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PREVENTING AN ENERGY CRISIS IN THE 1990s

We have seen the cycle before. The world's appetite for oil grows to a point where production levels approach capacity. Oil prices rise, their rate of increase growing as the market becomes tighter. Taking advantage of the tight market, one or more supplier countries may try to use their valued commodity for political purposes by cutting off supply, prompting further price increases.

Since petroleum is essential to the production of many manufactured goods, the price hike causes price increases on many consumer goods as well. And the world economy falters as global wealth is simultaneously eroded by inflation and redistributed to oil-producing nations, leaving oil-consuming countries with less capital to invest in their continued economic productivity.

Countries respond to the oil crisis with crash programs to promote energy conservation, to switch from petroleum to other fuels, to explore for new sources of oil, and to develop synthetic fuels. The combination of depressed global economic growth, conservation measures, and new sources of supply then causes oil demand to drop. Production falls to a fraction of previous levels. Oil prices stabilize and eventually fall. Inflation rates decline. Slowly, national economies begin to recover, helped in part by conservation-induced increases in productivity. With memories of the crisis fading, commitments to reduce oil dependence relax. And the world's appetite for oil begins to grow once again.

This phenomenon first reached crisis proportions in 1973. Oil demand pushed OPEC production levels in excess of 80 percent of capacity, providing Arab members with a tool by which they could vent their displeasure with the West. Their ensuing oil embargo led to prices almost quadrupling, recession, and worldwide efforts to reduce oil dependence.

Nevertheless, by 1978, just five years later, global oil consumption levels were once again on the rise, this time pushing OPEC production levels close to 90 percent of capacity. And the effects of the cycle that followed—exacerbated by the loss of Iranian oil after its revolution—were both more severe and more enduring than the first. Many nations of the world, particularly those in the developing world, have yet to recover from the recession into which they were plunged at that time. And the oil glut that followed has lasted so long it is threatening the economies and stability of friendly supplier nations.

Clearly, the past two crisis have taken their toll; a third would likely deliver even more damage. Unfortunately, the seeds of a third crisis cycle are already being planted. At one time, expectations of sustained conservation efforts had led analysts to project a decline in oil use by industrialized countries in the years ahead. But now global conservation efforts are beginning to relax, leading the Department of Energy (DOE) to forecast that oil demand

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FIGURE 1
OPEC PRODUCTION TRENDS

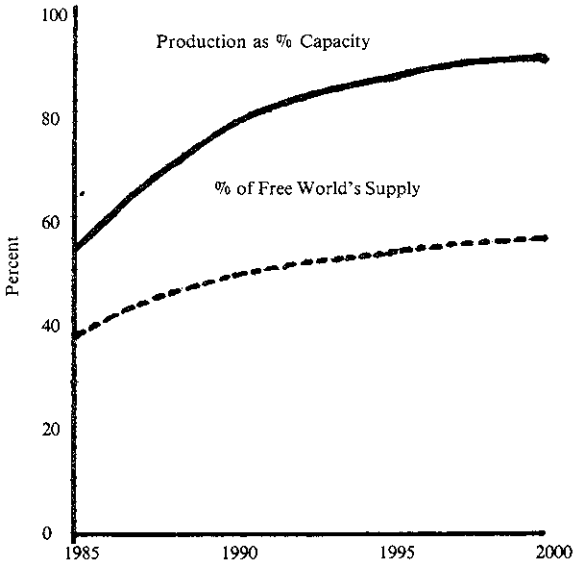
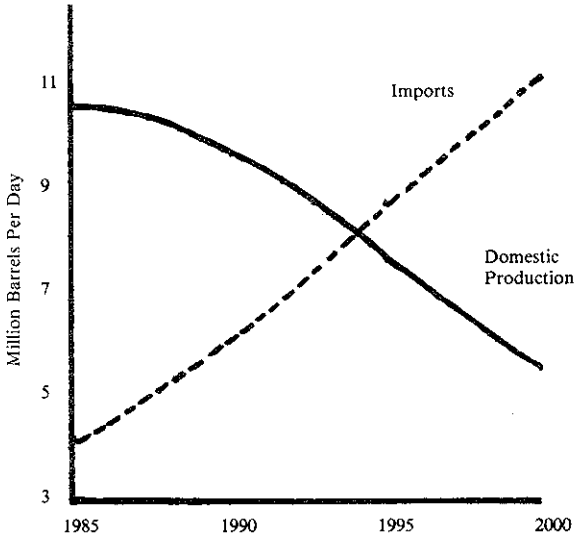


FIGURE 2
U.S. OIL TRENDS



Extrapolation of projections by EIA, DOE, and OTA indicate the reemergence of OPEC as the major world oil supplier (Fig. 1) at the same time that U.S. production capability is expected to decline and U.S. imports to reach unprecedented levels. (Fig. 2)

(Continued from page 1)

by the industrialized world, as it shifts its economic structure from an industrial to a less energy-intensive, service-oriented base, will merely remain level through the end of the century. Furthermore, as the economies of developing nations recover, their oil demand is expected to mushroom by 75 percent by the year 2000, according to DOE.

Where will the oil supply to meet the expected increase in demand come from? The United States is certainly not a possibility; its petroleum production is projected to fall sharply in the next fifteen years, from more than ten million barrels a day (MMBD) today to perhaps as low as five. Instead, it is OPEC, whose members sit on most of the world's remaining oil reserves, that appears the most likely supplier. If demand grows as expected, this cartel's production levels could be reaching 80 percent of capacity by the early 1990s and 90 percent by the end of that decade.

THIRD OIL CRISIS

Thus, the world is likely to be suffering through its third oil crisis cycle some time in the 1990s. But a well-planned and sustained strategy today of reducing oil dependence could buffer the boom-and-bust nature of this expected cycle, preventing both the skyrocketing prices that have threatened oil consuming countries and the plummeting prices that now threaten oil suppliers. By closely controlling oil demand, production levels could be kept low enough to prevent disruptions in supply from inducing global recession, but high enough to maintain adequate economic growth for supplier nations.

Critical to such a strategy is special attention for the world's light vehicle fleet which, unlike other oil consumers, relies almost entirely on petroleum products for its power and has few fuel-switching options available to it in the short term. 530 million automobiles are expected to be on the road in 2000, 60 percent more than in 1980. And light vehicles are expected to account for one-quarter of the Free World's oil use at that time.

