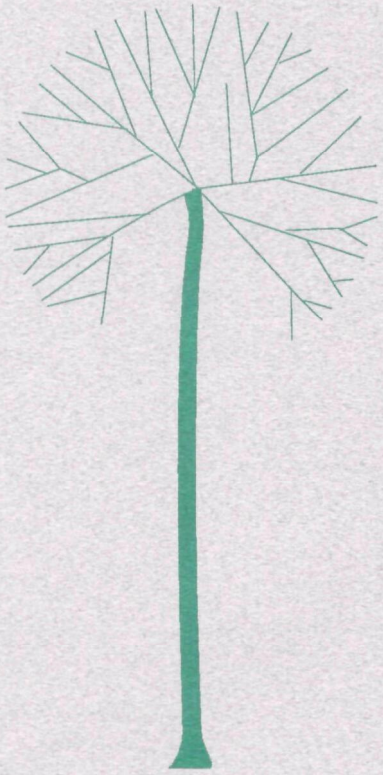
A Conference and Exhibition Sponsored by the U.S. Environmental Protection Agency

The Clean Air Marketplace

New Business Opportunities Created by the Clean Air Act Amendments

Summary of Conference Proceedings

April 22 - 23, 1992
Sheraton Premiere
Tysons Corner, VA



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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

July 24, 1992

To Participants in the Clean Air Marketplace Conference:

We are pleased to share with you this summary of the proceedings of the Clean Air Marketplace conference, convened by EPA and its cosponsors on April 22-23. We believe the conference was a big success in spreading the word both about the exciting business opportunities created by the Clean Air Act Amendments and about specific technological developments that have occurred since the Amendments were enacted. It also provided an opportunity for the EPA, state, and local officials charged with Clean Air Act implementation to meet with companies that are facing compliance challenges as well as those companies who are developing the new technologies and services to help meet those challenges. We believe it was a valuable learning experience for all.

Thank you for your participation and help in making the Clean Air Marketplace such a big success.

Sincerely,

Robert Brenner
Director
Office of Policy Analysis
and Review

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INSIGHTS GAINED FROM THE CLEAN AIR MARKETPLACE CONFERENCE

The *Clean Air Marketplace* conference, sponsored by EPA on April 22-23, 1992, provided a rare opportunity for leaders from both industry and government to meet and discuss the relationship between environmental protection and opportunities for economic growth. Fourteen panel sessions -- featuring senior representatives of leading air pollution control companies, as well as senior Federal, state, and local government officials, and other experts on clean air issues -- covered a wide variety of business opportunities and challenges created by the Clean Air Act Amendments of 1990. Many insights were gained during the two days of speeches and panel discussions. Some of the more important of these insights are summarized here. In addition, several companies at the conference highlighted new technological developments and business ventures aimed at garnering a share of the Clean Air Marketplace. Some of these developments are summarized in the Attachment below.

THE POSITIVE ECONOMIC IMPACTS OF THE CLEAN AIR ACT AMENDMENTS

Since the passage of the Clean Air Act Amendments in late 1990, considerable attention has focused on the compliance challenges, and the associated economic costs, facing U.S. industry. Discussions at the *Clean Air Marketplace* conference, however, emphasized the "other side of the story" -- the positive economic results of the amendments and, more generally, environmental laws and regulations.

Environmental Protection and Economic Growth are Compatible Objectives

The cornerstone concept of the *Clean Air Marketplace* conference was the interdependency of environmental protection and economic growth. Although they are often thought of as conflicting objectives, conference participants identified several different levels of linkage between efforts to protect the environment and to promote U.S. economic growth and exports. Exemplified by many of the projects highlighted in the Attachment, these linkages include:

- Most fundamentally, although environmental laws and regulations require the expenditure of funds on the part of business firms on control technologies and services, *environmental expenditures create business opportunities* for firms supplying such technologies and services. These opportunities *translate into jobs for U.S. workers.*

- Many of the jobs created by efforts to improve the environment are *high-skill, high-wage jobs* that are very desirable in terms of improving the skill base of the U.S. workforce and providing high multiplier effects on the economy.

- Complying with environmental requirements can *lead to a net cost savings* for companies. The need to find cost-effective ways of complying with more stringent environmental regulations often leads companies to evaluate more comprehensively their manufacturing process or other ways of doing business. This often leads to discovering "smarter," more cost-effective processes that both reduce emissions and the overall cost of doing business.

- Cost savings realized by companies in complying with the Clean Air Act Amendments and other environmental regulations *improves the international competitiveness* of those companies and the U.S. economy in general.

Domestic Regulations Breed Foreign Export Success

Considerable conference discussion focused on export opportunities for U.S. air pollution control companies. Many participants noted the historic role of the U.S. in setting directional trends that other countries follow in developing their own environmental requirements. This phenomenon creates prospective opportunities for aggressive companies. *Developing innovative, "state-of-the-art" technologies or services gives a company a competitive advantage* as foreign countries adapt the Clean Air Act model to their own situation and needs.

INSIGHTS FOR THE FEDERAL GOVERNMENT

The conference yielded numerous insights of value to the Federal government in shaping regulations under the Clean Air Act Amendments and in crafting future environmental laws. Perhaps the most commonly expressed belief was the *importance of the promulgation and enforcement of effective regulations to the development and sustenance of a clean air marketplace.* Historically, the size and shape of revenues in the environmental control market has been driven by the timing and stringency of laws and regulations. That relationship is expected to continue judging from opinions expressed by many conference participants. The role of effective enforcement was stressed as a key factor increasing the credibility of nominally stringent requirements.

Conference participants also stressed the *need for consistency and certainty in the direction of new air pollution regulations.* The private planning and investment decisions necessary to achieve the objectives of the Clean Air Act Amendments depend on companies -- on both the supply and demand side of the clean air marketplace -- knowing where EPA's "goal line" is. The operation of innovative trading markets, such as that created for SO_2 allowances under Title IV, is particularly vulnerable to uncertainty.

At the same time that conference participants emphasized the driving role of stringent and consistent environmental requirements in creating the clean air marketplace, there was equal stress placed on the *need for flexibility in the form of those requirements.* There was wide praise for the emphasis placed in the Amendments on the use of economic incentives and, more generally, the use of a performance standard-oriented approach (as opposed to mandated technology requirements). EPA repeatedly was urged to reinforce this statutory emphasis in formulating implementing regulations. Several panelists noted that special care must be taken that the permitting process not hinder the development and commercialization of new technologies by placing innovative pollution control methods at a disadvantage.

The process by which new technologies get commercialized was the focus of many panelists. There was wide agreement on the *need to improve upon current means of technology transfer* so that new developments can be accessed by those companies who can apply them most effectively in solving pollution problems. The concomitant *need to improve working relationships between environmental entrepreneurs and the financial community to improve the flow of capital* to environmental start-up companies, new ventures by established companies, and industrial firms seeking to finance air pollution control projects was also identified as a pressing problem.

The use of economic incentives to induce desired environmental behavior -- "*profits in the service of the environment*" -- was a theme in many panel presentations. The flexibility such incentives provide allows the most environmentally forward-thinking companies to set the pace in developing new technologies that achieve (even exceed) statutory goals at minimum cost.

INSIGHTS FOR STATE AND LOCAL GOVERNMENTS

The conference yielded insights relevant to state and local governments as well. Many participants noted the *power of state and local laws and regulations to reinforce, facilitate, or undercut the clean air marketplace.* The market for SO_2 allowances was cited as an example: the treatment of allowances in state tax laws and by public utility commissions may do as much to determine the market's ultimate effectiveness as will EPA's regulatory actions. *State and local air pollution control regulations will also interact with EPA actions to send important messages to industry.* The clean air marketplace will be buttressed if such regulations adopt the same flexible, economic incentives-based approach embedded in the Clean Air Act Amendments. The clean air marketplace can be strengthened further if state and local authorities take the type of proactive approach illustrated by the South Coast Air Quality Management District, which recently opened an economic development office focusing on bringing new, emerging technologies forward to create opportunities to reduce pollution quickly and cost-effectively.

INSIGHTS FOR THE PRIVATE SECTOR

Finally, the *Clean Air Marketplace* conference provided additional insights for corporate leaders. Several speakers and panelists, for example, stressed the *potential for new technological developments in the private sector to materially influence the shape of new laws and regulations.* The impact of ARCO's low-emission reformulated gasoline, EC-1, on provisions in both the Clean Air Act Amendments and South Coast District requirements, was cited as an example.

Numerous conference participants stressed that an *increased corporate concern for environmental results often is part of a broader effort to improve quality and reduce costs.* On the one hand, efforts to reduce the environmental impacts of a manufacturing process, through process design changes, input substitutions, or product reformulations, often lead to a rethinking of the entire manufacturing process, and the identification of ways to improve quality and/or reduce production costs. Reduced environmental impacts can likewise result from efforts motivated by quality improvement and cost reduction goals.

Another frequent observation concerned the dynamics of achieving improved environmental performance within companies. The *key role of the CEO in articulating a corporate commitment to the environment* was stressed by numerous panelists from the corporate sector. Without such a commitment, backed by an ongoing investment of corporate resources, positive change is seldom possible.

Finally, the evolving relationship between sellers and buyers of pollution control equipment and services was discussed in several panels. The consensus of many participants was that, for most air pollution problems, there is a role for many different technologies and services as part of the solution. Increasingly, the seller-buyer relationship involves a partnership with both parties working cooperatively to identify a package of technologies and services that constitute the least-cost solution to a particular problem.

ATTACHMENT

New Technological Advances & Business Ventures Discussed at EPA's Clean Air Marketplace Conference, April 22 - 23, 1992

STATIONARY SOURCES

- CEMS. Continuous Emissions Monitoring Systems (CEMS) are expected to play an important role in facilitating a reliable market-based emissions trading system. CEMS serve four primary functions in a market-based system: (1) providing the "gold standard" for measuring the success of emissions control, thereby allowing a company to maximize the value of its plant and equipment, and to improve its credibility; (2) expanding the applicability of market-based incentives; (3) providing "added value" to traditionally non-productive emissions control systems as companies seek to buy the most productive, rather than the cheapest, systems and as integration of CEMS maximizes the production process and extends process equipment life; and (4) forcing technology development by propelling market-based strategies, helping to verify the accuracy of emissions equipment, and enhancing the return on investments in emissions control equipment by making companies aware of their position in trading.

- Dual CO/NO_x Removal. W.R. Grace & Co. has developed the CAMET system, which removes CO and/or NO_x for cogeneration, fire heaters, and other clean fuel applications. These systems can be customized and are frequently designed for dual pollutant removal with a removal efficiency of greater than 99% for CO and up to 90% for NO_x.

- Mercury Emissions Control at Incinerators. Available technological options for controlling emissions of mercury from solid waste incinerators include: wet scrubbers; wet electrostatic precipitators; sulfide injection (which reduces mercury to form easily removable inert compounds); and activated carbon, which oxidizes and chemically adsorbs mercury. Of these, sulfide injection and activated carbon have been judged to be the most effective approaches. Activated carbon, in particular, achieved removal efficiencies in the range of 88%-94%. Two other approaches to reducing mercury emissions include: decreasing the amount of mercury in batteries to detection levels which should virtually eliminate mercury from the waste stream by 1995, and source separation/recycling which involves recycling batteries. A continuous emissions monitoring (CEM) system for mercury has been cited in the industry as an urgently needed technology.

- Toxics Control at Incinerators. Solid waste incinerator technology that reportedly achieves near perfect reductions of toxic emissions exists at the Coburg facility in Germany, which employs a spray dryer, a fabric filter, a packed wet scrubber, and an electrostatic precipitator to control pollution. Particulate emissions from the

Coburg facility have been measured at 1mg/m^3 and metals emissions have been recorded at less than 0.05mg/m^3. The removal efficiency at the facility approaches 99% for all toxic gases, and 95% for mercury.

VOLATILE ORGANIC COMPOUNDS (VOCs)

- Reducing VOCs in the Graphic Arts Industry. W.R. Grace & Co. is commercializing a new water printing plate to reduce volatile organic compounds (VOCs) for the graphic arts industry. Grace is also developing a water-based container-sealing product that eliminates the use of organic solvents; water-based photopolymers for printed circuit boards; fluid-cracking catalysts that have been redesigned to reduce process emissions; and silica-based coating materials that are reformulated for VOC paints.

- Thermal and Catalytic Oxidation. W.R. Grace & Co. also has developed "TEC" systems, such as thermal and catalytic oxidation systems for reducing VOCs in industrial processes. The Snyox Ceramic Honeycomb catalysts developed by Grace provide NO_x reduction over a wide range of flue gas conditions. Noxso is a dry, dual pollutant removal technology that removes both NO_x and SO_x with a high removal efficiency rate and virtually no solid waste by-products.

- VOC-Free Paints. Glidden Paint Corporation has focused on the control of VOC emissions from architectural and consumer paints and has developed two new lines of interior latex paint that are formulated without the use of solvents and are VOC-free.

- NO_x Control. Research-Cottrell has developed NO_x control technologies including combustion technologies, catalysts, and burners. The company currently is concentrating on developing technologies at 1/10 or 1/100 of the cost of currently available technologies. Three options are available for VOC emissions control: process modification, recovery, and thermal oxidation. These technologies encompass a range of sizes, structures, and flexibility.

- CEMS. Continuous Emissions Monitoring Systems (CEMS) are important new technologies for facilitating emissions trading. For example, the Fourier Transformer Infrared (FTIR) analyzer, supplied by Research-Cottrell, is an emissions monitoring technology for VOC emissions control. The FTIR is in increasing demand for fingerprinting chemicals based on their emission/absorption of a particular light spectrum.

- Biofiltration Technology. Research-Cottrell has been exploring the use of biofiltration technology for controlling VOC emissions, as it has been used in Europe.

- Fugitive Emissions Controls. Systems Applications International (SAI) collaborated with Shell's Deer Park, Texas Manufacturing Complex to develop a fugitive emissions control program that combines computer hardware and software designed for better data management and analysis. The SAI/Shell technology involves source tags containing unique identification numbers for each individual source, assigned to the source for its lifetime. Information about the source, such as the manufacturer of the source, the location of the source, leak definition, emissions history, and repair history, is associated with a particular source identification number, making it easier to identify a source. New software reads the tag number and scans a list of source numbers to determine whether the source requires monitoring. If so, the concentration from fugitive emissions are tested and the software program compares that concentration against the leak definition for that source. If the monitored emission exceeds the leak definition, then the software system directs the operator to make a number of repairs to that source. Thus the software system decreases the time required to locate the source, take the proper measurements, and make initial attempts to repair the source. In addition, software has been developed for the mainframe that centrally stores all the information on the various sources, allowing for across-the-board analyses of the equipment manufacturers, location of sources, or maintenance records.

CHLOROFLUOROCARBONS (CFCs)

- CFC Substitutes. W.R. Grace & Co. is developing an aqueous CFC substitute for cleaning operations.

ACID RAIN

- SCR Systems. Babcock and Wilcox designs and sells Selective Catalytic Reduction (SCR) systems which are among the most widely accepted technologies for achieving NO_x reductions in natural gas-fired and coal-fired boilers. In the SCR process, the flue gas leaves the boiler and passes through an injection grid. Ammonia is injected and mixed with the flue gas and nitrogen and water are formed when the ammonia and NO_x pass over the surface of the catalyst.

- FGD Systems. Flue Gas Desulfurization (FGD) systems, installed to help utilities decrease their SO_2 emissions, are now at a minimum 95% removal level. Cost-reducing advances in FGD technology include the production of commercial by-products, such as gypsum, of which 20 to 30 million tons per year are consumed in the U.S.

MOBILE SOURCES

- Pre-heated Catalytic Converters. Camet Corp., a division of W.R. Grace, has researched electrically heated converters (EHCs). EHC systems are reported to be the most effective converters available, eliminating an average of 85% of emissions during the first 505 seconds of operating a car. Working with auto manufacturers, Camet is integrating the electronic controls from the EHC with the engine logic controls and the large-scale integrated circuits provided by auto companies for an integrated system solution to emissions requirements. The Grace/Camet EHC core is formed from a metal foil about 2 mills thick and weighing only 0.01 pounds/cubic inch, yet it can withstand hot shake tests at 1850 degrees fahrenheit. The EHC system is expected to cost auto manufacturers $200-$300 and will weigh between 25 and 40 pounds. The system has met California standards and Grace/Camet will soon be preparing for full-scale production of the EHC core, with expected installation for the 1997 model year, as required by the California timetable.

- Electrically Heated Catalyst. Corning GmbH has unveiled the prototype of a new electrically heated catalyst which is designed to meet the cold start segment of the ultra-low emissions requirements. In laboratory tests, this system meets or exceeds the California 1997 ultra-low emission requirements.

- High Temperature Catalytic Technologies. Because catalytic conversions to reduce mobile source emissions require high temperatures, Allied-Signal has focused on technologies with higher temperature applications, in addition to a 100,000-mile durability requirement. One example is a vehicle equipped with an underfloor catalyst and a manifold cat which led to the development of a closed couple technology that meets California LEV standards. Ongoing work is being conducted to meet ULEV standards with this technology. Palladium, a relatively low-cost metal that is used as a catalyst to convert CO, NO_x, and hydrocarbons, meets 1992 and 1993 emission standards and offers a life-span of 100,000 miles. More advanced palladium catalyst technologies are currently being tested with promising results.

- Absorber Catalytic Systems. Allied-Signal and ULP, Inc. are developing an absorber catalytic system that converts hydrocarbons before releasing them. The absorber material can be used with ceramic, metallic, foam, and other types of substrates. Several new technologies being developed can be combined to achieve optimal hydrocarbon removal levels while improving high temperature performance and hydrocarbon absorption capacity, and reduce the time taken by the absorber material to hold onto the hydrocarbon before releasing it. Catalytic technologies are also being developed for alternative fuels including natural gas and organic emissions.

- Ceramic Catalytic Materials. In researching ceramic catalytic converters, Corning Inc. has developed a new, low-expansion ceramic material that combats thermal shock and corrosive agents and an extrusion process invention that provides substrate with its distinctive honeycomb structure, thereby creating a large surface area in a very small volume. Added surface area increased overall conversion efficiency by 14%. In 1990, Corning released two cell core XT (extra-thin) substrates that use newer, more dense ceramic material. One unit provides added surface area and improves conversion efficiency by 24%. The second reduces back pressure by 14% without compromising conversion efficiency. These units save space and weight and are made from low-cost ceramic materials. Corning has also worked on electrically heated catalyst units which combine electrically heated metal substrate with a standard cellular ceramic substrate. The heated catalyst starts the catalytic converter and converts most emissions during the cold phase when most pollutants are emitted. Durability and energy requirements are further research issues. The unit takes less than 5 seconds to preheat prior to ignition and begins to convert emissions immediately thereafter, in contrast to currently available converters that take two minutes to heat up.

