Because of the characteristics and scale of refinery operations, the petroleum downstream is a highly regulated industry. Refinery operations are subject to a wide array of health, safety, air and water quality, land use, and other regulations imposed by federal, state, and local agencies. As illustrated in Chapter Two, a large number of product specifications govern transportation fuels markets. Regulations may also affect refining indirectly, through mandates on motor vehicle design and performance.¹

Although many refining industry members disagreed with the scientific and economic merits of certain regulations, all acknowledged the importance of improving public health and protecting the environment, and they accepted the principle and reality of regulation in their industry. Corporate policies that place a premium on workplace health and safety have become widespread in refining, as they have throughout American industry. In recent years, some refining companies have elevated environmental protection on their list of corporate priorities and have tried to distinguish themselves by being seen as producing more environmentally friendly products.

**We all believe that fuels need to get cleaner. The question is how fast?**

—Operating company manager

Discussants expressed pride in the past accomplishments of their industry in reducing pollution from plant operations, producing cleaner fuels, and improving health and safety in the workplace. These accomplishments were often presented as a function of good management and the need to hire, retain, protect, and motivate employees in a competitive labor market. Banners touting low in-

¹ Slaughter (2002) provides an industry association view of the regulatory environment in which refineries operate.
jury rates were prominently hung at many refineries we visited. Many claimed that a strong environmental, health, and safety record was tantamount to good corporate citizenship and the sine qua non of staying in business. “We earn every single day the license to operate our facilities,” one executive said. “You can’t risk failure or you lose your license to operate.”

The level of optimism declined significantly for many industry members when they looked to the future. Executives in the RAND discussions addressed three regulatory concerns at length, all of them related to environmental protection: the reduction of sulfur in diesel fuel; the role of MTBE and ethanol as gasoline blending components; and New Source Review rules governing facility air pollution emissions. (The merits and drawbacks of these initiatives are the subject of a large body of literature and public discourse and are beyond the scope of this report.)

Four cross-cutting issues emerged during the RAND discussions—return on investment, capital constraints, flexibility, and uncertainty—and how they affect the planning and operations of refineries and, ultimately, the price and supply of petroleum products in the United States. These factors, it was said, have created a climate in which the industry will not be able to keep up with the growing demand for petroleum products in the coming years. These issues are addressed below.

RETURN ON INVESTMENT

Many participants in the RAND discussions noted that the refining industry has, in recent years, suffered from rates of return on investment (ROI) lower than those of both other sectors and the historical average for the refining industry. The mid-1990s were seen as particularly bad years, and discussants often cited EIA data indicating that larger companies’ average ROI for refining and marketing activities was less than 5 percent, and, thus, lower than the cost of capital.

The folks that I deal with are absolutely terrified with the capital expenditures.... With regulatory expenditures, there is no upside.

—Technologies and services executive

Many industry representatives suggested that this situation has been exacerbated by a tight sequence of costly “non-return investments” required to comply with environmental regulations. According to industry reports, capital
Regulatory and Financial Environment

Refining industry leaders asserted that consumers generally are not willing to pay a premium for fuels advertised as having environmental benefits.

Investment increased during the period from 1988 to 1994 in preparation for the introduction of oxygenated gasolines by late 1992, low-sulfur diesel fuel by late 1993, and reformulated gasoline by early 1995. Such requirements and the poor returns they produced, it was said, ultimately led to the drastic restructuring efforts that transformed the downstream through joint ventures, mergers and acquisitions, divestiture of assets, and plant closures. The industry discussants feared this scenario would continue through the current decade, producing further restructuring, deterring capacity increases, and possibly leading to supply disruptions.

Industry discussants made several assertions about how capital expenditures related to environmental compliance have a detrimental impact on a refiner’s ROI. First, capital investments required by regulations typically were portrayed as non-remunerative. For example, although cleaner refined products may have higher value in terms of enhanced motor vehicle performance, reduced environmental degradation, and improved public health, industry executives repeatedly pointed out that consumers generally are not willing to pay a premium at the pump for such mandated improvements, even when retailers advertise the vehicle performance and environmental benefits. As a result, the executives said, refiners find it difficult to pass on the investment costs needed to adapt their operations to the new regulatory measures.
Second, in some instances, regulations create what were termed “stranded assets” as regulatory measures are implemented and repealed. One example cited is MTBE production and blending capacity, which was created in response to the oxygenated gasoline mandate of the early 1990s and which is expected to become superfluous as MTBE is phased out. A second example is the extra tank capacity and distribution infrastructure industry officials expect to need to handle ULSD (viewed as a unique product that must be handled separately from conventional diesel) during its four-year phase-in starting in 2006.