With the cost of synthetic liquid fuels still prohibitively high, the most cost-effective means of reducing the petroleum dependence of light vehicles is to improve their efficiency. Efforts were made in the 1970s by governments of industrialized nations to improve the fuel economy of new light vehicles, but in recent years world leaders, led by the U.S., have turned increasingly to the "market" to drive further progress. And while the technical potential for achieving fleet fuel economies over the next decade in the 40 to 60 mile per gallon (mpg) range has been well established, today's oil prices are not high enough to stimulate this achievement.

No one would benefit more from a concerted effort to improve fuel economy than the United States, where transportation needs account for more than 60 percent of oil use. Without amelioritive action, liquid imports to this country promise to reach an unprecedented 10 MMBD or more by the end of the century, exploding the import bill from less than $50 billion today to over $200 billion (1984 $).

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Even more important, a domestic fuel economy strategy would prove a boon to the U.S. automotive industry both in the short term as it meets the competitive challenge of foreign automakers and in the long term as it meets the challenge of renewed consumer demand for fuel economy. At present, the industry is poorly positioned to meet either challenge well. Over the next five years, its share of domestic sales is considered likely to shrink substantially as it is undercut in price by many Third World companies and bested in technology by Japanese firms. This import challenge will not be in larger cars but in smaller, more fuel efficient models. A national fuel economy policy would therefore push domestic automakers to improve the very models most threatened presently by competition. In addition, both Japanese and European companies are better prepared in technology development at present than their American counterparts to meet the high fuel economy needs of the next decade, a situation a national fuel economy law could also remedy.

CRITICAL DECISION POINT

The world now stands at a critical decision point. Either it can choose to relax governmental conservation efforts and let the market carry us into a third oil crisis, or it can adopt a long term strategy—which would include fuel economy targets—to control oil demand and stop the crisis from developing. At stake is the political stability of many oil consuming and supplying nations and the health of the world's already battered economy.

The United States will play a pivotal role in this decision. As the world's largest oil consumer, adoption of fuel economy goals for its future light vehicle fleet alone could reduce its own imports ten to twenty percent by the end of the century. Moreover, such a policy would prove a boon both to its balance of trade and its automotive industry in the years ahead. And as a world leader, U.S. action would undoubtedly prompt other nations to follow.

THE OIL SUPPLY FUTURE: BACK TO THE 1970s

There is little doubt that oil supply and demand patterns have changed markedly since the last oil crisis. Between 1979 and 1983, some 3.1 million barrels per day (MMBD) of additional oil production from non-OPEC, non-communist sources were brought on line. Even more significant, the oil consumption levels of the 21 signatory nations of the International Energy Agency (IEA) decreased 6.2 MMBD. (The IEA was formed to coordinate global oil independence efforts after the Arab oil embargo.)

Oil Consumption Trends To Change

But many of these changes are merely transitory. A major reason for today's reduced global oil demand has been the failure of the world community to recover from the recession into which it was plunged after the last crisis. When economies stagnate or decline, industrial activity and transportation needs are reduced and thus so are energy requirements. Only a few industrialized nations, most notably the United States, and some Asian developing countries have enjoyed moderate economic growth in recent years. Most nations, however, especially those in the Third World, have been plagued by low and even negative growth.

For reasons of political stability, many analysts believe this stagnation cannot and will not be allowed to continue for any length of time; indeed, even the strictly non-interventionist Reagan Administration has begun to endorse moves to stimulate world economic growth. Therefore, recent projections of future energy use by both the Department of Energy (DOE) and the Energy Information Administration (EIA) have assumed the restoration of economic growth worldwide. As a result, DOE projects Third World oil use will grow by 75 percent between 1985 and 2000.

(Continued on page 4)

This report on automotive fuel economy is written by Deborah Bleviss, FAS Associate Director for Energy and Environment and is drawn from a study she is currently conducting on the future of automotive fuel economy and its implications for the world's oil market and the automotive industry. Copies of this study should be available by the end of the year. Deborah Bleviss is the Bernard Schwartz Fellow for Energy and Environment.

Deborah Bleviss testifying before the House Subcommittee on Energy Conservation and Power, September 19, 1985.

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Another factor signaling changes in consumption trends is the slowing by many nations of their conservation and fuel-switching efforts. Perhaps the best example of this can be seen in fuel economy policies: during the 1970s, the U.S., Japan, and numerous major Western European nations established fuel economy improvement targets for 1985. New fleet fuel economies rose to the high 20s (in mpg) for automobiles and the low 20s for light trucks as a result. However, except for France, new targets for the post-1985 era have not been established by any of these nations. With today's low oil prices holding little promise on their own of pushing future efficiency, DOE has projected auto fuel economy in the U.S. to rise only ten to twenty percent over the next 15 years, to the low 30s (assuming no intervening crisis, of course). Relaxing conservation efforts have led both EIA and DOE to project that oil use by the industrialized world will remain relatively stable in the years ahead rather than decline as some earlier estimates had forecast.

OPEC's Strength to Reappear

The combination of rapid growth in oil demand from the Third World and non-declining petroleum use by the industrialized world means that overall oil consumption in the Free World will grow by some 20 percent between now and the turn of the century, according to DOE forecasts. Where will that extra oil come from? Despite major efforts to identify new non-OPEC oil resources over the past decade, two-thirds of today's known reserves remain within the borders of OPEC member countries. In short, OPEC can be expected to re-emerge as a critical world petroleum supplier. If current trends persist, by the year 2000, this cartel will supply more than 55 percent of the Free World's oil, compared with less than 40 percent today.

OPEC's re-emergence will be assisted by another development—a dramatic decline in U.S. production capability. Since 1978, when rapid increases in oil prices prompted widespread oil exploration efforts, much hope has been hinged on the promise of the Outer Continental Shelf as a future source for domestic oil. But drilling results have been disappointing, recently leading the U.S. Department of the Interior to lower previous estimates of economically recoverable offshore oil by 55 percent. Analysts at the Congressional Office of Technology Assessment (OTA) have projected this decrease to mean that U.S. production will fall from 10 MMBD presently to between 7 and 4 MMBD by the turn of the century.

Increased Oil Imports

With the U.S. production on the decline, imports will be increasingly required to meet domestic oil requirements. If the OTA estimates are correct, by the year 2000 imports could be between 9.5 and 12.5 MMBD, surpassing the previous record set in the late 1970s of 9 MMBD. And extrapolations of DOE and EIA price projections indicate the bill for these exports could be in excess of $200 billion (1984 $), one-third more than today's already worrisome merchandise trade deficit.