- Intelligent Vehicle/Highway Systems (IVHS). Originally conceived to alleviate traffic congestion, the Intelligent Vehicle Highway System (IVHS) is a broad-based concept to control road traffic in much the same way that air traffic and harbor traffic are controlled. IVHS is based on technologies that can be grouped into three main functional areas: an Advanced Traffic Management System (ATMS) that is responsible for obtaining real-time information; an Advanced Traveller Information System (ATIS), through which information will be disseminated, either in vehicles or on a kiosk; and an Advanced Vehicle Control System (AVCS), which incorporates the idea of intelligent cruise control, which would allow future cars to determine their locations relative to other vehicles. IVHS may also be applied to develop "smart buses" that would provide location information to people at bus stops, or feature a farebox or "smart card" reader to count passengers. Carpooling could be made more efficient by IVHS and a computer system that could configure a "dynamic carpool," providing drivers with a daily schedule of people to pick up. Thirty field tests currently are being conducted for these technologies.

- IVHS. In order to deal with traffic delay more efficiently, the states of New York and New Jersey created Transcom to act as a hub for information for the New York City metropolitan area's IVHS. Transcom collects and relays real-time information to all other transportation agencies, including rail lines, subways, and bus drivers, to avoid spill-over effects on other routes. Another Transcom technology is electronic toll collection (ETC), already in use in Dallas, Louisiana, and Oklahoma. ETC for the New York City region will probably take the form of an electronic tag on a car which will record the amount of the toll as the car passes through the toll reader. The driver will receive a bill for the total number

of tolls at the end of each month. The technology may reduce CO and hydrocarbon emissions significantly by speeding cars through tollbooths (even if only a quarter of cars use the system). Another possible application of ETC would be to use tagged vehicles to monitor traffic flow and signal an operations center regarding any problems.

- Diesel Particulate Control Systems. Donaldson Corporation manufactures detailed diesel particulate control systems such as particulate trap oxidizers, catalytic converter mufflers, and replaceable/cleanable filters. A trap system consists of a filter to capture particulates emitted, a regeneration mechanism to burn off or clean the particulates periodically, and a mechanism for sensing when regeneration should occur. A popular filtration method is the wall-flow monolith -- a ceramic device in which the particulates flow through porous walls and are then collected. Filter regeneration systems include electrical heating, the use of diesel fuel burners, catalysts, throttling, or combinations of these. Donaldson has about 550 ceramic wall-flow monolith traps with electrical regeneration systems in use. These trap systems can be installed on new vehicles or retrofitted on vehicles with conventional diesel technology. The company is also testing a multiple cartridge approach that fits easily into an engine compartment with limited space. Another type of after-treatment, the catalytic converter muffler, integrates emissions and noise control. Particulate trap systems are commercially available now, improving in reliability, cost effective, and reportedly effective in achieving clean diesel performance.

- Diagnostic Equipment. Sun Electric, Crystal Lake, IL, produces diagnostic and enhanced I/M equipment, including a line of mobile recovery systems for reducing CFCs emissions; a hand-held scanner that gathers and displays diagnostic messages from the vehicles; a PC-based shop management system (Shopmax); and safety and inspection system equipment such as front-end aligners. Sun's MCA 3000 is a PC-based analyzer that performs "four gas analysis" and is capable of supplying mechanics with technical service bulletins. Sun's MGA 9000 bar exhaust gas analyzer is a 286/386-based system with sufficiently large memory for data management that can communicate with other computers. Additional technology options available for the MGA 9000 include a barcode reader; vehicle on-board computer interface; advanced diagnostic software; a PC option to retrieve technical service bulletins; a CD-ROM mass storage unit of 500 megs; on-line communications by modem (currently used in Florida to register information with the state); and the capability to incorporate a NO_x analyzer, opacity test, and dynamometer. Another technology option is the POD, which, if connected between the Sun analyzer and the vehicle's on-board computer, obtains real-time data and additional maintenance data. Future options to be offered by Sun include evaporative pressure and canister purge tests.

ALTERNATIVE FUELS

- "Flex-Fuel Vehicles." Ford and General Motors are certifying their "flex-fuel" vehicles that run on either methanol or gasoline to meet California's Transitional Low Emissions Vehicle standard by 1992. Chrysler is planning to sell its "flex-fuel" vehicle in 1993 for the same price as conventional gasoline vehicles, offering consumers the flexibility of filling their tanks with methanol in nonattainment areas where methanol will be available, or using gasoline on trips away from the city.

- Electric Vehicles. Battery technology represents the greatest cost component of the electric vehicles being developed by Ford Motor Co. These vehicles offer several positive features, including good performance within a 100-mile daily range; the ability to recharge overnight, at home, rather than requiring a trip to the service station; relatively quiet running; and the potential to be more reliable and to require less maintenance than internal combustion vehicles. Disadvantages include reduced driving range; high cost; and short lifetime of batteries making electric vehicles more expensive to operate, per mile, than gasoline vehicles. Electric vehicles may be used primarily for utility vehicles, such as vans or commuter cars. Under Ford's electric vehicle demonstration program, 82 Eco-Star vans will be leased to customers in early 1993 for 30 months and then returned to Ford for evaluation. Batteries for the Eco-Star will weigh 800 pounds, while the body and frame of the vehicle will made of lightweight materials to compensate. The Eco-Star has a range of 100 miles per day, acceleration of 0-50 mph in 12 seconds, a top speed of 70 mph, and a recharge time of 6 hours on a 220 volt/30 amp outlet. Air conditioning and heating are optional features. Ford is also developing data on a fuel-fired heater, which does not reduce the driving range of electric vehicles, although air conditioning does affect the driving range.

- Reformulated Gasoline. ARCO's EC-X, a reformulated gasoline that meets the California Air Resources Board (CARB) standard for Phase II gasoline, shows great promise to be competitive in the areas of environmental quality, energy efficiency, ease of implementation, and economic efficiency. ARCO estimates that the overall reduction in urban ozone formation would be 39% through the use of reformulated gasoline. Phase II gasoline also offers the advantage of achieving mandated emissions reductions without requiring new engine technology. EC-X is estimated to cost 16 cents per gallon more than conventional gasoline, but reportedly compares favorably with M85.

- Compressed Natural Gas. Enron NGV Co. has created Enfuels, a subsidiary, to build compressed natural gas (CNG) fueling stations in the Houston area. The first station is scheduled to open in Houston by June 1992, and five more are expected to be in operation by the end of the year. Liquified natural gas may be the alternative fuel of choice for diesel buses in Houston because it allows greater

driving range. Most compressed natural gas pumps will be at existing gasoline retail stations. In July, Enron will open a technology conversion center where customers can convert gasoline vehicles into natural gas vehicles. Natural gas vehicles are reputed to produce fewer of the precursors to smog formation, eliminate evaporative hydrocarbons, produce 5% of the CO produced by gasoline engines, achieve low cold start emissions, and eliminate particulate emissions. Some challenges to the industry include the lack of fueling stations; a reduced driving range; the need to develop low-cost, light-weight tanks; and requirements for compressed natural gas-specific fuel injection systems, catalysts, and engines to meet future emissions requirements.

- Natural Gas Electronic Fueling Systems. GMC has introduced a Sierra-class pickup truck featuring the first in a new generation of electronic fueling systems for use with natural gas.

- CNG Vans. Chrysler is producing full-sized compressed natural gas vans that utilize what Chrysler claims is the cleanest internal combustion engine available.

- CNG Buses. The Southern California Rapid Transit District (SCRTD) has 10 Flexible buses with Cummins engines that run on compressed natural gas, which, except for the time required to fill all six tanks on these buses, have performed well. The fleet has 30 methanol buses built by TMC. "Avocet", used by the SCRTD in 12 GMC RTS buses which run on methanol, increases the high octane, low cetane properties of methanol, facilitating combustion and allowing buses to be converted from diesel fuel to methanol avocet. For the past two years, the SCRTD has had a retrofit program using Donaldson/Owens Corning and Donaldson/3M particulate traps. The SCRTD is also exploring the following options: electric trolley buses; the development of fuel cells; the development of a lightweight bus with traction motors in which all four wheels run on a low combustion internal engine; and the use of liquified natural gas which weighs less than compressed natural gas and takes less time to refuel.

THE CLEAN AIR MARKETPLACE CONFERENCE

April 22 - 23, 1992
Sheraton Premiere, Tysons Corner, Vienna, Virginia

SUMMARY OF CONFERENCE PROCEEDINGS

WELCOMING REMARKS

The Honorable William Rosenberg
Assistant Administrator, Office of Air and Radiation, U.S. EPA
April 22, 1992, 9:00 a.m. - 10:00 a.m.

Good morning and welcome to EPA's Clean Air Marketplace Conference. We are happy to sponsor this event along with our seven distinguished cosponsors.

For the past three years, clean air, the Clean Air Act, and the Clean Air Act implementation have been my constant occupation and, often, my obsession. I have been called the "pit bull for clean air," "the clean airhead," and a few other names that I can't repeat in public!

But it's been an exciting process. At EPA, we are setting a new course, we are seeking new ways of doing business, we are boldly going where environmental regulators have never gone before: into the marketplace!

And what an active market it's become! Today environmental protection has become a $100 billion U.S. industry, according to EPA estimates, and it is growing exponentially. Consulting firms such as Farkas Berkowitz and Enviroquest estimated environmental protection revenues at $60-130 billion in 1990.

Wall Street reflects the diversity and the maturation of the industry environmental protection industry. Investors can now choose from a variety of stock portfolios made up entirely of pollution control companies.

At EPA we are certainly doing our part. The new Clean Air Act implementation is boosting a business that is already booming. We are producing clean air rules that not only meet our environmental goals, but also:

- stimulate breakthroughs in both technology and new environmental management strategies;
- rules that are flexible, using performance standards rather than prescribed technology; and that
- stimulate competition for the best possible pollution control and prevention systems

Together with American industry, including the environmental protection industry and its customers, we are seeking cost-effective solutions to complex environmental problems.

A great deal of attention has been given to the cost of the new Clean Air Act. The President's Council of Economic Advisors estimated (when the Act was passed in November of 1990) the total cost to

be $25 billion annually, when the Act is fully implemented in the year 2010. That amounts to 25 cents per day per person. From EPA's perspective, that's quite a bargain for the benefits derived and surveys show that the American people feel the same way. A Roper Poll, conducted last year, indicated that 85 percent of all Americans are seriously concerned about the environment. And in a recent Wall Street Journal/NBC poll, eight out of ten Americans described themselves as environmentalists.

Little attention has been given to the very tangible benefits of the new clean air laws. Let's just glance at some of the environmental benefits:

The new Clean Air Act will have a profound effect upon the health and environment of every American. Each year it is designed to remove 56 billion pounds of pollution from the air we breathe. Sulfur dioxide and nitrogen oxide emissions that cause acid rain will be cut virtually in half. Every part of the country finally will have the means to attain healthy air on a realistic schedule. The risk from toxic air emissions will be cut by three-fourths. And CFCs, that destroy the stratospheric ozone layer, will be phased out entirely by the year 2000. (More recently, the President called for accelerating the phase out by the mid 1990's.)

The Act firmly establishes clean fuels -- reformulated gasoline, alternative motor fuels like ethanol and methanol -- as a means of controlling air pollution, especially in "non-attainment" areas that have failed to meet established standards for ground-level ozone. It also introduces a clean-fuel cars pilot program in California -- and alternative-fueled fleets.

(On its own, California is developing "Reclaim," a market-based emission allowance system, designed to meet environmental goals with the least disruption to the Southern California economy.)

Seventeen months after the President signed this landmark clean air law, I am happy to say that we are making good progress in our implementation. To date we have proposed or finalized rules that will accomplish two-thirds of the pollution reduction mandated in the Clean Air Act. Most of these rules have been issued within a month of the statutory deadline.

In recent days we have had clean air rules stacked up at the Office of Management and Budget like planes over La Guardia. But the good news is that some of them have landed safely, and others are being cleared for final approach. On March 31st, EPA Administrator Bill Reilly signed the Reformulated Gasoline and Oxygenated Fuels Rule. We recently promulgated Title I provisions, providing essential guidance for the states to meet Federal standards for criteria pollutants. The WEPCO rule should also be out soon, as well as Permits. A workable and enforceable permits rule, which provides for industry flexibility and public accountability, is the key to the success of most of the regulatory reforms under the Clean Air Act.

In the next few months we expect to publish:

- Utility NOx Control rule, providing a two-million ton emissions reduction from utilities by requiring low NO_x burner technology, as well as

- Enhanced Inspection and Maintenance. High-tech I/M is the single most significant reg to reduce ground-level ozone, reduces mobile source emissions by 30 percent, through very cost-effective means;

- Hazardous Organic Neshaps, the first MACT standard for a broader set of chemical companies: it will reduce hazardous air pollutants by about a billion Pounds per year!

We believe that our clean air implementation policies have been totally consistent with the Administration's economic goals. The principles of the President's Regulatory Review -- initiated in January of this year -- parallel the principles we published a year earlier -- in January of 1991 -- for Clean Air Implementation.

The President called for policies that "Maximize net benefits to society", "set performance standards instead of prescriptive command-and-control requirements", promote "inclusionary rulemaking, "incorporate market mechanisms", "provide clarity and certainty . . . to avoid needless litigation."

These are the basic principles of the President's Regulatory Review -- and they are the same as the guiding principles that Bill Reilly established in January of 1991 to implement the Clean Air Act:

- **E to the power of three:**

  -- Achieve and maintain a healthy **environment** while supporting strong and sustainable **economic** growth and sound **energy** Policy.

- **Build consensus with all affected parties**

- **Develop market-based approaches**

Now let's talk about the economic benefits. How do these clean air programs support the economy? EPA recently received preliminary results of a study conducted by the noted Wall Street investment firm of Smith Barney, Harris Upham & company together with the research organization of ICF Resources Incorporated. The topic of the study was "Business Opportunities of the New Clean Air Act." Its purpose was to provide guidance for EPA in our rulemaking so that we can stimulate industry innovation and competition in the pollution control industry, and to lower costs.

The study shows that in the next three years, revenues in the air pollution control industry are projected to jump dramatically -- by $4 to $6 billion dollars annually; and by $7 to 9 billion annually in the five years after that. This represents a $50 to $70 billion cumulative increase by the year 2000. According to the study, profitability will increase significantly for certain market segments, including NO_x control equipment and clean fuels.

And by the year 2000, projected increase in labor demand -as a direct result of our clean air requirements -- will create tens of thousands of new jobs. These will be good jobs: high-tech, highly skilled, well-paying jobs.

Demand for air pollution control and related services will increase dramatically, with significant new business for engineering, design, and construction companies, as well as the makers of instrumentation and monitoring equipment.

The Air Pollution Control Equipment industry will benefit greatly, especially companies that manufacture stationary source pollution control equipment: electrostatic precipitators, SO_2 scrubbers,

fabric filters and baghouses, and carbon absorption system. The Smith Barney study estimates that this industry segment alone will realize cumulative new revenues of $36 to $49 billion by the year 2000.

Other big winners will be companies -- and regions of the country -- that produce and transport cleaner burning and alternative fuels: natural gas, low sulfur coal, reformulated gasoline and oxygenated fuels. These companies, new revenues, as a direct result of our clean air initiatives, are projected at $11-$15 billion cumulatively by the year 2000.

The greatest potential for revenues -- and for healthy air for all Americans -- is in the prevention side. Companies that have the foresight to invest in improved manufacturing processes will not only clean the air, they will also boost their productivity and strengthen their competitive position in the U.S. and overseas.

IBM, for example, recently converted an electronic chip cleaning process in their Elmira, New York facility from a CFC to a water-based process. The redesign is saving the company $22 million with a more efficient, cleaner process, using no CFCs. This is truly a win-win situation. (Incidentally, IBM, to their great credit, is completely phasing out CFCs by 1992, way ahead of the Montreal Protocol.

Progressive companies in American industry are focusing on the opportunities, both short and long term. The oil industry is busy developing alternative fuels. Amoco is advertising a "refueling emissions system, a pump that is much easier to operate than the "accordion pump" now used in many areas. Just last week Exxon announced it is selling "clean air gasoline." (And incidentally, gasoline is at its lowest cost in years. Instead of the high-priced "government gasoline" that some of our critics predicted, it appears that oil companies are finding solutions that are both practical and economical. The auto industry is competing to make the cleanest car on the road (Chrysler just announced it will sell "flexible-fuel vehicles in 1993, at no extra cost to the consumer; in response to the President's accelerated CFC deadline of 1995, chemical manufacturers are moving swiftly to eliminate CFCs and cut emissions of other harmful chemicals. EPA is helping out with a program to recycle CFCs in auto air conditioners. Across the spectrum, we are witnessing the "greening of American industry."

Corporate America is also embracing EPA's Green Lights Program, which invites companies to install energy-efficient lighting, reducing their lighting bills and cutting pollution. As of March 13, over 425 companies have joined this program. They are saving energy, cleaning the air, and saving on their bottom line an estimated $702 million.

At EPA we are tailoring these new clean air regulations to fit the agendas of the most progressive companies in each industry. In our rulemaking process, we continue to build consensus with industry, the environmental community, and all other parties. We are using a Reg-Neg process, advisory committees, round tables and other work groups -- to streamline the regulatory process, to reach compromise agreements by all parties sooner rather than later, and ultimately, to avoid the legal wrangling that would otherwise delay -- or derail -- our clean air programs. Finally, we are achieving the President's goal of balancing environmental progress, economic growth, and sound energy policy. E to the power of three.

At EPA, in the 1990's, economic incentives for clean air, indeed, profits in the service of the environment, will be our theme and our hallmark.

The rapidly growing environmental protection industry and its customers are an integral part of this transformation. You are the vanguard of the new "clean air alignment." For the first time in history,

the clean air forces, public and private, are aligned and moving together in the same direction. The environmental leaders in American industry are joining the alignment and adding to the momentum.