Third, it was said that regulation-driven investment forces refiners to forgo profit-making opportunities by crowding out “economic investment” elsewhere. One determinant of refinery profitability is conversion capacity (complexity). Refineries that have more-sophisticated equipment can process (upgrade) heavier crudes purchased at a discount. This is increasingly important because crude oil production worldwide is trending toward heavier stocks. Additionally, more-complex refineries can better shift production output to match demand and take advantage of higher premiums for specific fuels. This can offer refiners greater profit-earning opportunities when they produce higher value-added products, such as gasoline. During the late 1970s and 1980s, refining capital expenditures approximately trebled as U.S. refiners, especially those on the Gulf Coast, invested in hydrotreating and other upgrading capabilities to take advantage of price spreads of $3–4 per barrel between heavy/sour and light/sweet crudes as a result of tense political conditions in the Middle East—a major source of light crude stocks (EPA, 1997). A RAND discussant observed that, beginning in the 1990s, refiners had to curtail such economic investments to focus on producing cleaner fuels, thus prolonging their dependence on higher-cost crude feedstocks.

Other points raised by refining industry representatives, however, tended to refute or confound these arguments. Take, for example, the last point above: It could be argued that the low rates of return experienced during the early and mid-1990s were more a result of market forces (namely, crude oil prices) and incentives than of the burdens of environmental investment. With relatively ample and reliable supplies of crude oil from the Middle East and elsewhere available in the 1990s, the price differential between light and heavy crudes fell

---

2 For more detailed discussion of hydrotreating, see Appendix C.
to the $1–2 per barrel range, a ten-year low, significantly diminishing the return on recent investments in hydrotreating and other capital stock that was geared for processing heavier crudes. In short, the strategy of investing in refinery complexity became a disadvantage as a result of global market trends (Martin, 1998).

The cost of crude is the tail that wags the dog.
—Services supplier executive

Another confounding issue is the difficulty in cleanly measuring the ROI impact of environmental regulations. One challenge is accounting for motivation: Even in the absence of environmental regulations, some investments likely would have been made anyway for standard maintenance or to introduce new processes. Discussants frequently spoke about timing turnarounds and revamps to coincide with regulatory changeovers. A second accounting issue concerns the ancillary economic benefits of revamps initially undertaken for regulatory compliance purposes. For example, investment in deep-desulfurization capabilities can allow refiners to process heavier crudes and thus potentially benefit from the ability to refine less-expensive crude stocks. Similarly, requirements to reduce air emissions from process heaters can spur investment in boosting energy efficiency, thereby lowering refineries’ energy costs. Many refiners told RAND they strive to maximize such ancillary benefits in planning regulatory changeovers, and suppliers claimed that the technologies and services they provide to refiners deliver these benefits.

As in all capital-intensive industries, it often makes sense for refiners to maintain operations and earn whatever revenue they can as long as the sum of variable costs (feedstocks, labor, energy) is lower than the product price. Moreover, given process efficiency and reliability factors, it is typically better for petroleum refineries to operate close to design capacity than to operate at lower levels or to cycle on and off, even if demand for their output softens. However, to move their product under conditions of soft demand and oversupply, refiners have to cut prices. Refining executives generally felt that regulations were enforced evenly across the industry, except for the delayed implementation allowed for small refiners. In such an environment, asserted a supplier representative, the inability of refiners to pass the cost of environmental regulations on to consumers reflected the fact that “pace setter” refiners with the lowest production costs were able to comply with environmental regulations and keep their product prices down. Free-market competition, in turn, restrained other refiners’ ability to raise their prices for cleaner fuels.
Market restructuring, the expected response to persistently low returns and the elimination of excess capacity and supply, was slow in coming because refining executives were initially unwilling or unable to curtail production or sell or walk away from their operations. Eventually, a corrective wave of cost-cutting, corporate reorganizations, mergers and acquisitions, and strategic alliances ensued in the late-1990s, as some firms found persistently poor returns less tolerable. New business models also emerged that enabled independent refiners to grow. These changes appear to have had the intended salutary effect of lowering operating costs and boosting profit margins and ROI, as we saw in Figure 2.2.

Finally, the efforts of some discussants to compare returns on investment in refining with those of other sectors do not appear to fully characterize the relative health and sustainability of the industry. The demand for petroleum products in the United States has been growing steadily and is expected to continue growing at least over the medium term. This demand also is largely inelastic: Despite a 60-cent run-up in prices in early 2003, the demand for gasoline increased modestly. Because additions to capacity can occur only gradually and imports are constrained by domestic fuel specifications, the United States is essentially a reliable and protected market. Speaking of his firm’s decision to acquire and then significantly expand the capacity of a small refinery, one executive said: “If you look at the refining industry in the U.S., it is challenged, but refining capacity . . . there is not enough of it. We think there is an opportunity.”