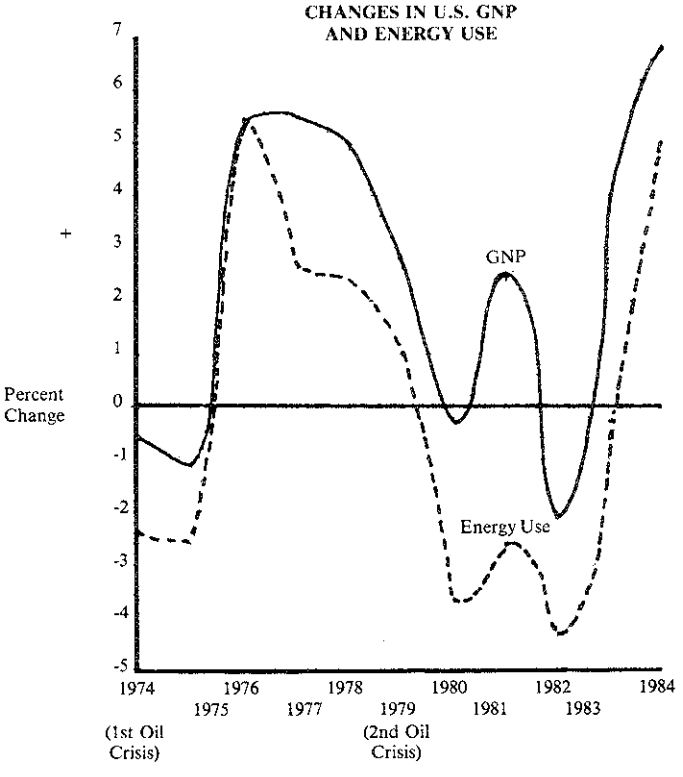
Options for Action

While present trends indicate a return to the turbulent oil market of the 1970s, actions taken today could prevent such an occurrence. All energy-consuming sectors need to be included in this endeavor, but the transportation sector is a good place to start, it being the most vulnerable to oil crises. And improving the efficiency of transportation use remains at this point the easiest and least expensive way to proceed.

There is presently a bill in the U.S. House of Representatives that would require new light vehicle fuel economy in 1995 to rise to 45 mpg for automobiles and 35 mpg for light trucks. If the U.S. were to embrace such a proposal and the rest of the world to follow—as it did in large part after the U.S. set fuel economy goals in the 1970s—global oil consumption could be lowered by some 3 MMBD by 2000. This savings would largely offset the expected loss in U.S. production capabilities.

Even greater improvements in fuel economy are possible, however. A report in 1980 by the U.S. Solar Energy Research Institute (SERI) found that cost-effective and technologically feasible levels of 60 mpg or more for new automobiles were achievable by 1995. If these targets were implemented worldwide, along with similarly aggressive targets for light trucks, oil savings could be 5.5 MMBD. And savings of this magnitude would reduce OPEC production levels at the end of the century below 80 percent of capacity, the figure generally considered the threshold at which oil price hikes appear.

FIGURE 3
CHANGES IN U.S. GNP AND ENERGY USE



Economic growth has a major impact on energy demand; as demonstrated by recent U.S. trends, energy demand has generally risen and fallen with the economy.

THE PROMISE OF FUEL ECONOMY

Over the past decade, the United States has achieved a remarkable accomplishment: the fuel economy of its new automotive fleet has almost doubled from 14 mpg to more than 26 mpg, approaching the efficiency levels of its Western European and Japanese counterparts. Are greater strides possible? The answer from research laboratories around the world is most assuredly yes, for the electronics and materials advances of the past ten years are now spawning an explosion of new "high technologies" applicable to light vehicles.

Improved Fuel Efficiency

Electronic controls are being developed for gasoline engines that will enable very lean, "gas-sipping" fuel-air mixtures to be burned, and new, more efficient gasoline combustion methods are being explored. At the same time, the performance of diesel engines, a common customer complaint in the past, is being improved, making them more attractive to new car buyers. Moreover, techniques are being pursued to increase the fuel economy of these already efficient engines. The most exciting of these is the replacement of metallic engine parts with heat-insulative ceramic ones. Conceivably a completely ceramic engine will be on the market one day which, when coupled with a waste-heat recovery system , will offer fuel economy as much as double that of today's diesels.

Vehicle transmissions are also seeing many changes. The efficiencies of previously-guzzling automatic transmissions are now approaching those of manual transmissions. At the same time, new types of transmissions are under development that seek to combine the convenience of automatics with fuel economy superior even to that of manuals. Perhaps the most celebrated of these is the continuously variable transmission which provides jerk-free driving while enabling the engine to operate at its optimum efficiency.

In addition, advances in aerodynamics are leaving cars looking sleeker and better able to cut through the air while burning a minimum of fuel. And new, lighter materials are being applied to cars. Plastics are beginning to replace steel in the body panels of automobiles and may eventually make up most of future body structures. At the same time, aluminum and magnesium seem destined to replace many steel and cast iron parts in engines and drivelines. Finally, flywheel energy storage devices are being developed that will enable engines to be turned off when vehicles are decelerating or idling; eventually they may even be able to recapture energy that is lost in braking. (A review of fuel economy development now being undertaken by the world's automotive industry is shown in Table 1.)

High Fuel Economy Prototypes Being Built

What levels of fuel economy can be delivered with these new technologies? In the past, the answer to such a question could only be based upon computer models and simulations. But in recent years, high efficiency prototype cars have actually been built, largely by European manufacturers, that incorporate many advanced technologies. They have average fuel economies generally in the range of 60 to 80 mpg, with a few actually nudging 100 mpg (see Table 2). And these prototypes do not even incorporate the most advanced technologies presently under development, for example, ceramic engine parts or energy storage systems. Conceivably, with these more advanced technologies, fuel economies in excess of 100 mpg may be achieved.