Finally, I encourage all of you in the environmental protection industry to promote, by every possible means, the benefits of air pollution control and prevention: both the environmental benefits and the economic benefits. Promote strategic approaches to environmental management, promote innovative voluntary initiatives that clean the air and cut costs, and finally, promote the idea that what's good for the environment is also good business.

Together we can prove that cleaning the air can profit everyone. The beneficiaries of our commitment to a healthy environment and a healthy economy will be our children and grandchildren, who will be endowed with a rich legacy of fresh, clean air.

Thank you.

SESSION 1 -- PANEL A
Control Technologies - Utility Emissions
April 22, 1992, 10:15 a.m. - 12:30 p.m.

INTRODUCTION

Eileen Claussen, Director, Office of Atmospheric and Indoor Air Programs, Office of Air and Radiation, U.S. EPA, moderated Panel A: Control Technologies - Utility Emissions. Before introducing the panelists, she noted that they represent different views and work with different technologies, both demand-side as well as the "other end of the pipe." The order of the presentations reflected the nature of the technologies involved.

Ms. Claussen stated that the direction in which the nation is moving is towards environmental programs where companies have a lot of choices; the object or goal of the program is defined and individual businesses may decide which technology best meets their overall needs in meeting the regulatory goal. She stated that the conference as a whole and this panel in particular would be influential in setting a direction for how we move in the future.

PRESENTATIONS

Dr. Michael M. Hertel, Manager of Environmental Affairs, Southern California Edison (SCE), discussed SCE's experience with clean air regulation, how the legislation relates to actually implementing controls on the power plants, and some of the firm's activities in the CO_2 area. In addition, he discussed Southern California Edison's approach to the marketplace.

Dr. Hertel discussed several of the rules put into place by the South Coast Air Quality Management District:

- 1987-level emissions in the Los Angeles region must be reduced by some 70% across the board in order to achieve clean air standards. Emissions sources may choose which method(s) they use to attain these reductions. Facilities are faced with attaining these reductions during a time period when studies estimate that the region will see growth equivalent to twice the present population of Chicago.

- Fuel oil sulfur content will be limited to .05% sulfur after 1993. In order to meet this requirement, SCE has been increasing its use of natural gas and phasing out its demand for oil. In fact, oil made up only .1% of SCE's 1991 generation "mix."

- Rule 1135 limits NOx emissions from utility boilers. In 1990 SCE emitted 1.1 pounds of NOx per megawatt hour (MWh); Rule 1135 requires that this be reduced to .15 pounds/MWh by the year 2000. In addition, the technological controls to accomplish NOx reductions must be in place by 1998. Other restrictions on NOx emissions include daily averaging time, a daily absolute limit of 13,000 pounds per day, and a system cap of 1640 tons per year. Sources must install continuous emission monitors with remote terminal units on <u>each</u> stack by 1993.

In order to meet the requirements of Rule 1135, SCE has developed a balanced NOx control program. Dr. Hertel described the series of controls by which SCE is achieving these reductions: combustion modifications, flue gas research, low-NOx burners, urea injection, selective catalytic reduction (SCR), repowering, and implementation of shutdown/standby on several units which would be too expensive to control. Using such a balanced approach allows SCE to achieve the mandated reductions in the cheapest way possible for each particular unit.

Dr. Hertel described the three types of SCR systems being considered for use by SCE:

- A proprietary catalyst using ammonia to reduce the NOx to nitrogen and water. This system requires extensive monitoring of the ammonia to ensure it is being introduced to the unit at the appropriate temperature range and volume flow. This type of back end conventional SCR installation ranges in cost from $90 to $150 per kilowatt hour (kW); however, SCE has received bids in the $100/kW-$110/kW range. These systems are large and complicated to install, which accounts for much of the actual cost. SCE expects a 90% reduction in NOx from these systems.

- The Economizer SCR uses the same chemical process, but is placed in the economizer section of the boiler. This system does not require the massive duct work and other control systems as does the typical SCR. While the cost is substantially less, SCE predicts a NOx reduction of only 70% with the economizer SCR. In order to make up the difference, additional controls will have to be installed, either urea injection, low-NOx burners or a combination of the two.

- The SCR/Air Preheater involves coating the gaskets with the catalyst. Currently SCE has one SCR/Air preheater installed and has seen excellent results in NOx reductions.

SCE calculates that, by using some combination of the three SCR systems, the cost of the entire NOx reduction program will be approximately one-half of original estimates.

Dr. Hertel then described SCE's efforts in demand-side management. SCE hopes to achieve 10 billion kW of conservation over the next decade and last year pledged to reduce CO_2 emissions from the 1987 base by 10% by the year 2000 and 20% by the year 2010. While Dr. Hertel is opposed to mandated controls on CO_2 emissions for utility systems, he did encourage companies to examine their systems and apply energy efficiency measures to reduce CO_2 emissions. SCE's Customer and Technology Application Center (CTAC) is designed to demonstrate source energy efficient technologies to their customers; SCE hopes to help its customers comply with clean air rules of the district while at the same time increase their productivity.

Dr. Hertel briefly described the RECLAIM program, the Regional Clean Air Incentives Market program of the South Coast Air Quality Management District. The program addresses the difficulty of achieving clean air through command-and-control systems versus the use of a market-based approach. Current plans call for NOx, ROG, and SOx regulations to be in place by January, 1993. While only addressing 15% of emissions, Dr. Hertel feels the program is a dramatic step because it allows the utility to join with its customers and help them reduce emissions.

Dr. Hertel concluded his remarks by discussing SCE's role in the marketable permits program. Depending on the timing of the Air Quality District's rule making, SCE may or may not be a net seller of emission allowances. He stated that the program will benefit the basin dramatically by incentivizing the

switch to electric technologies which will in turn reduce emissions rather dramatically. SCE will benefit from the reduction in costs associated with the clean air programs in both the savings realized by the company itself and the economic stability of the region as a whole.

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Edward J. Campobenedetto, Manager of NOx and Particulate Control Systems, Babcock and Wilcox, described Selective Catalytic Reduction (SCR) technology and its place in the marketplace. Mr. Campobenedetto opened his remarks by noting that many questions remain concerning what is meant by appropriate combustion systems under the Clean Air Act; there are several techniques that may be applied in order to achieve NOx reductions, depending on the particular boiler involved. Beyond combustion systems, Selective Non-Catalytic Reduction (SNCR) and Selective Catalytic Reduction (SCR) are the two major technologies that have been accepted world-wide. He mentioned that there are several new technologies in the early stages of development in the Department of Energy's Clean Coal Program.

Mr. Campobenedetto described the SCR process. As flue gas leaves the boiler, it passes through an injection grid; at this point ammonia is injected and mixed with the flue gas. When the ammonia and NOx pass over the surface of the catalyst, the catalyst reacts to form nitrogen and water. Some important factors involving SCR systems include:

- Maintaining the proper temperature range.
- Producing the proper mix of ammonia and flue gas.
- Gauging the size of the catalyst to the amount of the NOx reduction required.
- SCR systems for clean fuels can be installed in any configuration; horizontal, vertical, or even at an angle. For coal fired units, however, a vertical down flow system is required because of the fly ash.

When considering SCR technology, catalyst life is an important factor since the catalyst represents 60 to 70% of the capital costs of an SCR system. Mr. Campobenedetto discussed statistics from several countries demonstrating catalyst life and the conditions under which the catalysts were used. While typically suppliers guarantee the product for only two years, the actual life of the catalysts studied were as long as 15 years in some cases and averaged between eight and ten years. The catalysts studied were used on coal fired burners, which expose the catalyst to many damaging agents such as fly ash, particulates, and others agents which cause erosion. While some of the facilities surveyed added more catalyst in order to further prevent ammonia slip, these additions did not reflect a need to replace the catalyst.

Mr. Campobenedetto questioned some of the figures mentioned by Dr. Hertel involving installation costs. While retrofitting an older coal fired boiler could possibly approach $100/kW, Mr. Campobenedetto stated that he has never seen a system, retrofit or new, that cost as high as the estimates mentioned by Dr. Hertel. Mr. Campobenedetto suggested that those figures might have included contingency and external work in addition to SCR installation costs. Babcock and Wilcox (B&W) has sold jobs for approximately $25-$30/kW; Mr. Campobenedetto estimates that a new unit designed and installed by Babcock & Wilcox could cost under $25/kW delivered and erected.

Mr. Campobenedetto concluded his remarks by mentioning certain systems that cannot be retrofit with SCR systems. A combined cycle or heat recovery steam generator typically does not have the

necessary space to install a catalyst. Mr. Campobenedetto suggested that the design of new units should include room for the future installation of an SCR.

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Robert D. Conley, President, Pure Air Corporation, discussed the impact of clean air legislation on markets for systems that reduce SO_2 emissions, specifically Flue Gas Desulfurization systems (FGDs). Mr. Conley stated that one of the most important elements of the clean air legislation concerning SO_2 compliance is the shift in focus of the legislation from a command-and-control approach to a market-driven incentive type system. Utilities are given a target reduction level for their unit and allowed to comply with that target by the least-cost method available to them. The legislation also has affected the way in which air pollution control companies look at serving their customers. While historically there have been no incentives to exceed the mandated level of reduction, the emergence of emission allowance trading has created a tremendous incentive to apply the technology to achieve a higher level of removal than is required. Doing so will generate a "least-cost" (per ton of pollutant) strategy. Air pollution control manufacturers are driven, then, to serve this market by producing higher efficiency and higher performance systems to help drive down the cost of compliance.

Mr. Conley stated that the key issue of compliance in this law is that the use of a technology is not mandated. The utilities find themselves, however, with the very demanding task of evaluating every alternative that exists in the marketplace as a compliance strategy, not only on a unit basis but on a system-wide basis, in order to find the most cost-effective solution for their particular system.

Mr. Conley discussed the impact of emissions allowance trading on the cost of complying with the environmental targets. Original estimates suggested that trading of allowances would reduce the cost of compliance by 25%; Mr. Conley's research has indicated that these types of reductions are achievable and, in fact, exceeded in the marketplace through the use of air pollution control systems in combination with emission allowance trading. Every ton of SO_2 emitted now has a dollar value associated with it; if it is not emitted there is an emission allowance that goes with it that could be traded to another facility to help that facility meet its reduction requirement. Mr. Conley maintained that in order for FGD systems to be cost-effective, emission allowance trading must be used in conjunction with the high removal technology.

Mr. Conley then discussed three factors a utility company considers when developing a compliance strategy:

- **Cost.** What system results in the least cost for my rate-payers?
- **Risk.** What risks are associated with a particular option in terms of availability and a proven performance record?
- **Prudency.** Will this option be considered viable, and therefore approved, by the utility commission and generate an adequate return on the firm's capital investment?

Mr. Conley noted that the dominant solution in the marketplace to SO_2 reduction has been fuel switching; the second most common strategy has been the application of air pollution control technologies, particularly FGD systems. Other compliance strategies include:

- Fuel switching during Phase I and the use of air pollution control systems during Phase II as the level of reductions become more stringent;

- Curtail or eliminate production at those facilities with higher emission rates in favor of other facilities.

Mr. Conley discussed the advances made in FGD technologies over the past several years and how they have helped utility companies reduce the cost of compliance. The FGD systems currently being developed and installed in other countries are marked by a 30-50% reduction in both capital and operating costs versus the historical norms for these systems. Mr. Conley noted that these reductions in cost have been achieved without any negative impact on the availability of the systems along with a substantial increase in the level of removal efficiency. Virtually every installation being made is at least at a 95% removal level. Mr. Conley explained that the incremental cost to design a system to achieve a 95% removal level versus a 90% removal level (even with the additional operating costs of reaging and higher power consumption) is extremely low; this reduces the overall average cost on a dollar per ton basis. Other cost-reducing advances in FGD technology and the contracts under which they are offered include:

- Production of commercial by-products. A typical 500 MW FGD system treating flue gas from a 3.5-4% high sulfur coal generates 200,000 tons of gypsum per year. Approximately 20 million-30 million tons of gypsum are consumed in the U.S. each year, 40% of which is imported from Mexico, Canada and Spain.

- Long-term operating and maintenance contracts. Air pollution control suppliers are beginning to offer innovative contract options to utilities installing their systems that include financing and owning the facility, as well as operating and maintaining it. Instead of being uncertain about long-term operating costs, utilities can contract for the systems so that operating costs are defined throughout the useful life of the project.

Mr. Conley reiterated that the single most important factor in driving down compliance costs in using FGD is the effective use of the excess emission allowances that can be created by the system. He mentioned some contract proposals that have been offered on the basis of selling the right to emit SO_2 in line with the emissions allowance program, rather than selling services. These ideas help shift the emphasis in the marketplace from buying a piece of equipment to an overall project development effort.

Mr. Conley then explained figures delineating the effects the clean air legislation and advances in FGD technology have had on compliance costs. The conventional costs of an FGD system in 1990 were 25-30% lower as a baseline than in 1985. With the clean air legislation creating the value of emission allowances along with advanced technologies, third party ownership and operations, and the sale of a commercial by-product, utilities have the ability to reduce their costs from almost $40 million per year to under $25 million per year, or from $400 per ton to slightly over $200 per ton. The economic value of each of these factors plays an important role in developing a compliance plan that will achieve a least-cost strategy. Mr. Conley noted that by helping their customers attain these reductions in compliance costs, air pollution control companies are fundamentally changing what the least cost compliance strategy might be. Mr. Conley concluded his remarks by stating that these technologies and contract options may be found in the marketplace today and are being offered by innovative companies in order to give people more options in finding a least-cost strategy for compliance.

* * *

Kenneth Woodcock, Senior Vice President, the AES Corporation, discussed AES' efforts in pollution control at its several facilities world-wide. Mr. Woodcock began the discussion with background information on independent power producers. Typically an independent power producer is a cogeneration facility or a small power producer that signs a long-term contract with an electric utility. The utility buys the power under a long-term contract with guaranteed energy prices, capacity, and availability. The independent power producer, in effect, takes over the operating risk of the facility, lowering the price to the rate payer. There has been an influx of competition on the generating side of the industry recently, each firm trying to seek market share. This competition will serve as a tremendous force for innovation; the firms that build more efficient technologies, lower heat rates, and find cleaner ways to develop new facilities at the least-cost will benefit from an increased market share within the industry.

Mr. Woodcock gave an overview of the non-utility generating (NUG) industry and its place within the global market. With slower economic growth in this country, in addition to demand-side management efforts, many of the new markets for new generating capacity and pollution control will be found overseas:

- In 1991, 38,000 MW of non-utility generating capacity was in place and operating in the U.S. (6% of total U.S. generating capacity);
- The average NUG plant is only 13 MW; AES' average size plant is approximately 180 MW;
- NUGs are expected to provide about half of the new generating capacity beyond the year 2000, for a total of approximately 87,000 MW or 11% of overall generating capacity;
- The generating capacity world-wide stands at approximately 2.5 million MW.

Mr. Woodcock then described the pollution control efforts at several AES facilities. Most of AES' capacity comes from coal and circulating fluidized bed boilers (CFBs).

- A 100 MW gas-fired combined cycle facility in Southern California equipped with an SCR system is operating below-NOx permit levels; actual emissions are 6.5 ppm or .02 lbs/BTU.
- In Houston, AES' facility is equipped with a dry electrostatic precipitator and a gypsum-producing SO_2 scrubber. The plant actually produces four products:
  - -- 140 MW to Houston Lighting and Power;
  - -- Steam to a nearby refinery operated by Lyondell Petrochemical;
  - -- 100,000 tons of gypsum to US Gypsum (while US Gypsum receives the gypsum virtually for free, it prevents AES from spending $20-$30 per ton in disposal costs);
  - -- Vanadium, recovered from the fly ash, is shipped to Arkansas, where it is made into high-alloy steel.
- The AES Beaver Valley facility in Monaca, Pennsylvania, produces 125 MW for Allegheny Power Systems. In 1986, AES installed a lime scrubber which has reduced costs and achieved a SO_2 removal level of 93%.
- AES Thames, located in London, England, generates 180 MW via 2 CFBs and one turbine. NOx emission levels at this facility are quite low; the facility is operating with a

rate of .07 lbs/million BTU. SO_2 removal is approximately 90-92%. The plant recently began producing fly ash pellets, which are about the size of a thumbnail. The fly ash is surrounded by the bottom ash, which prevents the pellets from sticking together. The pellets will be shipped back to West Virginia (the source of the plant's coal) and mixed with the overburden in the mines. While disposal costs have been high, this program has allowed AES to dispose of its by-products in an environmentally attractive way. As a part of their CO_2 offset program, AES has invested $2 million in a tree planting program in Guatemala. AES will plant and maintain 52 million trees and achieve more than a one for one offset of the CO_2 emitted from this plant.

- AES' largest plant is a 320 MW CFB facility in Poteau, Oklahoma. Equipped with 4 boilers and 2 turbines, the plant consumes half the coal produced in Oklahoma. Although the plant is dispatched several times a day, the facility has been responding very well. The steam customer is an AES carbon dioxide production facility that strips and cleans the flue gas and makes liquid CO_2 and dry ice. They have developed CO_2 pellets that are sold to Tysons Chicken Farms. The customer receives a higher market value for their product since it is not frozen, but wrapped in dry ice pellets. AES is currently in the process of selecting a CO_2 offset program for this facility.

- The Barbers Point facility in Hawaii uses 2 CFBs and 1 turbine to provide steam to a neighboring refinery. This plant was equipped with a thermal de-NOx system to ensure meeting the .1 pounds/million BTU limit; AES expects to achieve this level without using the thermal system. Mr. Woodcock stated that thermal de-NOx systems are becoming fairly commonplace on CFBs to attain this degree of performance. AES developed a 140,000 acre nature conservancy in Paraguay to serve as the CO_2 offset program and is currently examining options for fly ash consumption on the island.

AES tracks its environmental performance; SO_2 and NOx emissions are calculated each quarter. While new source performance standards and permit levels are typically around 75%, AES plants operate in the 35-37% range. Mr. Woodcock attributed these figures to the SCR, CFB and scrubber technologies being applied at AES sites.

Mr. Woodcock stated that some of the new clean air requirements will demand creative solutions to find low emission levels. Independent power producers will have to achieve the lowest possible emissions in order to minimize risk over the long term for their facilities. Mr. Woodcock also discussed integrated gasification combined cycle (IGC) systems. AES currently uses other technologies at its facilities, but hopes to someday be able to install these systems. IGCs are approximately 20% more efficient than CFBs and produce considerably less solid waste.