CAPITAL CONSTRAINTS

A point made in the RAND discussions was that the large capital requirements for environmental regulations, combined with a tightly sequenced compliance schedule, was starving refiners of essential capital for growth. Discussants frequently cited American Petroleum Institute (2001) and other research, which estimated that refining’s capital expenditures for compliance with the 1990 Clean Air Act Amendments totaled $18 billion in the 1990s. In 1993–1994, such investments reportedly accounted for almost half of the industry’s total capital expenditures. In such a scenario, RAND discussants, warned, refiners facing a “horrendous capital constraint” have limited resources left over to boost productivity and expand capacity. Small refiners, they argued, would find it especially difficult to muster the capital needed and would be forced to exit the market. New capital expenditure requirements to comply with on-road ULSD requirements by 2006 are estimated at $4–13 billion (EIA, 2001); other environmental mandates may cost $10–15 billion. If such demanding financial condi-

3 The high costs of dismantling and environmental remediation required when a plant is decommissioned slow the industry’s reaction to market changes.
tions persisted, some warned, supply shortfalls and upward price pressure could result.

Refining decisionmakers’ increased attention to their capital constraints reflects a fundamental change in the industry. One of the critical aspects of corporate restructuring for vertically integrated oil companies in the 1990s was the aim of transforming downstream refineries into free-standing business units with little or no cross-subsidization from upstream exploration and production. This transformation led to a greater emphasis on boosting returns to capital and a more conservative corporate decisionmaking regarding capital outlays in the refining sector, compared with more liberal practices in the 1970s and 1980s. Opportunities for earning a better return on investment lay outside of refining. One result, noted by discussants and mentioned in Chapter Three, is that corporate decisionmakers apparently are now less likely to invest in capacity increases.

Companies are going to be a little more hesitant about making low-cost incremental increases in capacity. No doubt about it.

—Refining executive

On the other hand, many discussants did not consider capital availability a critical issue. A representative of a major integrated refining firm said the industry had problems attracting capital in the early and mid-1990s because the downstream got “off-focus,” resulting in a poorer record of safety and reliability. Refining operations in integrated firms could therefore not attract capital from corporate decisionmakers. The situation had since changed, he added.

An independent refiner representative was proud that his management team could consistently invest in growth projects because his firm was able to maintain control over its revamp costs. He contended that his firm paid 30 percent less than his competitors for comparable projects. The key was having “an exceptional workforce” and being “hard bargainers” so as not to pay “exorbitant prices like other refiners.” A technologies and services supplier asserted that decisionmaking conservatism in the industry actually works a different way: Refiners tend to plan for worst-case scenarios and then overdesign their equipment. One possible outcome is overcapacity in the sector, resulting in low profitability and ROI. Closer cooperation with suppliers, he posited, could save operating companies 30–50 percent on their capital expenditures.

4As noted in Chapter Three, refiners have an economic incentive to add capacity in an effort to recoup the costs of regulatory investments.
Many participants in the RAND discussions spoke of their firms’ recent discretionary investments to increase both product volume and quality. One refiner noted that regulatory investments tend to be cyclical rather than constant. His firm’s share of capital expenditures for strategic investments dipped into the 20–30 percent range in the mid-1990s as it sought to comply with reformulated gasoline requirements. The firm now enjoyed a window of opportunity to make more strategic investments before it addressed ULSD regulations in 2006. An independent refiner said that the strategy of minimal investment was unwise in an era of constantly tightening product specifications. Another independent refiner maintained, “You must be proactive if you’re in the business.” In a similar light, an operating company manager stated: “You have to be a leader to be a major player in the world market.”

The fact that independent refiners, in particular, were able to attract and dedicate capital resources to execute so many mergers and acquisitions since the late 1990s attests to the enduring attractiveness of the downstream as an investment target. By combining and growing, these firms sought to further enhance their ability to muster capital resources over the long term. Over the short term, however, it could be argued that the mergers and acquisitions may have constrained expenditures for capacity expansion and other projects. As noted in Chapter Three, several technology and services providers said that mergers and acquisitions led to delays in project decisionmaking.

The fate of small refineries and smaller refiners was a major topic of speculation during the RAND discussions, especially in the area of capital availability. Representatives of larger firms often suggested that small refiners (especially those with small refineries) can’t stay in business, given the expected investment requirements of environmental regulations. Yet here, too, there were differences of opinion. All the smaller firms with whom RAND spoke expressed optimism about their operations and the markets they supply. “We’ve thought that refining was a good business much longer than others in the industry,” said one executive. “We’re probably too stubborn to give up.”