The technology revolution not only promises to deliver high fuel economy, it may also solve some of the problems presently associated with high fuel economy, namely poor performance and comfort, safety and emissions tradeoffs, and high costs. With the use of light materials, vehicles

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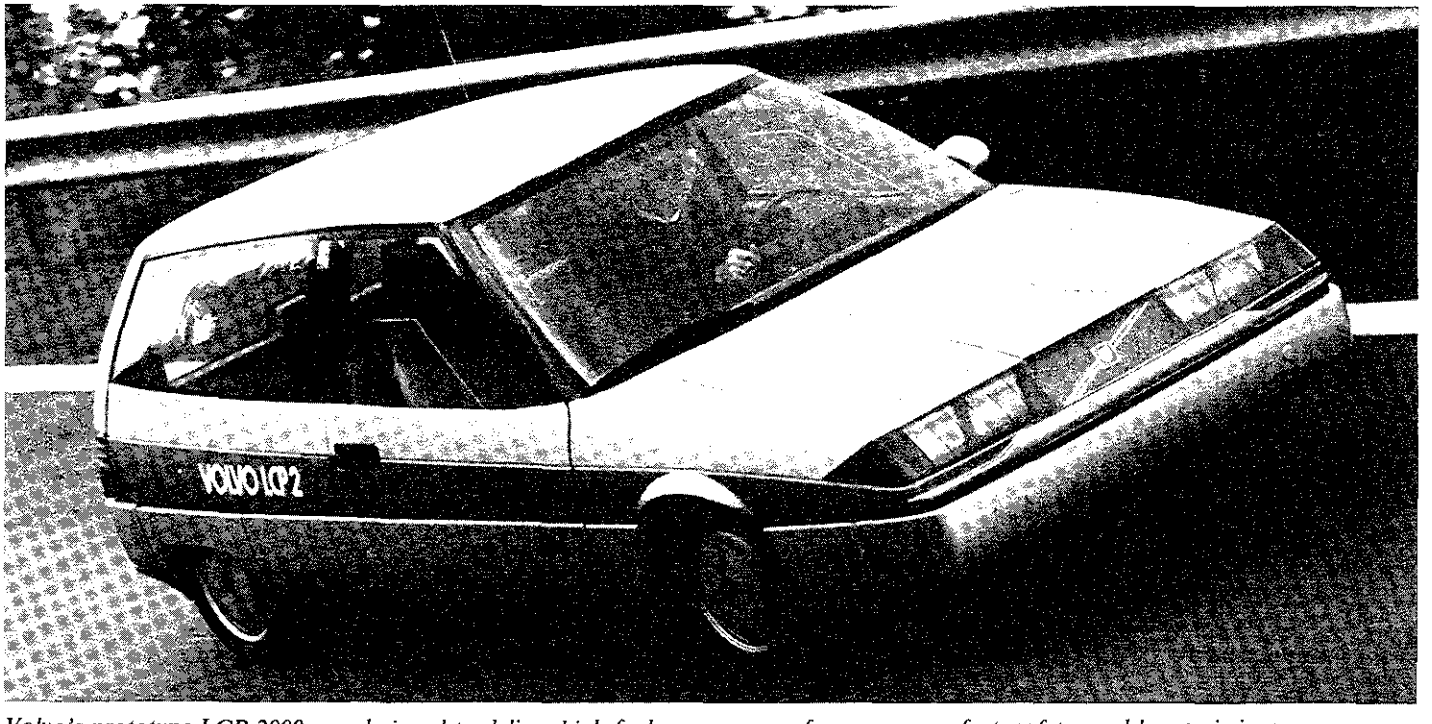

Volvo's prototype LCP 2000 was designed to deliver high fuel economy, performance, comfort, safety, and low emissions.

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need no longer be small to have good fuel economy; many of the prototypes mentioned previously seat four or five, adequate sizing since 80 percent of all automobile trips have two or fewer individuals in the car. Less weight also helps acceleration; the Volvo prototype accelerates from 0 to 60 miles per hour (mph) in 11 seconds; in contrast, today's highly popular automatic Chevrolet Cavalier takes more than 17 seconds.

Stronger light materials can also increase safety. The Volvo prototype was built to withstand front and side impacts of 35 mph and rear impacts of 30 mph, vastly more stringent requirements than the crashworthiness test presently applied to cars—withstanding a frontal collision of 30 mph. In addition, better combustion techniques promise to limit emissions problems, particularly those of diesel engines; at the same time, new "aftertreatment" technologies have been introduced by both Mercedes Benz and Volkswagen that enable even their larger diesels to meet California's tough new diesel particulate emissions standards.

But perhaps the most exciting of technology strides has been in manufacturing and assembly techniques, for these promise to lower assembly costs and thus offset the higher costs of many fuel efficient technologies. Expectations of lower assembly costs have led Volvo engineers to project that their high fuel economy prototype could be produced at the *same* cost as today's average subcompact at a remarkably low "breakeven" rate of 20,000 vehicles a year.

Thus the potential for high fuel economy is great. But will it be realized? The answer to this question depends on three factors: expectations of the oil supply future by governments and industry alike, perceptions of the other benefits that introduction of these technologies would bring, and perhaps most importantly, the willingness of companies to risk introducing new products.

TABLE 1
ADVANCED FUEL ECONOMY INNOVATION CURRENTLY BEING UNDERTAKEN BY AUTOMOTIVE COMPANIES

TECHNOLOGY	INNOVATION	REGIONS INVOLVED IN DEVELOPMENT	COMPANIES INVOLVED IN DEVELOPMENT	DEVELOPMENT STATUS
Engines	Direct Injection Diesels	Japan	Isuzu	2.5 liter engine in production, 1.5 liter engine being tested.
		Europe	Ford	2.5 liter engine in production.
			Volkswagon, Peugeot, Fiat, Volvo, Renault	In pre-production prototype cars.
		U.S.	Ford	2.4 and 1.3 liter engines being tested.
	Ceramic Diesels	Japan	Isuzu	Ceramic hot plug & glow plug in production cars.
			Toyota	Ceramic hot plug in production cars.
		Europe	Opel	Prototype under development.
		U.S.	Ford	Research.
	Ultra-Lean-Burn Engines	Japan	Toyota	Pre-production prototype engine.
			Honda, Mitsubishi, Mazda	Research.
		U.S.	Ford	Research.
	Variable Displacement Engines	Japan	Mitsubishi	Orion engine in production.
			Toyota	Installed in prototype FX-1.
		Europe	Porsche	Research vehicle testing.
Transmissions	Advanced Discrete Gear Transmissions	Japan	Isuzu	NAV15 5-speed automatic in production.
			Honda	Hypershift semi-automatic in production
		Europe	Renault	Prototype 5-speed automatic.
	Continuously Variable Transmissions (CVT's)	Japan	Subaru	Introduction in production Justy planned for Spring '86.
		Europe	Ford, Fiat	Installed in prototype Ford Fiesta & Fiat Uno, production decisions pending.
		U.S.	Ford, G.M.	Research.