Mr. Woodcock discussed the future of the marketplace from an equipment supplier's standpoint and the competition facing the coal-based market. He expects to see fewer coal-fired facilities as demand-side management puts off the need for new generating capacity until the early 2000s. He stated that the natural gas market will be a serious competitive threat to CFBs and other coal-fired facilities, because of the large quantity of natural gas available for combined cycle facilities and the long-term contracts that are written as a result. The public perception of coal is another obstacle for firms such as AES. Even with its strong environmental performance, AES must factor in public perception when calculating risk.

Mr. Woodcock concluded his remarks by stating that the long-term goal for each AES facility is to reduce emissions to essentially zero. The firm would thereby manage its own risk effectively and provide its commodity, electricity, in a socially responsible manner.

QUESTIONS AND ANSWERS

After the panelists had each given their presentations, Ms. Claussen opened the session up to questions from the floor.

The Honorable William Rosenberg, Assistant Administrator, U.S. EPA, began the questioning by asking Dr. Hertel what was the expected compound growth rate of generation for SCE over the next ten years?

> Dr. Hertel stated that SCE's growth in sales is probably going to be 1-1.5%; growth in capacity, other than 600 MW of repower, is going to be zero. Currently the Public Utilities Commission Biennial Resource Plan Update is determining what capacity need will be required by the service area. One of the big questions facing the Commission is the role of so-called environmental adders: penalties for perceived residual emission values from control plants. Dr. Hertel mentioned that the adders are currently determined by a calculus, but hopes that eventually it will be determined by the marketplace. If the adders concept is adopted, SCE would build or buy perhaps $2 billion worth of geothermal-produced power that is probably unneeded during that time period.

Mr. Rosenberg followed up on the question by asking what effect the demand-side management program has on those estimates?

> Dr. Hertel stated that, without demand-side management, SCE would require approximately 1500 MW during that time period, a very small percentage of their overall capacity. Dr. Hertel continued by mentioning that SCE is committed to the concept of not producing electricity if it is not necessary. If it does have to be produced, the electricity should be used as efficiently as possible and the production system should be as clean as possible.

Mr. Rosenberg asked what would happen to earnings without an increase in the production of electricity?

> Whether it is due to conservation or competition, if the firm does not make capital investments in plant, the traditional means of making a rate of return, then earnings go flat. The Public Utility Commission is considering a program where companies can earn on the investment they make in conservation. While the returns are immediate, they are small. Dr. Hertel explained that in a capital investment you can project a fairly stable set of returns over a 30-year life; in conservation you get the returns over the first two or three years, but the amount is commensurately smaller. Ultimately the rate payer is generally better off with investments in conservation and therefore the utility ought to get some rate of return on that investment.

Mr. Rosenberg asked if Dr. Hertel expected the rate of return on conservation investment to be higher than the rate of return on investment in more generating capacity?

> Dr. Hertel stated that he did not mean to imply that the rate of return would be higher. The Public Utility Commission has been very careful about the concept; their aim is to price or give a rate of return on conservation investment that is at least equal to the investment incentive that one would have had in capital additions.

Another member of the audience asked for the panelists' comments concerning operational issues when using SCR technology including ammonia slip and the disposal of spent catalysts and by-products, especially vanadium.

> Mr. Campobenedetto explained the problems with ammonia slip. The ammonia reacts with SO_3 in low temperature areas, typically in an air heater. The reaction produces ammonium sulfate and ammonium bisulfate, which are particulates. These particulates may cause pluggage in the air heater. Mr. Campobenedetto explained that the use of a precipitator or "bag house" removes the particulate emissions problem because the particulates will be collected at some point. In order to control ammonia slips, Mr. Campobenedetto recommended increasing the number of catalysts within the system; more catalysts in the system gives more control against ammonia slip. In fact, NOx reduction capability doesn't deteriorate so much as ammonia slip begins to increase. Adding catalysts will also reduce ammonia consumption, which lowers operating costs.
>
> Mr. Campobenedetto continued by stating that while recycling capabilities do exist, the majority of spent catalysts are disposed of. He also stated that there is little vanadium in SCR catalysts and that, to his knowledge, SCR catalysts are still listed as nonhazardous.

A member of the audience asked the panelists if they had any figures estimating the costs of applying SCR technology to coal-fired power plants with cyclone furnaces?

> Mr. Campobenedetto replied by stating that his company has not looked specifically at cyclone boilers; however, a number of plants with cyclones in Germany have been retrofit with SCRs. The figures he quoted in his presentation were for natural gas fired boilers and for new coal-fired boilers. Mr. Campobenedetto stated that, based on a number of studies undertaken by his firm, $100-$150 per kilowatt hour is a high estimate. He would estimate that cyclone-type boilers would approach the $70-$90 per kW range. In general, the more NOx that must be removed, the higher the cost is going to be.
>
> Mr. Conley added that while the capital cost might be high, the dollars per ton of pollutant removed is actually quite low, because there is so much NOx being removed from those units.

A member of the audience asked what the environmentally attractive means of disposing of fly ash pellets are and do they fall under any of the RCRA provisions?

> Mr. Woodcock stated that AES disposes of its fly ash by mixing it with the overburden in the mines. The process has been declared a soil-enhancer in Oklahoma. In West Virginia, where the pellets from the AES facility in London are disposed of, the pellets actually offset some of the acidic soils and runoff from mines in that area. Thus far, the fly ash in either form has not been defined as a hazardous substance.

Another member of the audience asked Mr. Campobenedetto if Babcock & Wilcox had done any studies on the effect of separated overfire air on SCR installations and operations for coal-fired boilers and do the dollars that he mentioned hold up for large (e.g., 600 MW and larger) size boilers?

> Mr. Campobenedetto stated that the only special considerations that should be made for separated overfire air systems is maintaining good carbon utilization and the cleanliness of the catalyst surface. This is an important consideration for other portions of the unit as well, since accumulation of unburned carbon deposits can cause fires and/or explosions.

Mr. Campobenedetto pointed out that the figures he quoted during his presentation ($25-$30 per kW) were taken from a 550 MW system Babcock & Wilcox is developing in Thailand. Mr. Campobenedetto noted that in some cases, the cost per kW can actually be lower for larger units, because there are not as many kW over which to spread the costs in smaller units.

Finally, someone asked Mr. Woodcock if his plants were a little larger (e.g., on the scale of utility plants), did he think AES would be as successful in getting rid of the by-products?

Mr. Woodcock stated that small size works in favor of finding better opportunities for selling by-products. AES produces 90,000-150,000 tons per year of by-product and must consider the real potential of saturating a given market.

SESSION 1 -- PANEL B
Control Technologies - Urban Incinerator Emissions
April 22, 1992, 10:15 a.m. - 12:30 p.m.

INTRODUCTION

Jeffrey C. Smith, Executive Director of the Industrial Gas Cleaning Institute, introduced the topic for panel discussion with the question, "Why bother with urban incinerators at all?" One possible answer, Mr. Smith stated, is the magnitude of the solid waste crisis: 200 million tons of solid waste are generated each year in the United States, enough to fill 35 million garbage trucks. Programs that encourage people to reduce, reuse, and recycle their wastes will never reduce the size of the waste stream enough to eliminate the need for incineration. Even if 50% of all solid waste were recycled, a highly optimistic assumption, there would still be over 100 million tons of solid waste annually requiring disposal. Landfill capacity is not sufficient to accommodate all of our waste, leaving incineration as the only alternative, according to Mr. Smith. Therefore, waste recovery through incineration must be part of our overall waste management strategy.

PRESENTATIONS

Peter G. Maurin, Director of Operations for Dry Scrubbing Systems at Wheelabrator Clean Air, began by noting that the term "incineration" has negative connotations. The term Mr. Maurin prefers to use is "waste-to-energy." Mr. Maurin proceeded to illustrate the state-of-the art technology employed at modern waste-to-energy facilities, epitomized by Wheelabrator's waste-to-energy facility in Bridgeport, Connecticut, which handles 2,250 tons of solid waste per day. If not for the opening of the Bridgeport facility in 1987, Mr. Maurin stated, Connecticut's landfills would have reached capacity by 1990.

Mr. Maurin described the waste-to-energy process as follows: Refuse is deposited by trucks in a refuse pit, where it is mixed and inspected for materials that require separation. Next, waste is hauled into the upper portion of a reciprocating grate burner. As the waste moves along the grate, it is dried and combusted. Flue gas from the combustion process proceeds through a traditional boiler, where steam is generated. Flue gas subsequently passes through a scrubber to remove acid gases, and a particulate collection device (either an electrostatic precipitator or fabric filter) to remove fly ash. (Approximately 85% of the ash is removed as bottom ash, and the remainder is treated as fly ash.). Steam generated at the boiler runs through a turbine generator to produce electricity for sale to the local electric utility. Typical operating temperatures approach 1800 degrees Fahrenheit, which is sufficiently high to remove all organic compounds.

Mr. Maurin also provided an overview of some of the air pollution control technology being introduced into the marketplace by Wheelabrator. In particular, Mr. Maurin described a number of different techniques for controlling acid gas emissions.

- Dry injection systems, the simplest and least-costly approach, involve bringing alkali absorbent material into contact with flue gas. Mr. Maurin stated that these systems are good for incinerator units that have adequate particulate control but lack gaseous pollutant control.

- Fabric filters operate much like a large vacuum cleaner employing thousands of collection bags. The principle of the fabric filter is to pass flue gas through a cloth that removes solid material, principally through contact with a growing "filter cake" of dust. Trapped particulates are later removed by reversing the flow of air and/or by shaking the filter to dislodge collected material, which accumulates in a hopper.

- Spray dryers utilize calcium hydroxide (or some other alkali material) which is flaked into a lean slurry and subsequently "atomized" to provide maximum gas-liquid contact. Atomized calcium hydroxide reacts with gaseous pollutants in the liquid phase, forming solid reaction products that are dried for removal. Spray dryer systems may vary in design, depending on the type of alkali material and the method of atomization.

Each of these options, Mr. Maurin noted, has characteristics that make it appropriate for some systems. No single approach can be considered the "right" one to use for all systems.

* * *

J. Michael Valentine, Director of Air Services for Braun Intertec Environmental, Inc., described his experiences as Air Quality Director for the Minnesota Pollution Control Agency, where he was responsible for air quality policy development. Mr. Valentine distilled his experiences into three "realities" regarding municipal solid waste incinerators:

- Incinerators are among the most stringently regulated point sources of air pollution;

- The degree of regulation, Mr. Valentine believes, is driven by public perceptions and goes far beyond what the air pollution potential of those facilities would dictate; and

- The best pollution control technology in the world does not provide a guarantee that a plant will receive a permit to operate. If incinerator advocates resolve traditional environmental concerns (such as controlling air and ash emissions) only, facilities are unlikely to be approved for operation.

Mr. Valentine provided an overview of Minnesota's waste management law for background on his perspective of solid waste incineration. Under the Minnesota law, Mr. Valentine stated, counties are responsible for developing solid waste management strategies following a specified hierarchy of waste disposal options: reduction, recycling, composting, incineration, and landfilling. Because the law set specific goals for recycling, it fundamentally changed the way incineration was regarded.

Mr. Valentine summarized the principal air pollution issues facing incinerators in Minnesota during the 1980s:

- 1980-1983: particulate issues were of primary concern;

- mid-1980s: dioxin and acid gas became key issues, leading to dry scrubber requirements and stringent combustion controls;

- late 1980s: mercury control became the most important issue, prompting proposals for activated carbon filters and the removal of mercury from the waste stream.

Mr. Valentine explained that permitting for incineration facilities became more difficult even as the environmental standards of the facilities grew more stringent. Permit approval was increasingly difficult for the 13 incinerator applications he handled. The first 12 eventually won approval. The last was rejected not because of traditional environmental concerns, but because the facility would take enough waste from the recycling stream that recycling goals would not be met.

Solid waste management plans that set specific goals for recycling, Mr. Valentine concluded, result in close tracking of the waste stream. A vocal minority of citizens that opposes incineration uses recycling goals to kill proposed incineration projects. The bottom line, he added, is that it is almost impossible to generate political momentum to support incineration facilities. Incineration advocates, therefore, must focus on political issues as well as environmental technology, and promote incinerators as an integral part of a well-balanced waste management plan.

* * *

Svend K. Hansen, Vice President for Scrubber Systems at Environmental Energy Corp., discussed some of the technologies and regulations in place to control urban incinerator emissions in Europe. Emissions from incinerators, Mr. Hansen noted, have been regulated in Europe only since the mid-1970s. Emission standards have become much more stringent since then, however, and currently exceed the requirements for incinerators in the U.S. Mr. Hansen also pointed out that Germany defined an emissions standard for mercury as early as 1986. Mercury has not yet been addressed at the federal level in the U.S., although a number of states have proposed standards.

Mr. Hansen proceeded to describe some of the latest incinerator emissions control technologies employed in Europe, where more stringent requirements have spurred innovation in the field. He provided a flow diagram of a facility in Germany, the Coburg, as an example of a typical European incineration facility. Pollution control technology at the Coburg facility consists of a spray dryer and a fabric filter, similar to those described by Mr. Maurin, as well as a packed wet scrubber and an electrostatic precipitator. The spray dryer and fabric filter, Mr. Hansen stated, represent the best available control technology (BACT) in the U.S., while the wet scrubber and precipitator are utilized because they are necessary to meet Germany's emission standards. Particulate emissions from the Coburg facility have been measured as low as 1 mg/m^3, and metals emissions have been recorded at less than 0.05 mg/m^3. By comparison, the standard in the U.S. for particulates is 34mg/m^3, and for metals is 0.1 mg/m^3. Systems similar to the one employed at Coburg have been used in the U.S., Mr. Hansen added, but only for hazardous waste incineration, not municipal solid waste treatment. The removal efficiency for the Coburg facility approaches 99.9% of all toxic gases, and 95% for mercury.

Mr. Hansen compared capital costs and removal efficiencies for a facility employing the technology used at Coburg to those for facilities utilizing technology typically employed at municipal solid waste incinerators in the U.S. If the U.S. norm of employing a spray dryer and fabric filter (or electrostatic precipitator) is augmented by employing activated carbon treatment, Mr. Hansen estimated that mercury removal could be improved from 60% to 95%, while capital costs would increase by 5%. To achieve the nearly perfect removal efficiency of a facility such as Coburg, capital costs increase by 80% from the baseline. In other words, Mr. Hansen concluded, the technology to achieve near perfection exists. Whether it is used, however, will be a strict function of regulatory requirements.

* * *

Paul Chrostowski, a Vice President of ICF-Kaiser Engineers, gave a presentation on approaches to controlling mercury emissions from municipal solid waste incinerators. The evolution of mercury emissions awareness, Mr. Chrostowski stated, represents a paradigm that has occurred with many other chemicals:

- Environmental groups raise an ecological or human health concern about a particular type of emission;
- The regulatory community responds to concerns by developing emissions standards; and
- Industry must comply with the regulatory initiative.

Mercury was targeted by the environmental community, Mr. Chrostowski stated, primarily because of its high toxicity.

Mercury gets into municipal solid waste primarily through the disposal of household batteries, which account for 88% of mercury in the waste stream. Other sources of mercury cited by Mr. Chrostowski include fluorescent lights, indoor latex paint, and other pigments.

Existing best demonstrated technology for mercury removal (a spray dryer used in conjunction with a fabric filter) operates at approximately 60% efficiency. However, this efficiency fluctuates widely from virtually 0% up to 70%. Ironically, Mr. Chrostowski, added, modern facilities have some of the lowest removal efficiencies. The affinity of mercury for activated carbon is responsible for this unusual result. Under poor combustion conditions, which occur in older incinerators, a lot of unburned carbonaceous material is generated. Mercury is adsorbed by this carbon material, enabling it to be removed by a fabric filter. With stringent combustion requirements now in place, Mr. Chrostowski stated, an "add-on" technology for mercury control is now needed.

Most state-of-the-art incinerators have mercury emissions in the range 180-250 micrograms/m^3 of dry gas. At these levels, Mr. Chrostowski stated, there are virtually no health risks. However, EPA is required to develop a standard for mercury. No facilities in the U.S. currently utilizes an add-on technology for mercury control. The available options for mercury control include:

- Wet scrubbers;
- Wet electrostatic precipitators;
- Sulfide (NaOH) injection, which reduces mercury, forming inert compounds that are easily removed; and
- Activated carbon, which oxidizes and chemically adsorbs mercury.

EPA decided that the two approaches with the greatest potential were sulfide injection and activated carbon. The Agency conducted tests of both approaches at Ogden Martin's Stanislaus plant in California. The results of these tests showed that activated carbon is an extremely effective approach for reducing mercury levels. Sulfide injection was not very effective, however. The tests also showed that the single most important determinant of mercury removal efficiency is the amount of carbon used. Twelve pounds of activated carbon per hour or greater is optimal, which is roughly the equivalent of 50mg/m^3. Using optimal quantities of activated carbon, mercury removal efficiencies were in the range of 88-94%, yielding mercury emission levels less than or equal to 150 micrograms/m^3. Emission levels as low as 40 micrograms/m^3 were recorded as well.

The results of EPA's testing of activated carbon corroborate data from Europe and Canada. Mr. Chrostowski anticipates that EPA's mercury regulation for solid waste incinerators, which he expects to be promulgated by late summer 1992, will specify activated carbon as the best demonstrated technology for controlling mercury emissions. Mr. Chrostowski also predicted that the EPA emissions standard for mercury will be approximately 130-200 micrograms/m^3.

Mr. Chrostowski went on to describe several state and local standards that have been considered.

- New Jersey is considering a 50-70 micrograms/m^3 mercury emissions standard.
- Florida is considering a 70 micrograms/m^3 mercury emissions standard.
- Permits currently under review for several facilities with which Mr. Chrostowski is familiar are defining maximum mercury emissions levels at approximately 130 micrograms/m^3.

Mr. Chrostowski also described two other ways to reduce mercury emissions from incinerators:

- Source reduction: The four largest battery manufacturers are participating in a voluntary program to reduce mercury in batteries to detection levels by 1993. Given the two-year battery life cycle, mercury virtually will be eliminated from the waste stream by 1995.
- Source separation/recycling: Many communities have battery disposal locations. Unfortunately, however, the U.S. has only one mercury battery recycling facility, which is operating at capacity and has been unable to get a permit to expand. Batteries that are collected are deposited instead at hazardous waste landfills.