Representatives of smaller refiners usually asserted that their firms were more innovative than their larger counterparts and their decisionmaking more flexible. In some cases, a small refinery in a large company can be more capital constrained than a comparable refinery at an independent firm because executives focus resources on their major operations. For example, one executive at a smaller, independent refiner noted that the firm’s investments were keyed not only toward environmental compliance but also to improving its “competitive position.” He pointed to its investment in new hydrotreaters and a large hydrogen plant (major capital investments many other firms reported they were try-
Representatives of smaller refining firms were optimistic about their ability to raise capital, comply with environmental regulations, adopt new technologies, and earn a reasonable return on investment. Another reported that his facility was operating an alkylate unit on behalf of a neighboring small refinery from a major integrated oil company. The latter could more easily justify the operating expenses of a tolling arrangement rather than capital expenses to its management. These small refineries are the “bread and butter” of small refiners with one or two facilities, and they are thus the focus of their investment decisions. On the other hand, a major miscalculation could potentially bankrupt them. However, they believed their refineries were in markets relatively isolated from outside markets and could afford to take these risks.

The real threat to many small refineries, several discussants said, was the construction of a product pipeline into their market, which would increase competition.
REGULATORY FLEXIBILITY

Refinery assets are by nature not very flexible, yet operational flexibility is central to most refiners’ operating philosophy and business strategy. To maximize profits, refinery managers must manage and optimize, to the greatest extent possible, their capital stock, product slate, energy and raw material inputs, and maintenance and repair protocols. In this light, regulatory flexibility is viewed as critical to the economic sustainability of a refinery. Several themes on this point were raised in the RAND discussions.

Many industry discussants asserted that the detailed and inflexible manner in which many regulations were implemented vitiated their potential impact. Generally speaking, refiners felt that regulations should be crafted in a way that recognized that “refiners are good profit maximizers.” One approach consistent with this philosophy is to use economic incentives, such as tax breaks, to encourage production and consumption of cleaner fuels. This practice, discussants noted positively, was more prevalent in the European Union where it is being used to promote a greater reliance on diesel fuel for the passenger vehicle fleet. Refiners also stated that they would prefer plant-wide bubbles or “applicability limits” governing the measurement and accounting of stationary emissions, rather than emissions limits on each piece of equipment. This would enable refineries to meet global emissions objectives by focusing on the least-expensive reduction targets within a plant.5 Market mechanisms tried in the United States, such as the banking and trading of credits for reduction of refinery air pollution emissions and production of cleaner fuels (features of the EPA’s ultra-low sulfur-gasoline and diesel rules), generally were not seen by refining industry executives as widespread or strong enough to have an impact on management decisionmaking.

Given their desire for operational flexibility, refiners typically prefer environmental regulations that stipulate environmental performance goals rather than mandate specific technologies or products. One of the most onerous mandates from the perspective of the refining industry is the requirement to blend in ethanol into gasoline as a replacement for MTBE in high pollution areas and as a crude oil replacement elsewhere, as proposed under the Renewable Fuels Standard. Given the advent of new refining capabilities and better process monitoring and controls, cheaper and cleaner-burning fuels could be produced without any special additives. “Do you need ethanol to make clean fuel? No!” said one refiner. Compliance with performance specifications, however, can be harder for officials to monitor and enforce than technology and fuels specifica-

---

5 In November 2002, after the conclusion of the RAND discussions, the U.S. Environmental Protection Agency issued a final rule establishing plant-wide applicability limits for permitting purposes under the New Source Review program.
tions, one executive admitted, leading regulators to avoid performance specifications.

We try to anticipate regulations so if possible we can skip a generation of regulation.... We are ahead of the market in gasoline sulfur.... We are going to size our reactors for a 10 ppm world and operate them [for] 30 ppm, because in 2012 I think we are going to be in a 10 ppm world.

—Refining executive

To provide maximum flexibility, some refiners and technology developers said that they would like to have as much lead time as possible before regulations are implemented. Typically, U.S. EPA rules provide 3–5 years, in addition to the initial proposal and discussion period of a year or two in which industry is involved. Longer lead times, it was posited, would enable refiners to coordinate their investment and changeover timing with regulatory changes. They would also give technology developers more opportunities to develop, test, and prove more innovative solutions. Smaller refiners asserted that extended regulatory phase-ins and other means of flexibility made available to them by the EPA were very helpful by

• spreading their capital expenditures over longer intervals
• reducing competition with large refiners for scarce process equipment and engineering and construction services
• enabling them to take advantage of the learning curve in new technologies and practices gained by earlier adopters.

“There definitely is an advantage for those who can wait,” said one small refiner representative.