ADVANCED FUEL ECONOMY INNOVATION CURRENTLY BEING UNDERTAKEN BY AUTOMOTIVE COMPANIES CONT'D

TECHNOLOGY	INNOVATION	REGIONS INVOLVED IN DEVELOPMENT	COMPANIES INVOLVED IN DEVELOPMENT	DEVELOPMENT STATUS
Advanced Aerodynamics (Drag coefficient, or C_D, (below .30)		Japan	Subaru	Production car has C_D of .29.
		Europe	Renault	Production car has C_D of .28, lowest worldwide. Prototype car has C_D of .22
			Peugeot	Prototype car has C_D of .18
			Volkswagen	Prototype car has C_D of .25.
			Volvo	Prototype car has C_D between .25 and .28.
			British Leyland	Prototype car has C_D of .25.
		U.S.	Ford	Probe V has lowest prototype C_D .137, no production plans for low C_D.
			G.M.	Prototype car has C_D of .18.
Advanced Materials Substitution	Plastics Substitution	Japan	Honda	Production CRX has thermoplastic body-panels on 40% of panel area.
			G.M.	Production Fiero has skin entirely of plastic.
	Magnesium Substitution	Europe	Volvo	Prototype LCP 2000 has magnesium wheels, chassis and engine block.
Accessories	More Efficient Air Conditioning	U.S.	G.M.	Variable displacement air conditioning in production.
		Japan	Nissan	Thermal ray reflecting glass in production that lowers a.c. load 12%.
			Toyota	Electronically controlled air conditioner under development
Energy Storage	Flywheel Stop-Start Systems	Japan	Nissan	In pre-production stage.
		Europe	Volkswagen	Production ready, awaiting decision.
	Flywheel Storage Systems	Japan	Toyota	Research.

THE DOMESTIC AUTO INDUSTRY: ILL-PREPARED FOR NEW CHALLENGES

In the final years of this century, the domestic automotive industry faces two of the toughest challenges it has ever confronted: withstanding the competitive heat of imports slated to be introduced in the U.S. market over the next few years, and meeting consumer demand for fuel economy and alternative fuels as oil supplies become tighter and more expensive in the 1990s. Presently, the industry is prepared to meet neither challenge effectively. And the reason lies in its reluctance to move aggressively forward with the development of advanced technologies, especially fuel economy innovations.

That the domestic industry is according low priority to fuel economy comes as no surprise. Earlier this year, the two largest automakers, General Motors (GM) and Ford, requested and were granted relief from meeting the modest 27.5 mpg automobile fleet federal fuel economy standard for 1986 that was set back in 1975. Domestic manufacturers point to diminishing consumer demand for fuel economy to justify their actions. And there is no doubt that consumer interest in fuel economy has changed in recent years. Rather than seek fuel economy to the detriment of other desires such as performance and comfort—as happened in the early 1980s when sales of subcompacts and diesels were at their peak—consumers are now asking for performance, comfort, and fuel economy. Thus, instead of buying subcompacts, they are buying roomier, but still efficient, compacts.

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This same phenomenon of relaxing consumer preoccupation with conservation is being seen in other countries as well. In Japan, for example, companies such as Toyota and Mitsubishi are having difficulty meeting their own, more stringent, fuel economy targets because their customers want more automatic transmissions and air conditioning. And in Europe customer demands are on the increase for high performance engines.

But manufacturers abroad have not responded to these new consumer wishes in the same way as American companies. For example, rather than delivering performance by switching to larger six- and eight-cylinder engines, as many American companies are doing, they are turbocharging smaller four-cylinder engines, a more efficient, albeit more advanced, approach.

More importantly, unlike their American counterparts, foreign manufacturers have generally not relaxed either their highly efficient prototype development nor their pursuit of new fuel economy technologies. As a result, they have largely surpassed their U.S. competitors in the development of these new technologies, as shown in Table 1. While they may be reluctant to put many of these developments into production at present, this lead undoubtedly means foreign manufacturers will both be introducing these technologies sooner than American producers and be better prepared to meet consumer demand for high fuel economy when it reappears.

Fuel Economy Has Multiple Benefits

Why is fuel economy development still being pursued abroad? First and foremost, foreign automakers see multiple benefits deriving from these technologies that justify their pursuit even though consumer interest in fuel economy has dropped. The use of new light materials, for example, delivers not only good fuel economy but better vehicle durability. Continuously variable transmissions are not only efficient but more comfortable than today's jerk-prone automatics. And all of these technologies yield an image of a company at the "cutting edge" of technology, an important marketing tool.

In addition, foreign manufacturers, largely as a result of the historic dependence of their countries on imported oil, have always appreciated the need to use this fuel sparingly. In contrast, American manufacturers have seen this country's rich resource base as adequate protection against oil crises—when domestic oil supplies disappear, they believe synfuels produced from domestic coal and oil shale will take their place.

Unfortunately, the present lag in the development of advanced fuel economy technologies by American manufacturers will not help their competitive standing. And future competition in the U.S. market is expected to reach an intensity heretofore unseen. Both Japanese and Western European companies have home markets with little potential for growth; thus, greater efforts can be expected in the years ahead, especially by the financially-sound Japanese, to market their products abroad, both in the U.S.—where the potential for market acceptance of their products has long been recognized—and in the developing world. Introduction of new technologies in the sophisticated U.S. market will doubtless gain these companies valuable market shares.

In addition, several Third World and Eastern Bloc manufacturers, most notably those in South Korea, Brazil, and Yugoslavia, will be introducing their low-cost products to the U.S. market. Hyundai of South Korea has already successfully been selling its subcompact Pony for a couple of years in Canada where the car recently assumed the status of the top-selling model, imported or domestic, in the country.