Mr. Chrostowski concluded with a discussion of one urgent technology need: a continuous emissions monitoring (CEM) system for mercury. Current programs rely on isokinetic sampling, which is not as accurate as CEM for monitoring mercury emissions.

QUESTIONS AND ANSWERS

Do incinerators require feed preparation to enable more efficient combustion?

Mr. Maurin stated that there are two approaches to incineration: mass burn and refuse-derived fuel (RDF). Wheelabrator utilizes the mass burn approach in part because mass burn facilities require no feed preparation to assure complete combustion. Under the mass burn approach, only items that obviously do not belong in an incinerator, such as refrigerators, engine blocks, or waste drums, are removed. The manner by which Wheelabrator's grate system moves waste through the incinerator, Mr. Maurin continued, enables very high combustion efficiencies despite the bulky nature of some waste.

Mr. Chrostowski added that grate system technology is a key feature that distinguishes competing vendors from one another.

How do vendors deal with community opposition to incinerators? Does community opposition pose a major obstacle to the permitting process?

Mr. Maurin stated that Wheelabrator spends a lot of time addressing community concerns, primarily through public hearings during the permitting process. People often ask about the public health risk of municipal solid waste incinerators. Mr. Maurin cited studies that estimate the cancer risk from chlorinated drinking water to be 5×10^{-4} and that of a chest X-ray to be 7×10^{-6}. According to Mr. Maurin, uncontrolled emissions from a waste-to-energy facility are roughly equivalent in cancer risk to a chest X-ray. Risk from a facility equipped with a spray dryer and fabric filter is approximately 4×10^{-7}. Wheelabrator's approach, Mr. Maurin added, is to present the facts about incineration and possible alternatives and let the community weigh the options for themselves.

Mr. Smith described his observations from hearings that he has attended. Vendors, Mr. Smith stated, have become very sophisticated in presenting incinerators to the community. It is not uncommon, he added, for citizens to be familiar with the elaborate technology utilized at facilities such as the Coburg. Someone may stand up at hearing and ask, "Why is my life less important than somebody's in Germany?" As a result, emissions standards tend to be "ratcheted down" during the permitting process. There is a certain irony, Mr. Smith added, that solid waste incineration is simultaneously one of the most highly controlled and highly resisted industries. EPA's regulatory controls become less significant because concerns raised at the permitting level need to be addressed on a case-by case basis.

Mr. Valentine stated of the 1,500 permits he signed during his tenure in Minnesota, the 13 waste-to-energy permits generated more community involvement than all of the others combined. The irony, he added, is that the stakes were higher at some of the other facilities where community interest was limited. As a result, permits for waste-to-energy plants that he signed were far more stringent than regulations required.

Mr. Chrostowski stated that waste-to-energy faces an organized opposition that travels around the country stirring opposition within communities where permits are being considered. These individuals, Mr. Chrostowski stated, don't trust regulators to protect their health and will be satisfied only by an outright ban on waste-to-energy plants. Mr. Chrostowski stated that in Lee County, Florida, which has a population of approximately 350,000, $20 million has been spent to appease the 25-30 people who oppose a proposed waste-to-energy facility.

Assuming permitting goes through, who are the owners and operators of waste-to-energy facilities? Who decides what technology is used for emissions control?

Mr. Chrostowski stated that in some cases, vendors merely build a plant and turn it over to some municipal authority, which becomes the permit holder. In other instances, a vendor may build, own, and operate a plant. Emission standards, he continued, are specified in the operating permit, which may require the approval of multiple regulatory agencies. Often, one company comes up with the technology specifications to satisfy the permit requirements. Vendors then bid to meet the specifications and subsequently turn to designers of air pollution control systems to provide the technology needed to implement the project.

Where is the market for municipal solid waste facilities going in the wake of the Clean Air Act Amendments (CAAA)?

Mr. Maurin replied that 15% of current waste goes to waste-to-energy facilities. Assuming solid waste increases to 220 million tons per year by 2000, and that 25% of this quantity goes to incinerators, approximately twice the current capacity of waste-to-energy plants will be required.

Has the market for retrofitting facilities to meet the requirements of the CAAA been quantified?

Mr. Maurin did not have a figure available. He pointed out, however, that owners/operators face a compliance date of January 1, 1996. Considering that it takes approximately two years to complete a retrofitting project, facilities that are out of compliance don't have much time. Some of the roughly 200 facilities currently operating may be forced to close down because they will not economical to retrofit, while others may have to scramble to meet the deadline.

Mr. Smith added that, typically, vendors are the last to benefit from a new regulatory initiative. The first to benefit generally are consultants and design engineers. The scope of opportunities for vendors, he stated, has been reduced by the emergence of architect/engineering firms, which now provide many of the services that once were provided by vendors. Ultimately, he concluded, business opportunities arising out of Title I of the CAAA will dwarf those of Title IV.

Mr. Chrostowski stated that he believes that although waste-to energy is a limited market, it should experience moderate growth. He cited polls indicating that a majority Americans are in favor of waste-to-energy. He estimated that approximately 6-10 new facilities will be developed per year, when the requirements of the CAAA are fully implemented.

Because of the permitting process, EPA regulations have limited significance. Will that be true in the case of the forthcoming mercury regulation?

Mr. Chrostowski said that he expects the forthcoming mercury regulation to have a positive effect on the waste-to-energy industry, although he noted that organized opposition doesn't care what EPA does. If recycling or composting facilities were regulated as heavily as waste-to-energy, the industry probably would enjoy better opportunities.

Mr. Valentine added that some states have a policy not to impose emissions standards that are more stringent than corresponding federal standards. When there is no federal emissions standard, as is currently the case for mercury, this policy is of no use.

What role do secondary impacts of siting, such as odor or transportation problems, play in the permitting process?

Mr. Valentine stated that these issues have very little effect on the permitting process. Often, these concerns are resolved in one public discussion.

Mr. Maurin added that these secondary concerns are easily addressed. For perspective, he stated that environmental control accounts for approximately 25% of the $200-250 million cost of a large waste-to-energy facility.

SESSION 1--PANEL C
Control Technologies - Stationary Source Ozone
April 22, 1992, 10:15 a.m. - 12:30 p.m.

INTRODUCTION

Susan Wyatt, Chief of the Chemicals and Petroleum Branch of EPA's Office of Air and Radiation, introduced the session by stating that the Clean Air Act Amendments have challenged us to find new, better, less costly ways of controlling air pollution. The purpose of the meeting would be to share information and to exchange ideas.

Ms. Wyatt asked for a show of hands to determine the backgrounds of people attending the session. Consultants made up about half of the group; about a third of the attendees were from industry; a handful of people represented state and local governments; also present were one or two vendors and one person from an environmental group.

PRESENTATIONS

Jim Hyde, Vice President of W.R. Grace Co., and President of Grace's Davison Chemical Division, which manufacturers catalysts and industrial chemicals, began his presentation by stating that the CAA creates an opportunity for innovation which may be risky. Solutions found for air pollution control must be creative, effective, and in some cases may be expensive.

Mr. Hyde described his company as the world's largest specialty chemical company. Grace manufactures a wide variety of products, including catalysts, silica-based products, packaging, construction specialty products, water treatment chemicals, container sealants, health care products and services, and other products. With such a broad base, Grace must meet a complex web of demanding regulations, and is at the forefront of control technology. Grace is experienced in the design of control systems and spends $100 million per year to develop control technology. When a chemical manufacturer is faced with additional air pollution control regulations, it has four options:

- Process modifications are easiest to implement when constructing a new line or making substantial equipment changes. Recycling loops can alleviate costs by reusing valuable materials and energy. Retrofit of old systems can be difficult because of design, space, product quality, or cost considerations. Burner design changes and recycling of high temperature off-gases to low temperature dryers are two ways in which Grace divisions have been particularly successful in using process modification for environmental improvement.

- Increasing attention has focused on product substitution/reformulation, as certain materials are facing outright bans (e.g., CFCs). Product substitution/reformation can provide a solution, and can avoid the add-on cost. The substitution or reformation of the product must retain the quality and performance of the original. One example of a substitution effected at Grace is the substitution of organic-based inks to water-based inks in Grace's major packaging facility.

- Add-on control technology is often the last option before shutdown. It requires additional capital and additional operating costs, and is usually associated with a loss of efficiency. Many times, however, this is the only way to meet a specific emissions limit. Some add-on technologies have an economic benefit, some are costly.

- Shut-down is the final option. America's economic strength requires that we find solutions short of this measure.

Evaluating these options involves an array of questions to consider: Does the proposed solution meet the emissions target? How reliable is it? What are the impacts on product quality? Would it affect another part of the operation? What is the cost impact? Does the technology fit, or will it require extensive modifications? Can it be customized to specific applications? Does it fill the customers' need? What is the supplier's long term commitment to services of the installed devices?

Pollution control solutions finally decided upon must not only meet the Federal, state, and local emissions regulations, but they must also be operable, understandable, and acceptable to employees and to surrounding community. The least cost route can cause an unhappy result. A balance must be found between cost, quality, service, operability, and long-term commitment.

Mr. Hyde remarked that the CAA and other environmental regulations have clearly had an impact in most of Grace's businesses. Grace is developing a variety of new clean air technologies, including the following examples:

Process Modification

- Grace is commercializing a new water printing plate to reduce VOCs for the graphic arts industry; and

- Grace is working with the refining industry to develop new catalysts which will be feedstocks for refining products used in reformulated gasoline.

Product Substitution/Reformation

- An aqueous CFC substitute for cleaning operations;

- Container-sealing products reformulated to a water-based compound that reduces use of organic solvents;

- Water-based photopolymers for printed circuit boards;

- Fluid-cracking catalysts, redesigned to reduce process emissions; and

- Silica-based coating materials reformulated for VOC paints.

Control Technologies

- Grace has developed the Camet system, which can remove both CO and/or NO_x for cogeneration, fire heaters, and other clean fuel applications. These systems can be

customized, and are frequently designed for dual pollutant removal. They have a removal efficiency of greater than 99% for CO and up to 90% for NO_x.

- Grace also has "TEC" systems, such as thermal and catalytic oxidation systems for reducing VOCs in industrial processes, such as in the graphic arts industry.

- In addition to Camet, another option for control of NO_x provided by Grace is the Synox Ceramic Honeycomb catalysts, which provide NO_x reduction over a wide range of flue gas conditions.

- Many conventional SO_x reduction technologies have the drawbacks of high cost, limited removal efficiency, and high quantities of solid waste produced. Noxso is Grace's new control technology for coal-fired power plants. It is a dry, dual pollutant removal technology (both SO_x and NO_x), with a high removal rate, and virtually no solid waste by-products. It will be demonstrated in Ohio Edison's Niles, OH coal-fired power plant under the Department of Energy's Clean Coal Technology Program.

- Grace has developed a Camet electrically heated catalytic converter for automobiles. Most vehicles emit a large percentage of their total pollution when cold. The new converter heats up faster, and will reduced auto emissions to meet California's low emission vehicle requirements.

Mr. Hyde concluded his presentation by stating that Grace must meet challenges for control technologies both internally and for its customers. Grace will continue to meet the challenge by supporting their product lines with research and development, technical services, and performance and reliability.

* * *

Bob Kovalack, Manager of Environmental Affairs, Glidden Paint Corporation, gave the next presentation. A representative of the paint industry might have focused on the industrial settings where abatement equipment is an option for control of VOCs, began Mr. Kovalack. Instead his presentation focused on what he termed "the other side of the paint industry," the control of VOCs from architectural paints.

The CAA requirement to study and regulate emissions VOCs in consumer and commercial products is of great significance. It is the first time a huge stream of products available to nearly everyone will be regulated for solvent emissions. Critics believe that paint is a small percentage of VOC emissions, and that regulating VOCs in paint does not warrant the cost; however, commercial and consumer coating products present the largest source of VOC emissions remaining not directly controlled at the Federal level. Glidden's goal is to remove all solvents in its consumer paints by the end of the decade.

Glidden has to meet the demands of the marketplace. The consumer wants paints that apply easily, dry fast, emit less odors, and clean up with soap and water. The performance and price of paints must meet consumer demand.

Mr. Kovalack gave an overview of the paint and coatings industry. Sales total $12 billion a year, 0.2% of GNP. Architectural and consumer coatings account for 1/2 of the $12 billion. Anywhere between

392,000 - 675,000 tons of VOCs are released per year. VOCs account for 7% of architectural coating paint, 42% of automotive paint, 40% of industrial coatings.

Glidden announced last month two new lines of interior latex paint formulated without the use of solvents. The lines include a flat paint, an eggshell, and a semi-gloss sheen wall enamel. The new paint is called SPRED 2000, and is VOC-free.

In conclusion, Mr. Kovalack made the point that Glidden, as well as the National Paint and Coatings Association, supports VOC elimination for consumer coatings on a national scale. State by state or air district by air district law-making is an economic hardship to national paint manufacturers. However, he does not want to see undue limit of VOCs where the purpose of the coating is specialized and the volume of VOC emissions is small.

* * *

Dr. Morris Trichon, Vice President of the Environmental Services Technology Division at Research-Cottrell, opened his presentation by describing his firm. Research-Cottrell licenses and develops control technologies for NO_x and VOC emissions. Dr. Trichon gave his opinion that the CAA may not simplify emissions control because states are moving ahead with their own legislation; control may still have to proceed case-by-case. After his introduction, Dr. Trichon began to talk about NO_x and VOC emissions control, and made the following points:

- Dr. Trichon began with NO_x control technologies, such as combustion technologies, catalysts, and burners, and emphasized the need to develop more effective, more efficient NO_x control devices. Research-Cottrell's main research goal is to develop technology at 1/10 the cost or even 1/100 the cost of existing technologies.

- There are three options for VOC emission control:
  - -- Process modification;
  - -- Recovery; and
  - -- Thermal oxidation.

- All three have advantages and disadvantages, therefore a complex matrix of decisions must be made for choosing which type of air pollution control to employ. Some of the elements to consider are size, structure, and flexibility. Retrofit of equipment may be cost effective, because retrofit can be 1/10 or ever 1/20 of the cost of new equipment. It is important that the supplier guarantee that the pollution control will be effective. The state of California, for example, requires guarantees.

- Continuous Emissions Monitoring Systems (CEMS) technology is important in the emissions marketplace. Firms can trade emissions, either total quantities or specific types of pollutants. The trading of speciated pollutants requires equipment that can accurately determine which pollutants are being emitted and in what quantities. A firm must be certain that it is within its permit shield before it begins to trade emission credits. It is Dr. Trichon's opinion that those firms that choose to implement CEMS early will have a high rate of success in the 1990s and in the next century.

The challenge is to find cheaper, more efficient ways of controlling emissions. Research and development, both government and industrial, is key to this endeavor.

* * *

Denise Viola, Commercial Manager of the Stationary Source Catalyst Business, a subdivision of the Environmental Catalyst Group at Engelhard Corporation, presented last. Engelhard is involved in stationary source pollution control for NO_x, VOC, and CO emissions. The company has been involved in environmental catalysts since the 1960s.

Ms. Viola outlined several methods a firm can choose to reduce their pollutants:

- Process modification, which will mean either a change in the system design or the inputs;
- Recovery; and
- After-treatment.

Ms. Viola made the case for after-treatment, pointing out that it allows the manufacture of an uncompromised product, it can eliminate up to 99% of emissions, and it can result in no additional by-products. However, this solution is not without concerns. First, it is an additional process, requiring additional people; second, it may dictate the product process; and third, it can slow down the main process if it is not reliable. Engelhard, as a supplier, sees it as their duty to handle those concerns.

Many different after-treatments exist: catalytic thermal, flares, adsorption, absorption; there are also "high-tech" alternatives, for example cryogenic, UV, and addition of ozone. The current after-treatment technologies fall into three categories: catalytic, thermal, and chemical.

Engelhard and other emission control firms should focus on selling a solution to industry, working with industries to meet their individual needs. Flexibility in terms of cost and design is key, because the stream of emissions may vary in flow rate, concentration of emission, or type of contaminant. Other important aspects of selling a solution are the availability of the technology and cost, its warranty, and service. Engelhard provides cradle-to-grave operability, routine maintenance, and compliance testing.

System improvements include increasing the range of applications. Catalysts can handle many contaminants and can be regenerated since the contaminants can be removed. Catalysts have a low operating cost, and a low operating temperature. For NO_x reduction, catalysts that can operate at higher temperatures would require no cooling air and thus lower costs. Innovations have been made in catalyst development, and by combining different types of catalysts, Engelhard has been able to make units that operate in a wider range of temperatures.

Many industries use VOC catalytic after-treatment, for example the wire coating, paint finishing, wood treatment, house siding, automobile, tire cord, printing, food, and pharmaceutical industries. There are many applications that use NO_x after-treatment as well, such as gas turbines, coal-, gas-, and oil-burners, refinery heaters, reciprocating engines, diesel engines, and chemical process gases.

Ms. Viola ended her presentation with a look to the future of emissions control. A firm's small incremental investment may result in higher control than necessary, and the firm would have an emissions credit to sell. The technology is the only limit to the laws we enact. As the technology improves, the requirements to be met will become more stringent.

QUESTIONS AND ANSWERS

After the panelists had given their presentations, Ms. Wyatt opened the floor for questions:

What applications does biofiltration have as a means of controlling VOC emissions?

> Dr. Trichon replied that there have been applications of that technology in Europe. Research-Cottrell has been looking into it for the U.S., but there is concern that the organisms will enter the environment.

How the cost of SPRED 2000 (Glidden's VOC-free paint) compare with the cost of other paints?

> Mr. Kovalack explained that the cost relates to a paint's performance; its cost is not all that different from Glidden's other paints: the VOC-free flat is 10% higher than Glidden's flat line, the eggshell costs more than the flat but comparable to the other eggshells, and the semi-gloss is about on par with the other semi-gloss paints. SPRED 2000 will be available nationally in June.

Have you seen an increase in sales of control technologies?

> Mr. Hyde answered that Grace has seen a 30-100% increase in sales.
>
> Dr. Trichon said that there has been a big increase in VOC emissions control. There has also been an increase in the demand for FTIR analyzers (Fourier Transformer Infrared analyzers, which can fingerprint chemicals based on the chemicals' emission/absorption of a particular light spectrum). But there seems to be a "wait and see" attitude since the government has placed a moratorium on regulation.
>
> Ms. Viola basically agreed with Dr. Trichon. Engelhard saw a big increase, but recently there has been a lull.
>
> Dr. Trichon added that industry was unwilling to invest without a return. There is still much interest in New England and California in NO_x reduction.