On the other hand, many industry representatives suggested that longer lead times probably would not have the suggested beneficial impacts, given other more-immediate drivers of refinery decisionmaking. First, many discussants noted that refinery executives tend to avoid unproven technologies and that few see a business advantage in being an early adopter of new technologies. In considering technology options, refiners “like to be first to be second,” said one supplier representative. Second, it was repeatedly pointed out that decision-makers increasingly wait until the last minute to make regulatory investment decisions in an attempt to minimize financial risk created by economic volatility and concern that the rules will be changed. “They are doing week-to-week and month-to-month planning,” said one services supplier. Efforts under the Clinton administration to give the industry longer-term targets, it was said by
one discussant, were used by operating companies as an opportunity to put off implementation.

On several occasions, industry members faulted regulators’ efforts to provide flexibility. For instance, larger firms tended to view the longer implementation periods EPA has granted to small refiners as unfair. Another example cited was the gradual phase-in of ULSD starting in 2006: “The two-tier system is going to be terribly disruptive and confusing,” said one technology developer. The boutique fuels phenomenon, a manifestation of state regulators’ efforts to develop targeted solutions to air pollution problems, was also seen by some as adding unnecessary complexity to the system.

REGULATORY UNCERTAINTY

Many refiners with whom RAND spoke touted their past efforts to comply with regulatory requirements, noting that they sometimes did this ahead of the mandated schedule. But they also cautioned that attitudes among decision-makers in the industry were changing. Refiners felt that increased regulatory uncertainty in recent years had added excessive and unnecessary risk to their investment calculus and had generated incentives for them to delay compliance as long as legally possible. “There is no certainty in our business,” said one executive of a leading refining firm, pointing to the prevalence of international political risks and crude oil price volatility in the upstream sector. “There is no reason not to have regulatory certainty” in the downstream.

One form of regulatory uncertainty cited in the RAND discussions concerned the uncoordinated timing and phase-in of regulations. Desulfurization of gasoline and diesel, it was said, has been approached in a piecemeal manner. After the current round of mandates, which were spread out over a decade, most refiners with whom RAND spoke in 2002 expected new regulations to be implemented requiring substantial reductions in the sulfur content of off-road diesel.\(^6\) Some predicted that sulfur removal would be extended to jet fuel and home heating oil in the future. Ultimately, many argued, the goal likely would be shifted again to “zero-sulfur” fuels. If zero sulfur indeed is the objective, and some discussants said they were not opposed in principle to this challenge, the best approach would be to set it as a long-range goal and then coordinate the intermediate steps to get there. Facility revamps, it was asserted, could then be better coordinated and accomplished at lower cost.

\(^6\)After the conclusion of the RAND discussions, the U.S. Environmental Protection Agency in April 2003 officially proposed that the sulfur content of diesel fuel for off-road applications be phased down from its current levels typically over 3,000 ppm to 500 ppm beginning in 2007 and then to 15 ppm in 2010.
I’m not offended by changing rules in the future, but about changing rules in the past. To look back and hold a hammer over your head is a real shame.... When the rules are [firmly] set, we will do it, whatever it takes. We tend to have pretty bright people in this business.

—Refining executive

A second form of uncertainty is reinterpreting rules with the effect of tightening them—what one discussant termed “a regulation that is subsequently taken back.” EPA actions in the late 1990s to challenge existing emissions permits under the New Source Review provision of the Clean Air Act were considered by nearly all discussants to be an unwarranted step. The ensuing disagreement over what constituted “routine maintenance, repair and replacement,” which triggered a full permitting process, added uncertainty to the permitting process and had a chilling effect on investment for capacity increases. Even small-scale efforts to remove physical bottlenecks in processing units, which were credited for increasing capacity and blunting price increases over the past decade, had begun to incur burdensome New Source Review permitting and enforcement processes at some facilities, creating substantial disincentives for some refiners. This also was causing executives to delay changes for regulatory purposes until the last possible moment: “You are penalized for moving early,” said one technology supplier. An executive at a major refinery referred to this as a “schizophrenic” situation, because New Source Review rules were causing refiners to delay and perhaps avoid investments in cleaner fuels production. “Everybody wants clean fuels, but nobody wants to give you a permit to build facilities. If somebody could make up their mind. . . .”

A third form of uncertainty was changing and waiving (i.e., relaxing) rules when problems with implementation arise. An example cited was the opt in/opt-out provision given to state decisionmakers in the nationwide reformulated gasoline mandate in the early 1990s. Many states opted out of the regulation as soon as they experienced price increases. Several instances of modifications in regulations in California were cited:

- Implementation of low-sulfur (500 ppm) diesel fuel in 1993 was delayed when prices in some markets jumped by as much as 30 cents per gallon
- Sale of conventional (non-reformulated) gasoline was permitted in summer 1999 when prices doubled as a result of refinery breakdowns

---

7 After the conclusion of the RAND discussions, the U.S. Environmental Protection Agency issued a proposed rule in November 2002 clarifying the definition of routine maintenance, repair, and replacement in accordance with refining industry arguments.
The MTBE ban was postponed by one year, to 2004.

