELIUS, WAYNE A., AND ANN L. CRAIG

1988 "Politics in Mexico." In *Comparative Politics Today: A World View*, 4th ed., edited by Gabriel A. Almond and George B. Powell, 425–86. Boston, Mass.: Scott, Foresman.

COSTA, DALMAU

1979 "Transfer of Technology and the Fuel Cycle." In *Pan American Nuclear Technology Exchange: Proceedings of the American Nuclear Society*, 307–26. Hollywood, Fla.: American Nuclear Society, 1979.

DOS SANTOS, THEOTONIO

1970 "The Structure of Dependence." *American Economic Review* 60 (May):231–36.

EIBENSCHUTZ, JUAN

1982 "Mexico." In KATZ AND MARWAH 1982, 245–56.

ESCALANTE, CECILIA

1988 "Energy Planning for 1977–1982." In WIONCZEK, GUZMAN, AND GUTIERREZ, 498–535.

EVANS, PETER B.

1979 *Dependent Development: The Alliance of Multinational, State, and Local Capital in Brazil*. Princeton, N.J.: Princeton University Press.

1987 "Foreign Capital and the Third World State." In *Understanding Political Development*, edited by Myron Weiner and Samuel P. Huntington, 319–52. Boston, Mass.: Little, Brown.

FITZGERALD, E. V. K.

1985 "The Financial Constraint on Relative Autonomy: The State and Capital Accumulation in Mexico, 1940–1982." In *The State and Capital Accumulation in Latin America*, Vol. 1, *Brazil, Chile, Mexico*, edited by Christian Anglade and Carlos Fortín, 210–40. Pittsburgh, Pa.: University of Pittsburgh Press.

FRETZ, DEIRDRE

1989 "Laguna Verde Face-Off." *Mexico Journal* 3, no. 4 (23 Oct.):25–26.

GARCIA MICHEL, HUGO

1988 *Más allá de Laguna Verde*. Mexico City: Posada.

- GRAYSON, GEORGE W.
1988 *Oil and Mexican Foreign Policy*. Pittsburgh, Pa.: University of Pittsburgh Press.
- GRIECO, JOSEPH M.
1984 *Between Dependency and Autonomy: India's Experience with the International Computer Industry*. Berkeley and Los Angeles: University of California Press.
- GRINDLE, MERILEE S.
1977 *Bureaucrats, Politicians, and Peasants in Mexico: A Case Study in Public Policy*. Berkeley and Los Angeles: University of California Press.
- GUTIERREZ R., ROBERTO
1990 "El sector eléctrico de México hacia el año 2000." *Comercio Exterior* 40, no. 3 (Mar.):272-79.
- HAMILTON, NORA
1982 *The Limits of State Autonomy: Post-Revolutionary Mexico*. Princeton, N.J.: Princeton University Press.
- HVEEM, HELGE
1983 "Selective Dissociation in the Technology Sector." In RUGGIE 1983, 273-316.
- INTERAMERICAN PUBLIC OPINION REPORT
1987 "Post-Chernobyl: Mexican Doubts about Nuclear Energy." *Interamerican Public Opinion Report*, no. 6 (Sept.):1-3.
- KATZ, JAMES EVERETT, AND ONKAR S. MARWAH, EDS.
1982 *Nuclear Power in Developing Countries: An Analysis of Decision Making*. Lexington, Mass.: Lexington Books, D. C. Heath.
- KATZENSTEIN, PETER
1985 *Small States in World Markets: Industrial Policy in Europe*. Ithaca, N.Y.: Cornell University Press.
- KAUFMAN, ROBERT R.
1977 "Mexico and Latin American Authoritarianism." In *Authoritarianism in Mexico*, edited by José Luis Reyna and Richard S. Weinart, 193-233. Philadelphia, Pa.: Institute for the Study of Human Issues.
- KRASNER, STEPHEN D.
1985 *Structural Conflict: The Third World against Global Liberalism*. Berkeley and Los Angeles: University of California Press.
- LATIN AMERICAN WEEKLY REPORT
1985 *Special Reports: Latin America's Nuclear Development Programmes Today*. April-June.
- LUDDMANN, MARGARETE K.
1983 "Nuclear Power in Latin America: An Overview of Its Present Status." *Journal of Interamerican Studies and World Affairs* 25, no. 3 (Aug.):377-415.
- MARES, DAVID R.
1985 "Explaining Choice of Development Strategies: Suggestions from Mexico, 1970-1982." *International Organization* 39, no. 4 (Autumn):667-97.
- MILLAN GAJARDO, VICTOR
1986 "Nuclear Proliferation and Nuclear Power Programs in Latin America." In *Latin America and the Caribbean: The Contemporary Record*, edited by Jack W. Hopkins, 30-65. New York: Holmes and Meier.
- MIRAMONTES, OCTAVIO
1989a "Wooing Mexico to Nuclear Power." *Bulletin of the Atomic Scientists* 45, no. 6:36-38.
1989b "Las consecuencias de un accidente radiológico en Laguna Verde." *El Colegio de México: Boletín Editorial* 26 (July-Aug.):11-14.
- MONTAÑO, CRISTINA, DANIEL M. LUND, AND WILLIAM BOLLINGER
1988 "A Critique of Nuclear Politics in Latin America." *Review of Latin American Studies* 1, no. 1: 69-86.
- MUMME, STEPHEN P., C. RICHARD BATH, AND VALERIE J. ASSETTO
1988 "Political Development and Environmental Policy in Mexico." *LARR* 23, no. 1:7-34.
- NADAL, ALEJANDRO
1989 "El plan de emergencia de Laguna Verde." *El Colegio de México: Boletín Editorial* 26 (July-Aug.):3-9.
- NUCLEAR ENGINEERING INTERNATIONAL
1978 "Update: Mexico to Generate Its Own Nuclear Technology." *Nuclear Engineering International* 23 (Sept.):14.