Who are the largest players on the monitoring side, and are they different from the abatement players?

> Dr. Trichon responded that any firm can be a player, if they can perform over time. The market is heading towards FTIR technology, one type of CEMS, which will replace the monitors on stacks. The financial market for trading emissions credits requires quick information.

What's the cost differential between FTIR and a VOC monitor?

> Dr. Trichon explained that it depends on the outfit. The cost is "not outrageous," and FTIR is a technology that can measure all kinds of things. Research-Cottrell was able to outfit a firm with an FTIR device that can speciate chemicals for less than $60,000.

Does the reduction in VOCs in paint include solvents for cleaning?

> Mr. Kovalack responded that it only includes paint.

How will people get credit for VOC emissions reductions in paint, as opposed to other manufacturers that reduce their use of VOCs in the manufacturing process, but still have a high amount of VOCs in the

paint? Maybe focus groups could help paint manufacturers find out how the consumer uses paint, or other creative solutions?

> Mr. Kovalack emphasized that Glidden's goal is to eliminate 100% of the VOCs that enter a can of paint, because 100% of the VOCs in the can get released to the environment.

Are you expecting emissions trading for VOCs?

> Dr. Trichon answered that the market will demand it.

What if a plant was having trouble with their emissions on a particular day, could they buy extra emissions on a day-by-day basis?

> Dr. Trichon thought that it will depend on how regulatory agencies allow the marketplace to be set up.

When do you foresee the end of the "wait and see" approach taken by industry? Will there be an upturn, or will spending be delayed indefinitely?

> Mr. Hyde predicted that some technologies may not come into their own until the late 1990s, but reformulations are happening on a daily basis and will have increased acceptance in the marketplace around 1993 to 1995. NO_x gas-fired emission control systems will increase around the middle of the decade.
>
> Dr. Trichon outlined a three-step process: taking inventory of what you have, technical assessment and selection of a solution, and the purchase of equipment. The last step is probably five to seven years away.
>
> Ms. Viola's opinion was that the upturn will happen in the later part of the decade.
>
> Mr. Kovalack added that the three steps are learning, reaction, and panic. We're in the learning stage right now. The first MACT standard will be for the customer, the second will affect Glidden, which gives them time to be prepared.

There's the perception that being environmentally responsible is incompatible with being a good business. Grace seems to take a proactive stance towards the environment. How do you present that to investors, to those that are concerned about the bottom line?

> Mr. Hyde responded that Grace is among the 85% of Americans that think being environmentally responsible is the right thing to do. Grace is also a manufacturing company that is on both sides of the equation. Grace has its own environmental problems to solve and is in the business of helping others solve their environmental problems. But Mr. Hyde saw no incompatibility between chemical industry and control of that industry, and expects an economic return. He also remarked, though, that the playing field is not level between American firms and their counterparts overseas.

What's the state of the world in terms of standards for VOCs?

Dr. Trichon responded that this has not been determined yet, but it will have to be standardized. The marketplace will make it happen.

What's the best way to handle low-concentration, high-flow streams? And what is the timetable for the development of that technology?

Dr. Trichon answered that the timetable is as soon as possible. Biofiltration is one possibility that Research-Cottrell is looking into, as well as oxidizing organics in a scrubber, and another process Research-Cottrell has developed: a unit for high volume gas that is 1/10 to 1/100 the cost of oxidation units. He was not sure if it would support high concentrations. The technology to emerge will be the one that is most practical, cheapest, and easiest to use.

Is there a catalyst for chlorohydrocarbons?

Ms. Viola answered yes, and that is it already being used in practice.

LUNCHEON ADDRESS
Transportation Fuels of the 90s
Robert E. Wycoff, President, ARCO
April 22, 1992, 12:45 p.m. - 2:15 p.m.

Thank you. I'm delighted to be here today to give you ARCO's point of view on the transportation fuels situation in this country as we continue through the turbulent 1990s.

As the theme of this conference suggests, we in the oil business also see business opportunities coming out of the clean air movement. But sometimes it seems that while the air may be getting cleaner, the political haze gets denser by the day.

It reminds me of the surgeon, engineer, and politician who were arguing about whose profession was the oldest.

"Mine of course," said the surgeon. "Eve was made from Adam's rib--clearly surgeon's work."

"Wrong," said the engineer. "Genesis tells us that the heavens and the earth were formed out of chaos. That's obviously an engineering task."

"Oh yeah?" chimed in the politician. "Who do you think created the chaos?"

That's a bit unfair, of course. Air quality is a hugely complicated issue and it will require a political solution. Whatever the reputation of the oil industry, I can assure you that we are as interested as anyone here in cleaning up the air over our cities--and arriving at the correct political solutions. It is clearly a critical issue for a company like ARCO and for our customers.

And as part of that solution, we continue to favor gasoline--reformulated gasoline--as the most logical transportation fuel for America in the 90s and many years into the next century.

ARCO, of course, has taken the lead in developing reformulated gasoline and advertising its advantages to the world. That's why I'm here today. But simply saying that we continue to believe in gasoline doesn't end the argument--indeed, for many sitting in this room today, it merely revs it up. And we realize that Americans will accept only solutions that are fully explored through the political process and ratified by public approval. And that, of course, is as it should be.

In a problem as ubiquitous as dirty air, the government clearly must act to correct what amounts to a serious shortcoming of the market system. And without government action ARCO wouldn't have been able to introduce reformulated gasoline. And because of that introduction I can say that we at ARCO are firmly convinced that the turn of the 21st century will find us still strongly in the gasoline business. We believe millions of cars and trucks will be operating in Southern California--our principal market--and most will burn reformulated gasoline.

Then, what about methanol, CNG, electricity? Will they be operating in the turn-of-the-century transportation market? Probably. There has certainly been a flurry of announcements lately about methanol cars, electric cars, even a hydrogen-powered car--highly experimental--from Japan. I suspect that we'll see more and more of such vehicles on the road as the years pass and the technology advances. But that doesn't mean the hydrocarbon era is dead--far from it. Advances are happening here, too. Last week

Ford introduced two new gasoline cars in California that are very clean, producing emissions at less than half the levels permitted in the state. That's the direction we need to go.

And I saw in the parking lot outside the hotel a car equipped with something that may be a major advance--the preheated catalytic converter. It's made by Camet, a subsidiary of W.R. Grace. We've been testing one at our lab in Anaheim and have been getting exceptional results. Another very good development for the future, especially when combined with reformulated gasoline.

So despite these new entrants into the market, we continue to believe that gasoline will hold center stage for many years to come. Of course, that forecast is consistent with our own wishes and expectations. After all, that's what ARCO in the main is--a gasoline producer and marketer. Over the past decade, we've managed to fight our way to the top of the largest gasoline market in the world, California. It's a good business. We don't want to see it disappear.

But our expectations about gasoline's future must be based on more than simply wishing. And we do have the facts on our side, facts that say that for many years to come, gasoline will continue to be what it is today--the most available and most cost-efficient transportation fuel for America and the rest of the industrialized world.

And we are currently marketing gasoline which demonstrates these facts. It's available now. It's affordable and it will operate today's cars with no modifications. We introduced the first of our reformulated fuels--EC-1 Regular--back in September of 1989 because it had become obvious that we had to do something. Either we would act to preserve our gasoline business or see it literally legislated out of existence. We wanted to show what a clean gasoline could do in old cars that had been running on leaded regular. Not a test, but a real commercial product.

What really prodded us to do this was when the South Coast Air Quality Management District published its Air Quality Management Plan early in 1989. To bring the L.A. Basin into compliance with the Clean Air Act regulations--something that had obviously never been done--the AQMP called for the complete electrification of automobiles in the region by the year 2010. M85--85 percent methanol, 15 percent gasoline--was to be the transition fuel, with gasoline phased out and all refineries in Southern California closed.

I can tell you, that got our attention. We said, hey, wait a minute--you're talking about putting us out of business! You're also talking about something that can't possibly be done--converting maybe 15 million cars plus changing out the entire distribution system in Southern California to methanol and then, in another 10 years, abandoning all that and shifting to electricity.

The most curious part of that bizarre plan was the fascination with methanol. For policymakers in Los Angeles--the ones trying to comply with the Clean Air Act--it must have seemed like the answer to a prayer, a sort of white knight that was going to clean up the air pollution in Southern California or, at least, do it on paper.

But it turned out to be an illusion. Methanol has about half the energy of gasoline, meaning you have to use nearly twice as much to go the same distance. It's more expensive to manufacture, requires newly designed automobile and fuel-distribution facilities. It's highly toxic: Swallow a tablespoonful and you'll go blind. I hate to think of the accidents that will happen if people try to syphon their fuel tanks.

And, finally, there was very little data on just how clean methanol really was as a fuel. Some of us doubted the advertised cleanliness of methanol. And those doubts were confirmed by the recent tests conducted by the oil/auto task force--representing 3 automakers and 14 oil companies, ARCO included.

For the first time, gasoline and methanol were tested in auto company test facilities to compare their emission characteristics. These tests were complicated and I'm not able to convey all the results to you this afternoon. In some areas methanol performed somewhat better, in others gasoline came out better. The fact is, they have different products of emission. And that makes comparisons difficult.

But in the most important test, the ozone air quality modeling results, conventional gasoline was clearly better than methanol in our marketing area, Los Angeles. And a reformulated gasoline, though not as good as EC-X, did even better.

I know these tests have been challenged. Some even say the oil companies distorted the results in favor of gasoline. But the fact is that the auto companies ran these tests and they certainly have no vested interest in gasoline. The auto companies do argue that the flexible fuel vehicles (FFVs) used in the tests were relatively primitive. They say they can tighten up on evaporative emissions and improve methanol's performance. I'm sure they can, but I don't think that will substantially change the implication of those tests.

If the auto/oil tests had come out with the result that methanol was considerably less polluting than gasoline, then this country would have had a problem--to decide whether the additional cost--and methanol is far more expensive than gasoline--was worth the environmental benefit in the cost-benefit tradeoff. But that problem is avoided because the cost-benefit tradeoff as it came out was a pretty simple one: there is not benefit to methanol and there's a huge cost. So why do it? Nevertheless, the romance with methanol obviously intrigued many policymakers in California and Washington, and I guess still does. We refer to them as "methaholics" because of the intensity of their efforts to force this fuel on the public.

But perhaps there's a silver lining to all this. Because that's why ARCO got busy and introduced our first reformulated gasoline. We didn't introduce EC-1 to get share of the market; we did it to get share of mind. We wanted to tell the world, look, there is an alternative to methanol. It's cheaper than methanol, has nearly twice the energy, can be used in cars with no alterations to the engines and is at least comparable environmentally.

Well, it worked beyond our wildest imagination. We put a new phrase in the energy vocabulary--reformulated gasoline. And if ARCO hadn't done that, reformulated gasoline would not be in the Clean Air Act Amendments as an alternative to conventional gasoline. That's the impact EC-1 has had on U.S. law and regulations.

In 1990, we came out with EC-Premium for the top end of the market. Two months later, AQMD announced that the L.A. Basin had the fewest smog alerts in the previous six months since they'd begun keeping records in 1955. We'd like to take the credit, but in reality we can't. But we do know that these two fuels are cutting pollution in Southern California by over 120 million pounds a year.

Progress had clearly been made, but not enough. We realized we would have to go a lot further before L.A. air quality would be acceptable--and the future of our gasoline business reasonably secure. That led us in July 1991 to announce our third reformulated gasoline--EC-X.

EC-X is the state-of-the-art--the ultimate gasoline. If all cars and trucks in California were using it today, vehicle pollution would drop 3.8 million pounds a day--that's 1.4 billion pounds a year--over 10 times the improvements of EC-1 and EC-Premium. That would do as much to clean the air as taking eight million cars off the road. That's nearly a third of all the vehicles registered in California.

Now, we had a clear agenda in announcing EC-X when we did. We knew that the California Air Resources Board was deliberating over the gasoline emission standards that would be imposed in the state starting four years from now, 1986. Our hopes were that CARB would make EC-X, or something with very close to equivalent results, the standard for all refiners. That would allow us to make the investment to refine it.

Well, that's how it's worked out. Last November, CARB issued the emission regulations that will govern gasoline sold in the state beginning in 1996. They're virtually identical to the results produced by EC-X.

In developing this new formula, it's interesting to note that ARCO was not only duelling with the regulators--we naturally expect to do that--but with the rest of the oil industry, too. The other oil companies were upset by the toughness of the EC-X formula and the cost of producing it.

Compared with conventional unleaded gasoline, EC-X produces remarkable results--31 percent fewer hydrocarbons, 26 percent less carbon monoxide, 26 percent less nitrogen oxides, 39 percent less ozone, 35 percent less evaporative emissions.

Performance like that doesn't come cheap. Compliance with CARB's stringent Phase II gasoline regulations will cost California refiners $6 billion to $10 billion, according to some estimates. I can't vouch for those figures, but we do know that converting ARCO's L.A. refinery to total EC-X production will cost in the neighborhood of $800 million. That means we'll have to increase our gasoline tankwagon price by about 16 cents a gallon.

But the prospect of such a sharp increase in the cost of refining upset our colleagues in the industry. Some oil companies joined with the methanol advocates in attempting to persuade California to soften the regulations. But ARCO was convinced that anything less than EC-X performance, anything that burned dirtier would give anyone looking for it the excuse they needed to get rid of gasoline altogether.

We didn't want that--and it appears that we've won that particular battle. But the regulatory wars are far from over, and now we're searching for ways to fight another skirmish with AQMD, this one having to do with the so-called smog tradeoffs. On the face of it, the idea of a market-based solution to stationary-source air pollution is an excellent one. ARCO pushed for it originally. But the program that has been introduced by AQMD under the name of RECLAIM is a far cry from what we envisioned. As it stands, we believe the program is unrealistic, unworkable and a threat to the whole reformulated gasoline movement.

The core of the idea is that companies like ARCO would be free to reduce air pollution in any way they see fit. If you can't modify your facilities to cut pollution, or decide that it would be too expensive, you could buy pollution rights from the overcompliers--those able to reduce their emissions well below their quotas. Thus, the free-market concept. The rights would be traded on the Chicago Board of Trade--I saw this morning that sulfur dioxide credits will be traded that way.

Sounds good. Unfortunately, the reality is less palatable. The program, to begin with, is too limited. Only about 2,700 companies would be included, accounting for less than 15 percent of emissions in the L.A. Basin. Year by year, these companies would be forced to cut emissions by 85 percent, according to an inflexible schedule. This comes on top of about a 75 percent improvement already accomplished. We're convinced that's impossible. For some, the answer might be to simply to shut up shop, sell the pollution rights and go somewhere else--Nevada or Arizona, perhaps. Good locations to sell back to the California market.

So, not only will RECLAIM drive established industry out of the state, it will also discourage new plant investment--including, possibly, ARCO's EC-X retrofit. When industry leaves, of course, jobs follow--not an encouraging prospect for California. The state has already lost more than a half-million jobs in the recession, and is hemorrhaging thousands more every month as companies seek relief from the unrealistic tax and regulatory climate that produces programs like RECLAIM.

This is something of a Catch 22. We may be prevented from making refinery investments needed to comply with mandates from one California regulatory agency by the mandates of another. Reminds you of the story of chaos that I opened up with.

Let me sum up my remarks with this disclaimer: I don't want to come off as a nay-sayer today. Cleaning up our fuels and cars is essential and we agree wholeheartedly with that. In fact, as I've outlined this afternoon, at ARCO we're trying to lead the charge.

But as the cleanup effort continues, there are some things that definitely won't work. We think it would be a mistake to try to reshape the transportation fuels industry in ways which ignore tradeoffs among economics, environmental benefits, energy security, public health or adequacy of supply.

For that reason, and <u>not</u> simply our own sense of self-preservation, we believe that misguided regulations that have the effect of crippling the gasoline industry are plain wrong and a gross disservice to the public. Such a move would not serve the people of this country from any point of view--cost, environmental benefit or national security.

We're not against sensible regulations for good environmental benefit. That's really what our EC-X gasoline is all about--paying a slightly higher cost to help clean up the air. But paying extra money <u>without</u> getting any environmental benefit--that we're against, and that's what will happen in our judgement if government tries to force methanol into the market.

In closing, let me say that our commitment at ARCO is to continue to press for the future of reformulated gasoline, a challenge we undertake because we are convinced the facts support our belief in the superiority of the fuel.

Eventually, as I suggested a moment ago, America may shift wholesale to electric cars, the zero-emission vehicle we all hunger for. I can't let that pass, however, without mentioning that the fossil fuel power plants emit some pollutants that make smog. Nothing is without its price.

In any case, I should mention that in the April <u>Smithsonian</u> an article about GM's Impact electric car gave me encouragement, not only about the future of electric vehicles, but about the future of gasoline, too.

If you haven't seen it, the article enthuses about the design of the car, acceleration, handling and so on. But the writer notes a major drawback: "When all 870 pounds of its batteries were fully charged, they contained as much energy as one gallon of gasoline."

The Impact performs as well as it does on the equivalent of one gallon of gasoline because it's so light--lighter, in fact, without the batteries than the old Volkswagen Bug. Imagine what it could do with two gallons of the real stuff--gasoline. The fact remains that no transportation fuel in the world is as powerful as gasoline, or provides so much energy in such a tiny package. And if it's ARCO EC-X, or something like it, we believe it will be a fuel that will meet society's needs for power, cleanliness, and cost-effectiveness for decades to come.

Thanks for listening.

SESSION 2 -- PANEL A
Control Technologies - Automobile Emissions
April 22, 1992, 2:30 p.m. - 5:00 p.m.

INTRODUCTION

Bruce L. Bertelsen, Executive Director, Manufacturers of Emissions Control Association, moderated. Before introducing the panelists, Mr. Bertelsen noted that the Clean Air Act Amendments of 1970, as well as the 1990 Amendments, set in motion changes in terms of how we as a nation deal with the air pollution problem and how we go about conducting business. He stated that the focus of the panel is to explore ways in which the 1990 legislation has affected the marketplace in terms of creating new market opportunities, examine the technological developments and new products that will bring automobiles into compliance with the new emission standards, and consider how these requirements affect the process of bringing forward new automobiles.