One discussant summed up the situation as follows: Refiners want regulatory certainty while the public, and, therefore elected officials, want price certainty. These interests can often be fundamentally at odds with each other. “The problem is that during a price spike, people go crazy,” he concluded.

When the EPA sets a rule, they should not grant waivers for political expediency because a company has a problem. What you’ve done is penalize all other companies for having done it right.

—Refining executive

Many RAND discussants predicted that EPA will have to make a mid-course correction and issue a temporary waiver when the ULSD rule is implemented in 2006 because either refiners or retailers will exit the market, refineries will not have sufficient capacity on line in time, or too much diesel fuel will become contaminated in the supply chain. “Our concern is that there will be so much contamination that the government [will have] to get involved,” said one technology supplier executive. A better alternative, it was posited, was for EPA to adopt rules that were economically and technologically feasible from the outset rather than go back and fix them after substantial investments had already been made. In the case of ultra-low-sulfur diesel, some suggested that the rules be rewritten to stipulate that ULSD production will be gradually ramped up in line with the diffusion of ultra-low-emissions trucks, rather than requiring a one-step shift to 80 percent ULSD in 2006.

Finally, even when the rules are stable and clear, one participant said, the time required to obtain permits for projects in the downstream is often lengthy and adds investment risk.

In any case, most RAND discussants preferred firm deadlines and rules. One executive of a major refining firm stated that last-minute “government intervention” to fix a regulatory problem “does not make problems go away.” Rather, it negatively affects refiners’ calculus down the road. Early actors are penalized by regulatory waivers and deferrals because they must shoulder the burden of a capital investment with no payoff, whereas competitors who delay or fall out of compliance effectively obtain a free grace period through regulatory waivers. “You penalize the other companies that did it right,” said one operating company executive. Referring to the California aromatics waiver, one discussant exclaimed: “That lesson is not going to be forgotten.” One operating company executive said that he was proud that he had not invested in expanded reformulated gasoline capacity in the 1990s, correctly predicting that some states would...
choose to opt out of the regulation as soon as they experienced price spikes. The opt-outs then resulted in an oversupply and soft markets.

On the other hand, the discussions suggested that industry behavior, too, has contributed to uncertainty. Some refining companies, arguing that they need regulatory flexibility, seek waivers and last-minute changes in the rules. And all refiners benefit from a public relations perspective when price surges are mitigated or averted. Industry challenges of EPA regulations in the courts, such as the ULSD rules in 2002, could be seen as adding a layer of uncertainty. Many technology and services suppliers suggested that the recent wave of mergers and acquisitions had added a noticeable measure of corporate hesitation within operating companies as corporate strategies are revamped and roles and responsibilities realigned. People are “focused in internal issues, such as ‘Who do I work for?’” stated a participant. “It’s causing delays in decisionmaking,” said one executive. “I can’t get a decision with efficiency like I used to.” Finally, the disaggregation of the refining business, whereby refineries increasingly are managed as independent business units responsible for their own bottom line likely has contributed greatly to the sense of exposure and uncertainty among managers.

**IMPLICATIONS FOR FUTURE PRODUCT SUPPLIES**

Looking to the future, many refining industry members, reiterating industry association statements, expressed doubts about the ability of the industry to manage the impending slate of fuels regulations and maintain adequate reliable supplies to the market. Some discussants warned that the disruptions and price volatility in the recent past were a harbinger of the future.

A few participants were particularly concerned about MTBE phase-out, with one calling it the “number one show-stopper.” This view coincided with a pessimistic report issued by an industry consultant that predicted prolonged gasoline shortages in California in 2003 (Stillwater Associates, 2002). In contrast, refiners in California with whom RAND spoke felt that the industry was ready for MTBE phase out by the end of 2002, as originally scheduled, and that the one-year delay granted by the governor in 2002 simply penalized those refiners who had planned and made the necessary investments on time.\(^8\) One refiner, however, questioned whether enough ethanol would be available in the future as

---

\(^8\)Reinforcing the personal statements made to RAND, four major California refiners publicly announced that they would be abandoning MTBE as originally scheduled by the beginning of 2003 (Industrial Information Resources, 2002). All refiners, as well as the distribution infrastructure, were expected to be ready for full implementation before the 2004 deadline (California Air Resources Board, 2003).
more states shift away from MTBE and if a Renewable Fuels Standard is implemented.