NUCLEAR LAW BULLETIN

- 1978 "Mexico: Organization and Structure." *Nuclear Law Bulletin*, no. 22:18.
1985 "Nuclear Legislation: 1984 Act on the Administration and Control of Nuclear Energy." *Nuclear Law Bulletin*, no. 35 (June):17-21.

O'DONNELL, GUILLERMO

- 1977 "Corporatism and the Question of the State." In *Authoritarianism and Corporatism in Latin America*, edited by James M. Malloy, 47-87. Pittsburgh, Pa.: University of Pittsburgh Press.
1978 "Reflections on the Patterns of Change in the Bureaucratic-Authoritarian State." *LARR* 13, no. 1:3-38.
1988 *Bureaucratic Authoritarianism: Argentina, 1966-1973, in Comparative Perspective*. Berkeley and Los Angeles: University of California Press.

POTTER, WILLIAM C., ED.

- 1990 *International Nuclear Trade and Nonproliferation*. Lexington, Mass.: D. C. Heath.

PRESIDENCIA DE LA REPUBLICA

- 1988 *Las razones y las obras: gobierno de Miguel de la Madrid, crónica del sexenio 1982-1988, quinto año*. Mexico City: Fondo de Cultura Económica.

PURCELL, SUSAN K.

- 1977 *The Mexican Profit-Sharing Decision*. Berkeley and Los Angeles: University of California Press.

REICHEL, LEONARD F. C.

- 1979 "Engineering and Constructing Nuclear Power Plants in Latin America." In *Pan American Nuclear Technology Exchange: Proceedings of the American Nuclear Society*, 261-82. Hollywood, Fla.: American Nuclear Society.

RUGGIE, JOHN GERARD, ED.

- 1983 *The Antinomies of Interdependence: National Welfare and the International Division of Labor*. New York: Columbia University Press.

RUIZ, ROGELIO

- 1984 "Observaciones analíticas sobre el programa nucleoelectrico de México." *Comercio Exterior* 34, no. 5 (May):432-43.
1988 "Nuclear Electricity Planning and Development." In WIONCZEK, GUZMAN, AND GUTIERREZ 1988, 133-65.

SARDAR, ZIAUDDIN, ED.

- 1988 *The Revenge of Athena: Science, Exploitation, and the Third World*. London: Mansell.

SCIENCE

- 1984 "Juárez: An Unprecedented Radiation Accident." *Science*, no. 223 (Mar.):1152-53.

SMITH, PETER H.

- 1979 *Labyrinths of Power*. Princeton, N.J.: Princeton University Press.

SOTOMAYOR TORRES, OLIVIA M., AND WOLFGANG RUDIG

- 1983 "Nuclear Power in Argentina and Brazil." *Journal of Radical Political Economics* 15, no. 3 (Fall):67-82.

SPALDING, ROSE J.

- 1981 "State Power and Its Limits: Corporatism in Mexico." *Comparative Political Studies* 14, no. 2 (July):139-61.

SPECTOR, LEONARD S.

- 1988 *The Undeclared Bomb*. Cambridge, Mass.: Ballinger.

STORY, DALE

- 1986 *Industry, the State, and Public Policy in Mexico*. Austin: University of Texas Press.

TEICHMAN, JUDITH A.

- 1988 *Policymaking in Mexico: From Boom to Bust*. Boston, Mass.: Allen and Unwin.

WILLIAMS, EDWARD J.

- 1979 *The Rebirth of the Mexican Petroleum Industry*. Lexington, Mass.: Lexington Books, D. C. Heath.

WIONCZEK, MIGUEL S.

- 1981 "On the Viability of a Policy for Science and Technology in Mexico." *LARR* 16, no. 1:57-78.

WIONCZEK, MIGUEL S., OSCAR M. GUZMAN, AND ROBERTO GUTIERREZ, EDS.

- 1988 *Energy Policy in Mexico*. Boulder, Colo.: Westview.