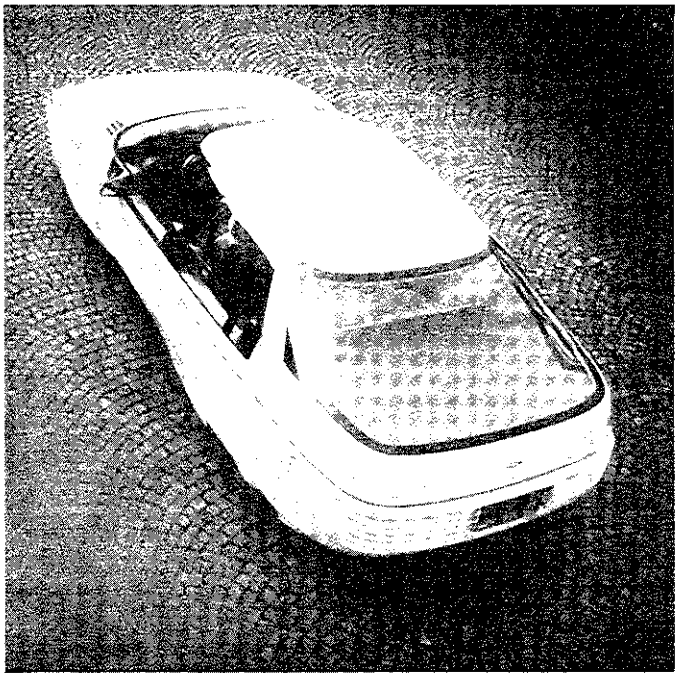
U.S. Producers Not Prepared for Competition

Early signs are that American producers will not stand up well either in technology or in price to this increased competition. Since April of this year when the Japanese Voluntary Import Restrictions were lifted, the Japanese market share has risen dramatically, was from 14 percent to a high of 23 percent only three months later. A report by the U.S. Department of Commerce projects this trend to continue such that by 1988 imports will account for 36 percent of sales. And Chrysler recently announced it expects domestic producers to have only a 50 percent market share by the end of the decade, with imports taking 39 percent of the market and domestically-produced Japanese cars the rest.

The impact this loss of market share will have on employment will be enormous. Commerce officials have estimated a job loss of 100,000 by 1988 in the industry directly and possibly another 400,000 in the supplier industry. Obviously, these numbers will be higher still if the Chrysler estimates hold up.

Big 3 Have Projects to Increase Competitiveness

To their credit, domestic automakers have recognized they are poorly positioned at present to compete with imports. With manufacturing labor wages at least nine times greater than Third World competitors, they probably cannot ever compete with these companies. But the wage dif-



Ford's prototype Probe IV is one of the most aerodynamic light vehicles in the world.

ference between American and Japanese workers is only a factor of two. Thus, with great fanfare, the "Big Three" manufacturers have announced programs designed to yield by the end of the decade subcompacts that can compete in price, quality, and technology with their Japanese counterparts—GM's Saturn, Ford's Alpha, and Chrysler's Liberty.

Tremendous expectations have accompanied the announcement of these programs, particularly that of industry giant General Motors. Lately, however, industry insiders have begun to express doubts about whether these cars will indeed be "state of the art" even if they are able to match Japanese prices. According to the trade journal, *Automotive News (September 9, 1985),* "GM watchers say the Saturn car currently being developed is evolving as a relatively conventional vehicle built in a highly automated but relatively conventional plant. One insider calls it the 'leading edge of old technology' ". The lag by domestic manufacturers in the development of advanced technologies that offer fuel economy benefits no doubt is part of the reason for this change in expectations.

Should the projects of the Big Three fail to meet Japanese technology levels, it is quite likely the companies will cease domestic production of subcompacts, becoming instead distributors of cars produced abroad. Indeed, GM and Chrysler are already selling cars made in Japan under their own names, and Ford has announced plans to do the same for cars made in South Korea. With domestic production of subcompacts eliminated, domestic compacts will suffer. Since both cars share many common components, domestic producers will inevitably find the costs to produce compacts higher because economies of scale are no longer enjoyed. Thus, the rate of introduction of new technology in these cars can be expected to slow, further eroding domestic market shares.

Lack of Small Cars Will Hurt in 1990s

With no subcompact manufacturing base and an eroding compact base, domestic manufacturers could well find themselves in a position remarkably similar to the 1970s should oil supplies tighten at the end of the century. Consumers will once again be clamoring for fuel economy and U.S. automakers will be unable to provide either the car sizes or the technologies to meet this demand.

TABLE 2

HIGH FUEL ECONOMY
LIGHT VEHICLES

Company	Model	No. of Passengers	Weight (lb)	Max Power (hp)	Fuel Economy (mpg*)	Innovative Features	Development Status
GM	TPC (gasoline)	2	1040	30	68 city/95 hwy	Aluminum body and engine.	Prototype complete, no production plans.
British Leyland	ECV-3 (gasoline)	4-5	1460	72	46 city/67 hwy	Plastic panels	Prototype complete.
Volkswagen	Auto 2000 (diesel)	4-5	1716	53	63 city/71 hwy	DI diesel with plastics and aluminum substitution, flywheel stop—start.	Prototype complete.
	VW-E80 (diesel)	4	1540	29, 38**	74 city/99 hwy	Modified 3-cyl DI diesel Polo with flywheel stop-start.	Subject of ongoing research, possible future commercial application.
Volvo	LCP 2000 (diesel)	2-4	1555	39, 66	63 city/81 hwy	Extensive magnesium use, 2 DI diesels developed, one heat insulated.	Prototype complete, adaptable to production.
Renault	EVE+ (diesel)	4-5	1880	50	63 city/81 hwy	Supercharged DI diesel, engine stop—start, low C_D	Prototype complete.
	VESTA (gasoline)	2-4	1124	32	104 city/124 hwy	Light materials substitution, low C_D.	Development on-going.
Peugeot	VERA 2 (diesel)	4-5	1740	62	51 city/67 hwy	Light materials substitution, low C_D.	Prototype complete, DI diesel VERA + under development.
	ECO 2000 (gasoline)	4	990	28	78 city/99 hwy	2 cyl gasoline engine, light materials substitution, very low C_D.	Development on-going.
Honda	CRX (gasoline)	2	1713	60	51 city/67 hwy	Plastic body panels, lean-burn engine.	Production vehicle.

* Normalized to U.S. EPA test
** With supercharger

A PRESCRIPTION FOR U.S. POLICY

The trends just described make very clear that the U.S. is looking down the barrel of a shotgun. At stake is future national security, the health of the domestic and global economy, and the stability of a major U.S. industry. Also clear is the fact that the "market", acting alone, has neither the long term perspective nor the predictive skills to warrant leaving the future entirely in its hands.