The most prominent supply issue raised in the RAND discussions concerned the implementation of ultra-low-sulfur diesel fuel for on-road uses starting in 2006, when maximum permissible sulfur concentration at the retail pump will drop from 500 ppm sulfur to 15 ppm (initially, for 80 percent of the supply). Discussants raised several arguments that suggested the potential for supply shortfalls and upward price pressure in 2006, including the following:

- Uncertainty about the ability of refineries to produce ULSD reliably in sufficient quantities
- Delays in refiners’ decisions to implement ULSD compliance strategies
- Inability of refiners to obtain the equipment and services to ramp up their ULSD production volumes in time
- Contamination of ULSD in the distribution and marketing supply chain
- Uneven distribution of ULSD to retailers across the country
- Curtailing of on-road diesel production by firms that cannot raise the required capital or elect not to make the required investments.

As we saw in Chapter Three, refining industry technology and services suppliers who spoke to RAND in 2002 were confident that the technologies and equipment for deep desulfurization on the scale required would be ready and available for timely implementation. “I personally believe the technologies exist to do it,” said one executive at a mid-size refiner. Essentially, most refineries’ strategy would be to increase their hydroprocessing capacity. One major refinery had already converted to ULSD production by 2002, and two more refineries were expecting their conversions to be completed in 2003—more than two years ahead of the regulatory mandate. Although refiners did not have much experience or exposure to full-scale ULSD production at the time of the RAND discussions, one participant suggested that operating companies’ learning curve would increase rapidly as the 2006 deadline approached.

RAND discussants raised the most questions about maintaining the integrity of ULSD in distribution and retail networks. ULSD may become contaminated in the distribution system through inadvertent commingling with high-sulfur products, creating large volumes of transmix that must then be reprocessed. Concerns also have been raised about the potential depleting of sulfur deposits that have accumulated in pipelines and tanks. “I am leery that the attempts to model ULSD behavior [in the supply chain] are not real-world,” said one refiner. “I’ll be surprised if we don’t have downgrading of a significant quantity of product.” This will lead to prices “higher than anyone predicts,” but he added
that his concerns were with the initial implementation and that prices would fall to the cost of production within three months. Many others saw less of a threat of contamination: Refiners would manufacture diesel fuel at 10 ppm sulfur or less to add a measure of flexibility during distribution. A major refiner representative was confident that other solutions would be available, such as additives that prevent sulfur deplating and better batching and dispatch control along pipelines. Product polishing at terminals, another available solution, would not be needed, he said.

[Company] designed a process to significantly reduce the cost of producing low sulfur gasoline [using] blend stocks which contain less than 10 ppm sulfur. Focused on becoming an industry environmental leader, [company] introduced its low sulfur fuels in Detroit in summer 1999, years ahead of federal requirements, and in other U.S. markets since then.

—Refining company publication

Hydroprocessing to manufacture ULSD is very expensive, many discussants observed. Moreover, while gasoline is a “bread-and-butter” business for most large refineries, the market for on-road diesel fuel is smaller and is managed more on a wholesale basis. Thus, it is less of a priority for major refineries. A number of discussants suggested that as a result of expected low ROI or a lack of access to capital, some refineries may opt out of this segment of the market and divert their higher-sulfur fractions to the off-road diesel pool or other markets. An independent refiner said, “If you have to take a hit in throughput to avoid the investment, fine.” Others may take a “wait-and-see” strategy. “For the first time there has been a real threat of market withdrawal,” said one industry observer.

I’ve never seen one of the predicted train wrecks come to pass. There has never been a time that the industry has not risen to the challenge.

—Technology and services executive

However, discussion of market exit, like concerns about the distribution system and a lack of technologies or equipment, typically involved other actors. When speaking about the prospects for their own firms, none of the RAND discussants expressed reservations about remaining in the on-road diesel market, even if they had not yet selected an implementation strategy. A point made by several discussants was that many refiners won’t have economically attractive alternatives for disposing of that portion of their distillate stream should they choose
not to produce on-road diesel. Diverting their higher-sulfur products to the off-road diesel fuel or home heating oil markets, for example, would push down prices to unacceptable levels.\(^9\) “All of the majors are going to do something” to reduce sulfur, said one supplier executive. “They have all of these fixed assets. They are not going to walk away from the market.” The pressure to be in compliance has increased as firms have consolidated because more assets are now at stake, observed another supplier executive. “I don’t think any one of those companies would not make the investment, because it would be commercial suicide.”