PRESENTATIONS

Dr. Jerry C. Summers, Director, Technical Department, Allied-Signal Inc., provided an overview of the activities at Allied-Signal aimed at mobile source emission control applications, particularly hydrocarbon emissions. Catalytic conversions in automobiles require high temperatures; therefore, the research being conducted at Allied-Signal and around the world addresses higher temperature applications in addition to the 100,000-mile durability requirement. Dr. Summers noted that future standards will require a whole new breed of catalytic technology.

One study considered underfloor performance when catalysts were placed off the engine manifold. A vehicle was equipped it with an underfloor catalyst and a manifold cat. Emissions reductions were high enough to move the program ahead into developing closed couple technology that would meet California LEV standards. These results having been achieved, Allied-Signal is currently working to achieve ULEV standards with the technology.

Dr. Summers explained that Allied-Signal research has shown that the various noble metals have different tendencies towards conversion of CO, NOx and hydrocarbon. Palladium, a relatively low-cost metal, has achieved impressive results: all palladium catalysts have virtually met the 1992 and 1993 emission standard levels with a life-span of 100,000 miles. A test vehicle was equipped with a closed couple catalyst and an underfloor catalyst of all-palladium composition. A second experiment with an all platinum/rhodium formation was conducted to compare results. The palladium catalyst achieved lower hydrocarbon emission figures and also proved to be much more resistant to sulfur poisoning. Dr. Summers noted that gasolines with lower sulfur content will further assist in emission reductions. More advanced palladium catalyst technologies currently being tested at Allied-Signal have achieved hydrocarbon emission rates of only .042 grams/mile.

Dr. Summers described another study, which examined the effects of increasing the amount of palladium in the catalyst. Since palladium is relatively inexpensive (Dr. Summers quoted a figure of $85/troy ounce versus $340/troy ounce for platinum), it will allow companies to realize better hydrocarbon conversion performance at a lower cost. A palladium/rhodium catalyst achieved 27% more reduction that the conventional platinum/rhodium catalyst, meaning only 11% of the hydrocarbons were emitted. By doubling the palladium content, only 8% of the hydrocarbons were emitted.

Allied-Signal, together with ULP, Inc., is developing an absorber catalytic system in which hydrocarbons are absorbed from the exhaust string and then released into a catalyst. After a few seconds, the catalyst is warm enough to handle conversion of the hydrocarbons, which are then released. Overall hydrocarbon removal levels through the first couple of cycles have been quite high. The absorber material can be used with ceramic, metallic, foam, and other types of substrates. There are no noble or base metals used in the process; technically it is a non-catalytic application. Dr. Summers stated, however, that the process is not a radical departure from the conventional systems previously developed. He added that there are several other new technologies being developed that can be combined to achieve optimal hydrocarbon removal levels. Improving high temperature performance, hydrocarbon absorption capacity, and the time that the absorber material holds onto the hydrocarbons are some of the technical issues that will be addressed during the next few years of research.

Dr. Summers continued by discussing catalytic technologies being developed for alternative fuels, including natural gas, and organic emissions. Because methane requires a significantly higher temperature for conversion than normal catalysts can effectively provide, the emissions standards that are developed for compressed natural gas vehicles will play an important role in the course of research. If the standards include a total hydrocarbon standard for compressed natural gas vehicles, conversion of methane will be a primary goal. If there are no total hydrocarbon standards, work on CO and NOx would become the main focus. Dr. Summers believes that global warming issues and the probable interpretation of the 1990 Clean Air Act Amendments will demand some sort of hydrocarbon standard. Dr. Summers continued by explaining that the California targets for organic emissions such as aldehydes and unconverted ethanol and methanol can be easily met by the application of combined systems (e.g., palladium systems combined with platinum/rhodium, closed couple and underfloor systems, etc.). Some of these technologies are actually in production.

Dr. Summers then discussed some of the benefits from the use of lean-NOx catalytic technology:

- improved fuel economy;
- reduced CO_2 emissions;
- improved hydrocarbon control;
- simplified emissions control systems; and
- solutions to major NOx emission problem of diesel engines.

Dr. Summers stated that this is probably the most highly researched topic in emission control catalysis around the world today. While laboratory activity is promising, applying the technology on vehicles has been discouraging. Rapid deterioration and poor performance of the systems caused by high temperatures and sulfur poisoning are the prime areas of concern. Dr. Summers noted that universities, car companies, and other firms world-wide are striving to achieve a breakthrough in durability in order for this technology to be applied. Dr. Summers concluded his remarks by stating that lean-NOx catalytic technology has been developed at a much faster pace than was predicted five years ago.

* * *

Clifton L. Smith, Vice President and Business Manager for Ceramics, Corning Inc., discussed Corning's involvement in the development of catalytic converter substrate technologies. He began his remarks by applauding the EPA's policy of determining the standards of the clean air program and leaving emission control technology to the automakers and their suppliers. The private sector is able to identify the most cost-effective means of achieving regulatory requirements.

Corning's emissions control work started in 1970 when research began on ceramic catalytic converters. Corning received patents for two key inventions:

- a new low-expansion ceramic material necessary to combat thermal shock and corrosive agents, and

- an extrusion process invention to provide the substrate with its distinctive honeycomb structure, critical to providing a large amount of surface area in a very small volume.

In the early seventies, approximately 9 million units were sold annually; today, 35 million units a year are needed. The first substrates that were generated had 200 squares per inch. By 1976, Corning had introduced a 300 cells/inch substrate. The added surface area increased overall conversion efficiency by 14%. In 1979, Corning introduced a 400 cell substrate which is still used today and achieves 29% more conversion efficiency than the original Corning substrates.

Besides the conventional substrates, Mr. Smith described three other Corning products: a Large Frontal Area Product (LFA), a diesel filter trap, and a 236-cell triangular substrate. He noted that space limitations under automobiles require different shapes and sizes of substrates.

In 1990, Corning released two cell core XT (extra-thin) substrates; both the 475 and the 355.5 mill wall units make use of newer, more dense ceramic material. The cell walls are extremely thin, about the size and thickness of two regular sheets of paper. The 475 unit provides added surface area and about 24% improved conversion efficiency without deteriorating any back pressure. The 355 offers improvement in reduced back pressure by about 14%, without any deterioration in conversion efficiency. These units save both space and weight, high priorities to auto manufacturers, and are made from the low-cost ceramic materials.

Mr. Smith also described Corning's work involving electrically heated catalyst units. Laboratory tests of the unit substantially beat the 1997 California ULEV regulations. The technology combines electrically heated metal substrate with a standard cellular ceramic substrate. The metal reaches 600 degrees Centigrade in a few seconds, preheats the exhaust gases through the metal honeycomb and into the ceramic unit; it is the ceramic unit where the bulk of the emissions are converted. Mr. Smith explained that, in effect, the heated catalyst "kick starts" the catalytic converter and is able to convert most emissions during the cold start phase when most pollutants are emitted unchecked.

The body of the electrically heated catalyst is a monolith, one piece of metal extruded from Corning-patented powdered metal composition. Both the electrode and substrate are formed from the same composition, eliminating thermal mismatch, and efforts are underway at extruding both the electrodes and the body as one unit. Durability issues and reducing the electrical energy requirements are two important questions that must be answered through further research. Corning has succeeded in dropping energy requirements by 70% in only two months, from 38 watt hours to 12.1. The unit takes less than 5 seconds to preheat prior to ignition, and begins to convert emissions immediately; in contrast, today's converters take two minutes to heat up and begin working.

Mr. Smith concluded his remarks by noting that the technologies he discussed have been developed due to the challenges presented by the California ULEV regulations. He reiterated his support of the EPA policy of setting regulatory goals and leaving the solutions to private industry.

Richard C. Cornelison, President, Camet Corp., a unit of W.R. Grace and Co., discussed Grace/Camet's research involving electrically heated converters (EHCs). Mr. Cornelison explained that cold start emissions can be classified as those occurring in the first 505 seconds of operation of a car in the FTP driving cycle, and are referred to as "Bag 1" emissions. Bag 1 emissions typically account for 80% of the emissions that occur in the entire driving cycle. In 1987 EPA initiated a search for a practical solution to the cold start emissions problem. The EPA study examined several different technologies and tested both alcohol fuels and gasoline. According to Mr. Cornelison, The data proved that EHC systems were the most effective and eliminated an average of 85% of Bag 1 emissions. W.R. Grace/Camet set out to develop an integrated system solution to these emissions, recognizing that the auto manufacturers would have to be included in the development process. Resources for integrating the electronic controls from the EHC with the engine logic controls and the large-scale integrated circuits would be required from the auto companies.

In 1990, the California Air Resources Board adopted a rule providing for several levels of LEVs. Mr. Cornelison pointed out that, because of the California rule, the funding by Grace and the resource commitment to the EHC program was increased significantly. Mr. Cornelison emphasized the importance of regulators recognizing that the planning and the financial resources can be committed only when the "goal lines" of a regulatory program are well-established and well-known to attract the resources necessary to do the job. He added that in recent months foreign governments and states in the northeast have moved to adopt the California standards.

Mr. Cornelison presented overheads illustrating the Grace/Camet EHC core and noted that it is formed from a metal foil only 2 mills thick. The EHC weighs about .01 pound/cubic inch, yet it has to be rugged enough to withstand hot shake tests at about 1850 degrees Fahrenheit. The power ratings on these units typically range from about 1 to 4 kilowatts or between 5 and 10 watt hours in order to achieve the California standards. Mr. Cornelison continued by explaining the support elements of the system being developed by Grace/Camet's alliance partners, other firms involved in the project. These support systems include mounting, electrodes, coatings, the battery and cables, alternators, power sources and power switching devices, and the electronics control strategy. He expects the system to cost auto manufacturers $200-$300 and weigh between 25 and 40 pounds, depending on the size of the engine and the development of smaller batteries.
He added that the system does not lend itself to retrofitting on older cars.

Mr. Cornelison stated that, although road testing on the part of the auto companies remains to be done, results of the durability tests have allowed Grace/Camet to begin tooling up for full-scale production of the EHC core as the support elements are shifted to alliance partners. The system has met the California standards and some of the data indicate that two-liter engines may not need EHC systems; if so, EHC systems will be targeted largely at some of the larger cars. Mr. Cornelison concluded his remarks by noting that the vehicle on display at the conference was equipped with a Grace/Camet EHC system and technical representatives were available to answer any questions. He expects that implementation of the EHC system will be achieved, with the help of the American automobile industry, in the 1997 model year as required by the California timetable.

* * *

Andrew Kaupert, Research and Environmental Staff, General Motors Corp., discussed the costs and challenges facing the automotive industry as a result of the 1990 Clean Air Act Amendments. In addition to the four mobile source areas of tailpipe and evaporative emissions, emission control systems, diagnostics, and inspection maintenance, the Act challenges the industry by its requirements for industrial plant emissions, alternatives to CFCs and fossil fuels, and potential hazardous or toxic materials. Mr. Kaupert cautioned that the economic state of the auto industry severely limits the capital available for radical solutions to all of the challenges presented by the Clean Air Act Amendments.

Mr. Kaupert expects that the mandated reductions in tailpipe emissions and evaporative emissions will be developed with in-house resources, as these controls will not require additional hardware or new inventions. Tailpipe emissions reductions will most likely be achieved by major additional air/fuel ratio control and the refinement of catalytic converter location. While the rules governing the demonstration of evaporative emissions compliance have not been finalized, except by the state of California, Mr. Kaupert stated that future evaporative emissions will be controlled by a combination of temperature control, purge management, and canister capacity.

Mr. Kaupert continued by stating that the Clean Air Act mandates for the diagnostics of the emissions controls is a potential area where the marketplace may be of assistance. The development of sensors could be done simultaneously with the vehicle systems; however, software development will most likely remain under the control of the manufacturers. Mr. Kaupert noted that the regulation could challenge the system without addressing the knowledge base of a wide-range of vehicle operating conditions. This could give rise to a situation of numerous false malfunction warnings, to which customer reaction will be vital. Customers could either ignore a real warning or raise such a cry that the regulation is eliminated. Mr. Kaupert noted that a similar situation occurred previously with seatbelt interlock case sensors, with a considerable loss in investment.

Mr. Kaupert stated that the enhanced inspection and maintenance provisions of the legislation offer the most potential for marketplace assistance. While the development of enhanced testing equipment and facilities will probably remain outside the vehicle manufacturer's interest, the upgrading of repair facilities and skill levels of the repair facility employees will directly affect the manufacturers. As future emission control systems emerge, the ability of the present repair facilities to rectify in-use emission failures and the skill levels of these employees will be severely taxed without immediate and costly upgrading.

Mr. Kaupert explained that, although the marketplace may expand due to the requirements of the Clean Air Act, potential suppliers and the manufacturers must address the technical concerns of timing, Quality/Reliability/Durability (QRD) and cost:

> **Timing.** The lead time necessary to place a quality product into consumers' hands has already passed for the near-term standards of the Clean Air Act and is rapidly diminishing for the mid-term standards. Opportunities for others to enter the marketplace are also reduced because of the lead-time necessary to develop new products. GM, for example, has a four-phased process that mandates that no later than four years before the model year the vehicle gets on the road, all of the quality will be built into that vehicle. Mr. Kaupert explained that GM is beyond the time for 1994, 1995 and 1996 model refinements; hardware for 1997 and 1998 models should be ready for production.

QRD. Mr. Kaupert stated that QRD will have an effect on the marketplace. Because of today's highly competitive market, QRD is paramount to survival in the automotive industry. Consequently, manufacturers are reluctant to abandon total control on quality, reliability and durability and rely on others for invention.

Cost. Cost is a major concern within the auto industry as it struggles to return to profitability. Beside the obvious hardware costs associated with meeting mobile source standards, the costs associated with raising the capital to finance both the development of new products and compliance systems can be staggering. Added to these are the administrative costs in demonstrating compliance with regulations during the next few years. One cost often overlooked is the cost necessary to accommodate the revised hardware (e.g., the major floor-plan revision to accommodate the closed couple exhaust catalyst). Mr. Kaupert provided figures recently published by the National Academy of Science that estimate the costs of compliance with emissions standards as high as $1600 per vehicle. Mr. Kaupert stated that if the $1600 per vehicle figure is correct, the economic elasticity models equate this to a loss of sales of about 9.9% This loss in sales in turn will result in approximately 24,000 jobs lost in the automotive and auto-related industries.

Mr. Kaupert concluded his remarks by stating that the Clean Air Act Amendments may create manufacturing of emission controls, but the potential of lost vehicle sales in the auto industry may offset gains in the manufacturing of the emission controls; serious concerns remain that the social costs of the legislation far outweigh the social benefits.

QUESTIONS AND ANSWERS

After the panelists had each given their presentations, Mr. Bertelsen opened the session up to questions from the floor:

A member of the audience asked Mr. Kaupert if he had any figures estimating the improvement in health as a result of cleaner air?

Mr. Kaupert replied that he did not recall any such figure from the National Academy of Science report, and that the $1600 figure is the potential cost per vehicle of meeting all of the emission reduction standards. Mr. Kaupert agreed that it would be interesting to examine figures comparing the number of deaths caused by complying with the regulations to the number of deaths caused by not complying with the regulations.

Mr. Kaupert was asked if sales have gone down because of the additional costs associated with options such as power seats and windows, airbags, and seat heaters?

Mr. Kaupert stated that GM is supplying those options to a customer who wants them; the consumer who asks for those features typically has no concern either about emission requirements or fuel economy requirements.

The same audience member suggested that there are consumers who would like to purchase vehicles that are clean.

A member of the audience asked Mr. Smith what car and fuel were used to attain the FTP results mentioned in his presentation, and was it still running at 24 volts?

> Mr. Smith replied that 24 volts was the correct figure; he was not sure of the exact make and model of the car used, since the testing was done by an independent firm.

Mr. Bertelsen then provided some questions that he had prepared for the panelists and members of the audience to consider:

What have been some of the strengths and weaknesses of the mobile source emissions control program over the past twenty years?

> Dr. Summers stated that one of the strengths of the legislation has been that it used technology to drive the legislation with the result of the creation of many new products and technologies to give us a clean car. He noted that the types of driving cycles used to generate the FTP cycles are not realistic in terms of what the driving public experiences. As a consequence, there have been more fuel failures than should have occurred. In the absence of an inspection and maintenance program, the severity of the problem was unknown.
>
> Mr. Smith stated that the regulations made the industry move forward and address a problem that was not being adequately dealt with. He added, however, that the legislation should have required continuous improvement of quality. The industry is now faced with a whole new set of requirements and a short time-frame in which to achieve compliance.
>
> Mr. Kaupert stated that the program has not been recognized as a great success story; the media has portrayed the auto industry as obstinate and argumentative.
>
> Mr. Cornelison recounted a panel discussion at an SAE meeting he attended two years ago. A group of retired executives who had pioneered this program admitted their amazement at how successful it was and about the large degree of cooperation among the auto makers and the suppliers to make it all happen. The reason it was successful is that the legislation was in place and it was clear to everyone what the goals were, and the time-frame involved. Consequently the resource commitment was made in an appropriately timely manner.

What changes have the panelists seen in government-industry relations over the past twenty years with regard to the motor vehicle program?

> Mr. Kaupert stated that the early 1970s were marked by an auto industry that was essentially saying "hell no we won't go" and a fledgling, struggling government agency in EPA, trying to help the auto industry and trying to understand the emission control problem. EPA's level of technical expertise was low at that time, but built up very rapidly. Overall, it was a helpful agency. He added, however, that the roles have reversed. He sees an adversarial role built up with the auto industry by the bureaucracy. In the last 4 or 5 years efforts by the auto industry to work with emission control advances have been met with somewhat of a reluctance on the part of the agency to be flexible and understanding. EPA has almost become overly bureaucratic about the regulations.

Dr. Summers noted that he now sees regulatory staff taking very aggressive stances in trying to develop new ideas and new technologies in terms of funding and encouragement.

Mr. Smith stated that there is more cooperation now. While there is a concern relative to the costs involved, the auto firms are conscientious and want to make a cleaner, better place for us to live in; that is, of course, what the regulatory agency wants as well. Both sides are trying to find a balanced approach to achieve the goals of the program.

Mr. Bertelsen stated that during his period with EPA, the relationship between the agency and the auto industry was very adversarial; communication was lacking and most issues ended up in litigation. He noted that there has been a change; there is more dialogue going on to try to identify the problems and potential solutions. There is a better understanding on both sides in terms of what their respective needs are. There will always be some healthy tension between the two, but the two are moving towards an era of greater cooperation.