A New Standard Is Needed

What then is needed? First, it is time to examine the efficacy of a new U.S. fuel economy standard for 1995. This is not a politically popular idea in today's anti-regulatory environment. Nevertheless, it is a prudent step. Many benefits that will be badly needed in the years ahead were derived from the 1975 law, which set standards rising to 27.5 mpg for 1985 and all subsequent years. Most obviously, this law, in conjunction with rising energy prices, led to a substantial energy savings, amounting to 20 percent of the oil reduction realized by IEA countries in recent years. It also prompted other industrialized nations to establish their own fuel economy targets, thereby multiplying energy savings. And it pushed the industry to prepare for the day when consumer demand for fuel economy would rematerialize; without this law, the domestic industry would undoubtedly have been plunged into an even deeper recession than it suffered after the second oil crisis.

The 1975 law had two other important impacts that, while enjoying less attention, played an important role in enhancing the competitiveness of the domestic industry. First, it removed much of the uncertainty about the future from automakers. They had a clear target to work towards and did not have to rely on guesses about the see-sawing oil market and its resultant impact on consumer demand. Thus, they did not have to adopt the exorbitantly expensive strategy of planning and developing products for a range of contingencies, as they are doing today. As a result, they had capital available to develop innovative new products, such as Chrysler's minivan, that established important new market niches for themselves in an increasingly competitive market.

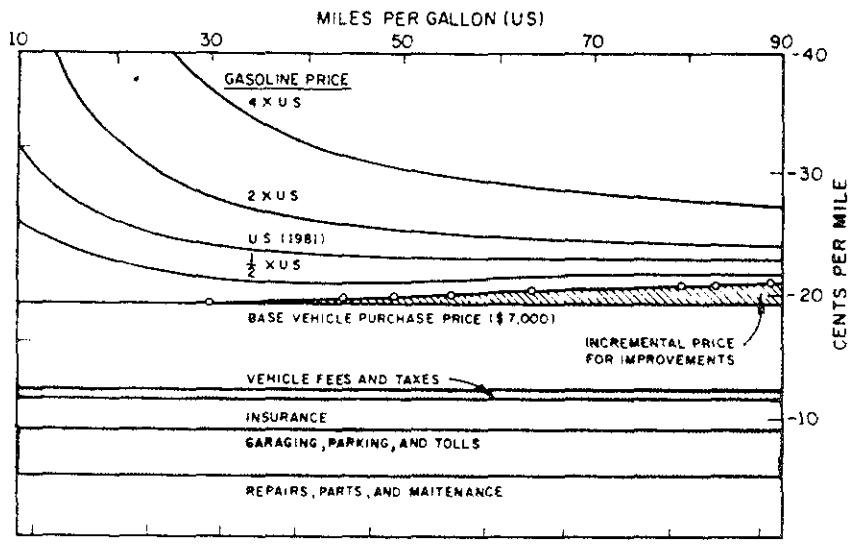
Second, the 1975 law forced domestic producers to accelerate their rate of introduction of new technologies such as front-wheel drivelines, fuel injection, and four-speed automatic transmissions with lock-up clutches. This enabled the traditionally risk-averse industry, usually hesitant to introduce new products, to maintain a "state of the art" image at precisely the time the risk-taking Japanese industry was surging ahead with its technological development.

Measures to Deliver Consumer "Push" Important

A new standard for 1995, modified somewhat to correct some of the problems with the old standard, would undoubtedly deliver these same benefits over the next decade. But such a standard, by itself, is not sufficient. For as much as automakers need to be pushed to make fuel-efficient vehicles, they also need to be assured that consumers will consistently demand such vehicles. Many have proposed a tax on gasoline to accomplish this task. But while a fuel tax may have other virtues, its prospects for prompting consumers to buy cars with very high fuel economy are limited. Though consumers see a monetary benefit whenever the fuel economy of their cars is improved, the effect in going from the 14 mpg car of a decade ago to today's 26 mpg car is much greater than in going from today's car to a 45 mpg car of tomorrow. (It should be noted that while the individual consumer sees little effect, the cumulative effect for the nation as a whole is substantial.) This fact of diminishing returns explains why new car fleets in Japan and Europe enjoy only a few mpg advantage-over the U.S. fleet despite a factor of two difference in fuel prices.

An alternative to changing fuel prices is changing vehicle prices. During the last oil crisis, then President Carter endorsed such an approach with his proposal for a "gas-guzzler" tax and "gas-sipper" rebate." The rebate was

FIGURE 4
COST OF DRIVING (1981 U.S. CENTS)



This graph demonstrates the limitations of a fuel tax in promoting vehicle fuel economy. Developed by former FAS Chairman Frank von Hippel, it shows that reductions in fuel costs could more than offset the cost of fuel efficient technologies, even for fuel economies as high as 90 mpg. But while consumers may enjoy lower operating costs as fuel economy increases, once a car surpasses 30-35 mpg, the reduction in driving costs is barely noticeable, even if a fuel tax were levied that caused gasoline prices to double, an unlikely political event.

thrown out at the time on the grounds it would primarily go to the Japanese, and only a weak tax was enacted. With the fuel economy gap between the U.S. and Japan narrowed considerably since then, revisiting this proposal seems appropriate now.

R&D Policy Must Be Reassessed

Finally, the U.S. needs to reassess its research and development policy. When the Reagan Administration first entered office, it eliminated federal funding among academic and research facilities for all but the most basic of research in transportation fuel economy. Nor surprisingly, the domestic industry generally failed to step in and pick up that funding. As a result, the development of many promising efficient light vehicle technologies—adiabatic diesel and stratified charge engines, to name a couple—has come to a halt, even as this development continues abroad. And in some cases, foreign support has actually substituted for the cut federal funding, nurturing the development by U.S. institutions of such promising technologies as energy storage systems and continuously variable transmissions.

It takes five years to design a new car and ten years to turn over an existing fleet of cars. Thus, U.S. policymakers must act now if there is any hope of forestalling a third energy crisis as the century draws to a close or of preventing a major U.S. industry from going the way of the dinosaurs. □

NON-PROLIFERATION TREATY REVIEW CONFERENCE IN GENEVA—FAS REPORT

By David Albright and Andre Carrothers

This article was written by David Albright, FAS Research Associate and an official observer to the Non-Proliferation Treaty Review Conference, and by Andre Carrothers, Associate Editor of the Greenpeace Examiner.