In aggregate, the statements of industry representatives with whom RAND spoke—including operating company managers—portrayed a more nuanced, and perhaps more optimistic view than is commonly presented in public forums and industry reports (e.g., EIA, 2001). Although desulfurization of both gasoline and diesel fuel will require fairly significant capital expenditures, said amid-size refiner executive, “Our strategy is to take every challenge and make it an opportunity.” An executive at a major refiner said, “I’m not a person who says: ‘Hell no, we won’t go to lower sulfur. . . .’ We have let sulfur stay high too long.” For mid-size and smaller refiners with whom RAND spoke, on-road

---

\(^9\) Should the U.S. EPA’s proposed off-road diesel rule, issued in April 2003, be finalized, the option of diverting high-sulfur diesel fuel to the off-road market would be curtailed by 2010.
diesel production was a critical element of their business plan, so market exit was not a possibility. “The sulfur has to come out,” said a mid-size refiner executive, but it will be a “big investment from the individual refinery standpoint.” An executive at a smaller refiner stated, “We are going to make the fuels required by law.”

There still could be glitches. One discussant surmised that while most refiners will remain in the on-road diesel market at some level, some may not remain at previous production levels, leading to local price disruptions until the market rebalances. Engineering, planning, and construction representatives noted that operating companies were waiting much longer to make decisions regarding their ULSD compliance strategy (corporate restructuring was seen as a contributing factor here), promoting concern that adequate equipment and personnel might not be available in time if there was a last-minute rush. One participant warned: “We can’t let things get out of hand. This country does not run without diesel. Without diesel things come to a screeching halt, as California found out.” But, he also admitted, “Whenever there was a problem in the past, we managed to cover it.” Speaking about the supply of equipment and services, a provider executive concluded, “I think they will manage.” Should shortages become too acute or widespread, most discussants seemed to expect that government regulators would again step in and waive the rules, even if this penalized timely compliers.

INDUSTRY VIEWS OF POLICY AND REGULATION

As we have seen, the views of the U.S. refining industry vary greatly on the merits and implications of regulation. This heterogeneity can be expected given the diversity of the industry in terms of company size, asset base, business model, and markets served. Such diversity of views also exists within firms. “Right now we are debating internally where we should be on the vision side,” a manager at an operating firm observed about its stance regarding environmental protection.

Some refiners whine [about regulation]. In the long run, it introduces business risk, but it is also business’s friend.

—Operating company executive

Firm size does not appear to determine one’s position on regulation. Opinions on regulation did differ depending on role. Technology suppliers and academic researchers generally suggested that more could be accomplished on the environmental front than did their counterparts in operating companies or industry
associations. It was noted that environmental regulations have a favorable impact on researchers and suppliers because they create demand for advanced technologies and services. Indeed, one technology supplier felt that his opinion on environmental regulations was “diametrically opposed” to those of operating companies, because it represented a steady business opportunity for his firm. “Change is good,” said one engineering, planning, and construction executive.

Several technology suppliers noted, however, that it was prudent to be guarded regarding the implications of regulation: When developers promote the capabilities of their technologies, they may motivate regulators to set even more stringent rules. One supplier representative described this as “tightrope walking” because he did not want to alienate his customers—the operating companies. Another technology supplier representative explained that his firm had concluded that sulfur reduction in gasoline would cost only 1–2 cents per gallon, whereas the industry leadership and others had estimated costs would be 5 cents or more. “We have to be very careful that we don’t come off helping set standards that are noxious to refineries.” Another supplier was reticent about talking about his firm’s technology capabilities altogether: “We make our living on technology. Sometimes we are not aligned with our clients.” He continued by acknowledging the stringent environmental regulations and the hard economic times experienced by his customers, adding, “We are trying to alleviate a very depressed situation.”

It’s very unusual when two companies agree, let alone forty. As an industry, we are our own worst enemy.... This industry just does not trust itself.

—Refining executive

Interestingly, industry executives repeatedly pointed to the lack of unity in the industry on environmental issues, among operating companies as well as between operating companies and their suppliers. “We are fractured as an industry right now,” one executive observed, referring to industry debates about the merits of ultra-low-sulfur standards. Several discussants asserted that a lack of unity in the refining industry on environmental issues was a reason for its losses on key regulatory issues such as the Renewable Fuels Standard, MTBE phase-out, and desulfurization. “The industry has a poor track record on talking to government,” concluded one refiner executive. Discussants repeatedly pointed to automobile manufacturing as a more cohesive sector, as more savvy in dealing with the government, and as more connected with the public. In contrast, they generally felt that the refining industry had done a poor job of promoting its interests, often appearing reactive or defensive. Unity, however, is not just a
matter of will power. Refining industry cleavages are partly a function of the much larger number and greater diversity of actors and greater variation in regional products markets in the sector compared with automobile manufacturing.