On September 21 after a stormy all-night session, the Third Review Conference of the Non-Proliferation Treaty (NPT) in Geneva reached agreement on a final document reaffirming the worth of the NPT. The last obstacle to achieving the consensus of all 86 participants was the result of the regional war between Iran and Iraq. Iran demanded that the final document condemn an alleged Iraqi attack on an Iranian nuclear facility, which Iraq refused to admit it had attacked. After several hours of intense negotiation in which they appeared to be fighting their own version of the war, Iran succumbed to pressure from the neutral, non-aligned, and western nations. The compromise reached took the form of verbal statements attached to the back of the final document in which Iran and Iraq attacked each other and the conference ended at 5:20 Saturday morning.

Conference Successes

In spite of the volatile ending to this four-week long conference, achievement of consensus will do much to bolster declarations of the robust health of the treaty. The nonproliferation regime is strengthened and hold-out countries, like India, Pakistan, Argentina, Brazil, Israel, and South Africa, were further isolated.

Throughout the conference, the participants expressed strong support for the treaty as a way to stop the spread of nuclear weapons. The International Atomic Energy Agency (IAEA) safeguards system, in which signatories to the treaty open their nuclear installations to IAEA inspectors to ensure they are not being used for military purposes, also received strong support.

The United States, Sweden, Australia, and others made progress in convincing nuclear suppliers, like West Germany, Belgium, and Switzerland, to require customer states to accept safeguards on all their nuclear facilities and activities, commonly called "full-scope safeguards". The final document, according to Ambassador Dunn, head of the U.S. delegation, "tilts" toward full-scope safeguards. Calls from Canada and European non-weapons states for the nuclear weapons states to clearly separate their military and civilian nuclear programs and to increase the number of their peaceful nuclear facilities under IAEA safeguards were at least partially addressed in the final document. And, conference participants acknowledged that quite a lot had been done in promoting the peaceful uses of nuclear power.

Unfortunately, the arms control objectives of the NPT, according to the final document, remain unfulfilled. Each of the parties to the NPT has agreed in Article VI of the NPT to "pursue negotiations in good faith on effective measures relating to the cessation of the arms race at an early date and to nuclear disarmament." The final document declared that the nuclear weapons states should "make greater efforts" to comply with their Article VI commitments.

Test Ban

More significantly, the conference, except for "certain states," called for the resumption of the trilateral negotiations of the Comprehensive Test Ban Treaty (CTBT) "in 1985," and called on all the nuclear weapons states to participate in the urgent negotiation and conclusion of a CTBT as a matter of the highest priority in the Conference on Disarmament (CD). The CD meets regularly in Geneva and is the only multilateral forum in existence in which binding arms control and disarmament agreements are negotiated.

There was little doubt as to the identity of the "certain states." The Swedish Ambassador stated that the United States and the United Kingdom were absolutely isolated on these issues. Their position, stated in the final document, is that "deep and verifiable reductions in the existing arsenals of nuclear weapons" are the highest priority in the process of pursuing the objectives of Article VI.

The dispute over the CTBT was the most divisive one during the conference. The CTBT is the only arms control measure cited by nearly all the participants at the conference as a first step in fulfilling the obligations spelled out in Article VI and the preamble of the treaty which calls for an end to all tests and to "continue negotiations to this end."

(Continued on page 12)

(Continued from page 11)

Faced with United States and British intransigence on the CTB and other arms control measures, the neutral and non-aligned nations, led by Mexico, introduced three resolutions on the Wednesday before the end of the conference. These resolutions, all requiring votes, demanded a resumption of negotiations of a CTBT, a freeze on all existing nuclear arsenals, and an immediate moratorium on nuclear testing.

The vote on the resolutions did not take place for several reasons. The threat of a vote pressured the United States to compromise. A successful vote would have led to an embarrassing defeat for the United States. Some delegations, like Sweden, believed voting to be only a last resort tactic to pressure the United States and they considered the compromise that was reached stronger than a vote could have been. In the end, however, neither side was sure who would have won the vote. While a resolution demanding the resumption of test ban negotiations would certainly receive the necessary two-thirds majority, many countries could resort to the "safe" position of supporting the resolution while simultaneously acquiescing to parliamentary maneuvers designed to prevent the vote from taking place. In addition, neither side was ever really sure what the Soviet bloc would do.

Other Obstacles To Consensus

Lack of progress on arms control was not the only obstacle to achieving consensus. The last minute conflict between Iran and Iraq mentioned above was an outgrowth of a controversy over the Israeli bombing of the Iraqi research reactor in the early 1980s. Originally, the neutral and non-aligned nations wanted the conference as a whole to condemn Isarel for its action. Due to tough U.S. opposition, they retreated from this demand. Achieving the agreement on full-scope safeguards mentioned earlier was also difficult. And African and Arab countries also demanded that the conference call for an end to all nuclear cooperation by all states with South Africa and Israel. Again, staunch U.S. opposition led to a much weaker statement in the final document.

Several factors contributed to the compromises that made the final document possible. According to David Fischer, former IAEA Assistant Director for International Relations, there was a less confrontational mood than existed at the 1980 conference and a desire to avoid the fiasco of that review conference, which failed to reach consensus. More and more non-weapons states have come to see the NPT as an important security document. The treaty's value as a hedge against the spread of nuclear weapons to other countries was seen as so important that participants did not want to endanger it because of disputes over the spiraling superpower arms race. And many of the disputes at the previous review conference over the tightening of restrictions on nuclear exports by U.S. legislation and by the nuclear Suppliers Group, an informal committee of the principal nuclear supplier states, have been resolved or have become mute because of the drastic decline in the fortunes of nuclear power in recent years.

Whether the non-weapons states will continue to make compromises for the sake of the treaty is unclear. Several non-aligned delegations at this conference were unsatisfied with the compromise on the CTBT reached by their leaders.

NPT Renewal in 1995

The NPT is up for renewal in ten years. Various scenarios are envisioned for this painful transition, from enthusiastic and unanimous long-term renewal to demands for its renegotiation or amendment. One fact, however, is clear. Continued lack of progress on ending the arms race will only fuel efforts to amend or renegotiate the treaty, which many observers believe would be very difficult to accomplish. Some countries, like West Germany, Japan, and Switzerland, had to overcome significant domestic opposition to ratification in the mid-1970s. If demands for renegotiation or amendments prevail in 1995, factions within these countries or others, might seize upon the opportunity to oppose its continued application.

Ultimately, the superpowers hold the key to the survival of the NPT. The non-weapons states have proven their willingness to compromise for the sake of the treaty. It is time for the superpowers to do their part.

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