Mr. Smith and Dr. Summers were asked to comment on the cost of the EHC systems available through their firms.

Mr. Smith replied that his company would provide only a part of an EHC system and therefore the costs will not be comparable to those quoted by Mr. Cornelison during his presentation.

Dr. Summers stated that his company focuses on conventional catalytic technology, but the three things that control the price of an EHC system are: cost of the substrate, the combination of the noble metals (this is the largest cost), and coating the substrates.

Mr. Bertelsen mentioned that the panel has focused to this point on two corners of the triangle, emission control technology and engine controls; the third element is fuel quality and serves as the final technological solution.

From the perspective of your individual company, what do you see as the greatest opportunities, challenges, and problems of the Clean Air Act Amendments of 1990 and the California LEV program?

Mr. Smith answered that there will be significant benefits as a result of "stretching" the technology; whether it be in the materials or the processes that are developed. There will be "fallout" into other businesses beyond mobile source emission controls. At the same time revenues will be generated. He added, however, that these programs will require a large amount of investment rather quickly. He suggested that the industry and government work together on these issues to move at a steady rate of improvement to allow for a more cost-efficient means of achieving the regulatory goals.

Mr. Kaupert agreed with Mr. Smith and added that the biggest challenge to the auto industry is the on-board diagnostics. He stated that there is a large potential to irritate the consumer by either poor performance or excessive cost, a big concern to auto makers. He also stated that the source of funding to meet the requirements is of concern given the current state of the American auto industry.

Mr. Cornelison stated that one of the great opportunities is the maintenance of the vehicles on the road. This will require that an enormous amount of people receive training. The main

challenge in implementing the Clean Air Act is cooperation among the parties to make all the programs work; they are complex and expensive and without cooperation it will not be done well.

Dr. Summers added that the extension of technology, today's computerized car, is a direct consequence of three-way catalytic controls; the automobile will continue to evolve as a high-tech product. Allied-Signal will see a return on the large investment in R&D with the sale of new products. He stated concern, however, with the enormous number of options that face the auto industry. He suggested that there are more options than even the largest firms can handle with the resources they have available to them.

Do you see any benefit or role for greater government involvement on the part of the government in terms of R&D?

Mr. Kaupert stated that we are starting to see more and more consortiums involving the government and noted the electric vehicle projects. He stated that there is a benefit in being able to pool resources and to be able to tap into the National Laboratories, previously involved in the defense industry.

Mr. Smith added that the U.S. should learn from the Japanese and develop more cooperation between government and industry in certain targeted areas

Paul Haluza, Motor and Equipment Manufacturers Association, referring to the success of the mobile source emissions control program, suggested that the Clean Air Act has removed any incentive for people to remain in the maintenance, or independent after-market industry. More and more emphasis has been put on "cradle to grave" protection, as we've gone from 50,000 mile durability to 100,000 durability. In the framework of the act, there is little allowable maintenance and more responsibility put on the manufacturer. There is a need for EPA to look at the whole educational system of bringing technicians on board to repair these cars. EPA's concern for the quality of these technicians is one of the reasons for increased manufacturer responsibility. The program is risking putting a $150 billion industry, the independent after-market industry, out of business.

Would you like to see more states move toward the LEV program? If so, in what manner?

Mr. Cornelison answered that in Camet's model assumes that the northeastern states will develop LEV programs, although he is unsure concerning timing. He stated that economies of scale are enormous, and as soon as states decide to implement these programs, it provides more incentives for companies to begin preparing for production.

Mr. Kaupert cautioned that the states considering LEV programs are going to require different and additional features than the California program. If they were to require exactly the same car as California, it would be beneficial due to economies of scale.

Mr. Smith stated that Corning will be in the business regardless of what happens in the northeastern states.

Will there be a supply problem in the next five to ten years of this catalytic technologies if half a dozen states adopt an LEV program?

Mr. Cornelison stated that his studies show this will not be a problem, and Dr. Summers agreed.

Mr. Bertelsen concluded the questioning by asking the panelists to give their ideas concerning the automobiles that will be in showrooms in the year 2000.

Mr. Kaupert stated that the customer won't recognize any of the differences; the changes will be in reformulated gases and other emission controls.

Mr. Cornelison stated that more lightweight materials would be in use, electronic systems will be in place, and the price-tag will be much higher; the longevity of these cars, however, will make up for the increase in cost.

Dr. Summers added that they will be more aerodynamic and fuel efficient, have sophisticated integrated components, and will have achieved the CO_2 and NOx emission reductions. He agreed with Mr. Cornelison that prices will be much higher.

Mr. Smith stated that he expects a hybrid car will be available, one which runs on electricity and/or batteries in the city and on fossil fuels for long-range driving, and that significant changes will have been made in diesel fuel technologies.

SESSION 2 -- PANEL B
Control Technologies - Alternative Fuels
April 22, 1992, 2:30 p.m. - 5:00 p.m.

INTRODUCTION

Mary T. Smith, Director of the Field Operations and Support Division of EPA's Office of Mobile Sources, opened the session by providing some background on the subject of alternative fuels. Ms. Smith noted that despite strict automobile emissions standards, vehicle emissions still account for approximately 50% of NO_x and volatile organic compound emissions, and up to 90% of carbon monoxide emissions in the U.S. Efforts to reduce total vehicle emissions have been hampered by growth in the number of vehicle-miles traveled annually, which have increased from 1 trillion miles in 1970 to 2 trillion miles in 1990. Given the continuing problem of vehicle emissions, Congress adopted a new strategy in the 1990 CAAA. While the 1970 CAA focused exclusively on automobile technology to reduce emissions, the 1990 CAAA adopts a dual approach, focusing both on automobile technology and cleaner-burning fuels, such as reformulated gasoline and oxygenated fuels.

PRESENTATIONS

Ray Lewis, President of the American Methanol Institute, began by stating what he believes is one of methanol's major accomplishments: the introduction of competition into the market for automobile fuels. By providing a clean-burning fuel that is comparable to gasoline in performance, range, and cost, methanol has spurred innovation in the fuel industry that will yield benefits both for consumers and the environment.

Methanol, Mr. Lewis continued, is a highly domestic source of fuel (1.5 billion gallons produced annually in U.S., with 750 million gallons of additional capacity by 1995) that has a diverse range of possible uses:

- "neat" gasoline (a direct replacement for gasoline);
- methyl-tertiary-butyl ether (MTBE, an octane enhancer used in reformulated gasoline);
- aviation fuel;
- turbine fuel;
- diesel fuel;
- boiler fuel; and
- fuel cells (a "chemical battery" technology that is not yet commercially available).

To illustrate the point that methanol engine technology is ready for the market today, Mr. Lewis presented previously unreleased data for a 1992 Detroit Diesel Corporation bus engine designed to run on 100% methanol fuel. When compared with data for the 1991 Detroit Diesel methanol engine, the 1992 data showed the following improvements:

- Hydrocarbon emissions declined by a factor of 5;
- Carbon monoxide emissions declined by factor of 2;
- NO_x emissions went down 30-40%; and
- Particulate matter emissions declined by factor of 2.

In all instances, methanol engine emissions were significantly below EPA standards. The city of Los Angeles, Mr. Lewis stated, has purchased 350 Detroit Diesel buses equipped with methanol engines. The Texas Air Control Board, he added, recently approved methanol as an alternative fuel meeting the required standard of being "comparably clean" to natural gas.

Mr. Lewis addressed the issue of methanol's toxicity. He pointed out that methanol is the primary ingredient in products such as windshield wiper fluid and model airplane fuel. While conceding that the toxicity of methanol is an issue that must be addressed, Mr. Lewis believes that with proper handling of methanol fuels, their toxicity can be controlled. For example, methanol automobiles will be equipped with anti-siphoning devices. He added that the toxicity of methanol can be avoided simply by not swallowing the product, while the toxicity of volatile compounds found in gasoline, such as benzene, are inhaled involuntarily.

Mr. Lewis also addressed the results of the "auto-oil" study, which evaluated the emissions of gasoline and methanol engines. Mr. Lewis stated that the "auto/oil" emissions study represents an excellent approach for comparing methanol and gasoline engine emissions. He identified several aspects of the study, however, that he believes contributed to misleading results:

- M-85 (a fuel mixture composed of 85% methanol and 15% gasoline) used in the test was blended with standard gasoline. Mr. Lewis stated that M-85 typically is blended with reformulated gasoline in the urban locations where it is available.

- To increase statistical significance, butane was added to the M-85. Mr. Lewis stated that the addition of butane increased the volatile emissions of M-85.

- Results of the study represent a weighted average of emissions from multiple engines, including methanol engines developed as early as 1984. Mr. Lewis stated that the technology for engines designed to run on methanol was in its infancy stages in 1984. Emissions from early engines used in the study, he added, were approximately three times higher than emissions from 1989 methanol engines that were evaluated, thereby raising the average for methanol engines as a whole.

The "auto-oil" study, Mr. Lewis concluded, does not reflect accurately the technology that is currently on the road. Ford and General Motors, he pointed out, have agreed to certify their methanol "flex-fuel" vehicles (vehicles that can run on either methanol or gasoline) to meet California's rigorous Transitional Low Emissions Vehicle standard by 1992. Methanol engines used in the auto-oil study do not meet this standard.

Mr. Lewis went on to describe some advantages of the flex-fuel vehicle, which Chrysler will sell in 1993 for the same price as its conventional gasoline vehicle. The flex-fuel vehicle, Mr. Lewis said, offers consumers the flexibility of filling their tanks with methanol in nonattainment areas where methanol will be available, or using gasoline on trips away from the city. If a consumer chooses to re-sell the car, no retrofitting would be required.

Mr. Lewis cited another benefit of methanol as an automotive fuel. By reducing pollutant levels in urban, nonattainment areas (both directly, through the use of methanol engines, and indirectly, by spurring the development of cleaner gasoline) methanol reduces the pressure on point-source facilities to reduce their emissions. Mr. Lewis advocates expanding the emissions credit trading program to allow

trades among stationary and mobile sources. If cities reduce NO_x emissions significantly through the use of methanal buses, for example, they should be allowed to trade emission credits with utilities. Mobile sources may turn out to be a more efficient way to reduce emissions.

Mr. Lewis concluded with an appeal for open competition in the alternative fuel market. The true cost of alternative fuels, Mr. Lewis believes, should be paid by consumers, not hidden through government subsidies. Consumer preferences ultimately will determine the most efficient way to meet the goals of the Clean Air Act. Methanol, he believes, can provide a very competitive alternative to gasoline, particularly after the infrastructure is developed to make methanol routinely available at filling stations.

* * *

Dr. Roberta Nichols, Manager of the Electric Vehicles Strategy and Planning Department at Ford Motor Co., presented an overview of Ford's efforts to meet the requirement for zero emission vehicles in California by 1998. Although other states are adopting this standard with the hope that increased production runs will reduce the cost of electric vehicles, Dr. Nichols noted that electric vehicle technology is so new that economies of scale do not apply. The most significant obstacle to reducing the cost of electric vehicles, Dr. Nichols emphasized, is battery technology.

Dr. Nichols pointed out several positive feature of electric vehicles:

- The performance of electric vehicles within their 100-mile daily range is surprisingly good.
- The ability to recharge electric vehicles overnight, at home, precludes the need to stop at filling stations.
- Electric vehicles are very quiet.
- Although not proven, preliminary indications are that electric vehicles will be more reliable and require less maintenance than internal combustion vehicles.

Dr. Nichols also discussed some disadvantages of electric vehicles:

- Reduced driving range means electric vehicles will never provide a perfect replacement for the traditional family sedan.
- The high cost and short lifetime of electric vehicle batteries make electric vehicles more expensive to operate than conventional gasoline vehicles. Considering electricity alone, electric vehicles are very inexpensive. However, when the cost of replacing batteries is included, the cost per mile of operating an electric vehicle is higher than the cost per mile of operating a gasoline engine.

Dr. Nichols pointed out that net emissions of electric vehicles are directly related to the primary source of electricity. In areas where the source of electricity is away from the urban areas, they can be very beneficial. Almost everywhere, she added, net emissions are lower than for gasoline vehicles.

Dr. Nichols projected that electric vehicles will be used primarily as utility vehicles, such as vans and commuter cars operating as a second or third family vehicle. Ford hopes to broaden this market,

however. The most likely customers for electric vehicles include "green people" (environmentally conscious individuals) and experimenters/innovators who want to be the first on the block to own an electric vehicle.

Dr. Nichols proceeded to describe Ford's electric vehicle demonstration program, through which 82 Eco-Star vans are to be delivered to customers in the first quarter of 1993. The vehicles will be leased for 30 months, after which they will be returned to Ford for evaluation of their performance.

Batteries for the Eco-Star, Dr. Nichols said, weigh 800 pounds. Because of the weight of the batteries, the Eco-Star is a modified version of Ford's European Escort van model, which has a high payload capacity. The development of lightweight materials for the body and frame of the vehicle to offset the weight of the batteries is a priority.

Dr. Nichols went on to describe the performance characteristics of the Eco-Star:

- Range is 100 miles per day.
- Acceleration is 0-50 mph in 12 seconds; Dr. Nichols pointed out that this figure is slightly better than the acceleration of the European Aero-Star van.
- Top speed is 70 mph.
- Air conditioning and heating are available as optional features.
- Recharge time is 6 hours on a 220 volt/30 amp outlet.

Dr. Nichols described the logistics of recharging. She noted that all homes built in the U.S. since the 1930s are equipped with a 220 volt outlet at the service box, which can be modified easily to accommodate the electric vehicle. The recharge time of six hours suggests that the most desirable time to recharge will be overnight, when demand for electricity is low. Later, as electric vehicles become more common, facilities that enable recharge while commuters are at work are likely to be developed. Dr. Nichols also discussed the concept of "quick recharge," which can be accomplished in 15 minutes. This method, however, is not practical because it requires a 440 volt/160 amps outlet, which is not available in homes. If many such outlets were built, they would soon exceed available electricity supply, requiring more power plants.

Dr. Nichols concluded with a forecast for electric vehicles. Environmental pressures, she anticipates, will lead to electric vehicle usage in urban smog areas, especially by commuters traveling over short distances. There is no one best fuel, she added, and it is likely that multiple fuels will occupy niches in the transportation market, giving consumers maximum flexibility to choose the option that best suits their needs.

* * *

Mr. Robert Trunek, Senior Vice-President of Manufacturing, Engineering, and Technology at ARCO, began by stating what ARCO perceives to be the challenge for the transportation fuels industry: to provide a low-cost, secure, non-polluting energy source to a diverse, highly mobile population. ARCO considered the following questions in evaluating what fuel would best meet that challenge:

- How much air quality improvement can be achieved through reformulated gasoline?
- How much will it cost to achieve those improvements?

- How do emissions from other fuels compare with those of reformulated gasoline?
- How much will these alternative fuels cost?

Five events in the past year, Mr. Trunek continued, have led ARCO to the conclusion that reformulated gasoline holds the greatest promise to compete in the areas of environmental quality, energy efficiency, ease of implementation, and economic efficiency. The five events supporting ARCO's conclusion are the following:

- EPA's "reg-neg" process, which defined reformulated gasoline for 49 states.
- The "auto-oil" program's joint research project was undertaken, representing the most extensive fuels emissions research program ever.
- ARCO developed EC-X, a fuel that burns as cleanly as M-85.
- California passed its Phase II gasoline standards in November 1991, imposing the most stringent gasoline emissions requirements ever enacted, beginning in 1996.
- The "auto/oil" program released the latest in a series of technical bulletins addressing the emissions characteristics of methanol.

California, Mr. Trunek continued, has 7 of the top 20 metropolitan areas with smog problems in the U.S. It is for this reason that California has pioneered the development of gasoline standards that are more stringent than Federal standards. ARCO supports this effort for two reasons:

- California needs to reduce emissions from mobile sources of urban smog to avoid more draconian measures against stationary sources; and
- Reformulated gasoline, in particular Phase II gasoline, offers the most cost-effective way to achieve emissions reductions from mobile sources.

Testing of EC-X in a sample of 10 different vehicles shows that it can meet the California Air Resources Board (CARB) standard for Phase II gasoline. ARCO estimates the overall reduction in the urban ozone formation potential achieved through the use of reformulated gasoline to be 39%. Additionally, Mr. Trunek added, emission results compare favorably to those of M-85 vehicles. Phase II gasoline, he added, offers obvious advantages because it achieves reductions without requiring any new engine technology. It is the most viable fuel-of-choice for low emissions vehicles to be introduced later in the summer of 1992.

Mr. Trunek stated that ARCO estimates that EC-X will cost 16 cents per gallon more than conventional gasoline. Even assuming high estimates of a 23 cent per gallon increase in cost, reformulated gasoline compares favorably with M-85. Mr. Trunek cited a study conducted by Robert Hahn, from the American Enterprise Institute, which shows that M-85 will incur high introduction costs in the short-term, with costs declining over time. Even over the long-term, Mr. Hahn estimates that M-85 will cost about 28 cents more per gallon than conventional gasoline.

Mr. Trunek also cited ARCO statistics comparing the full fuel cycle costs and energy efficiencies of reformulated gasoline to those of compressed natural gas, methanol, and electric vehicles.

- Reformulated gasoline was shown to be slightly less expensive than compressed natural gas on a full fuel cycle basis, and less expensive than both methanol and electric vehicles by a larger margin.

- The energy efficiency of reformulated gasoline was shown to be higher than that of all alternatives except compressed natural gas.

Mr. Trunek also stated his belief that although methanol is currently a domestic source of fuel, a large increase in demand for methanol will require imports.

Mr. Trunek concluded by stating that there is no zero-emission vehicle on the horizon, even over the long-term. Although other fuels will find niche markets, reformulated gasoline will play a predominant role in the alternative transportation fuels market.

* * *

Mr. Lee Papayoti, Senior Vice President and General Manager for Enron NGV Co., provided an overview of natural gas vehicles and of Enron's program to introduce natural gas vehicles into the fleet market in the Houston metropolitan area. Mr. Papayoti cited two significant developments supporting natural gas vehicle technology in the last year:

- A new generation of natural gas vehicle technology has emerged that is superior in emissions, performance, and customer acceptance; and

- In cities across the country, the natural gas industry is making a commitment to provide the necessary refueling and support infrastructure for natural gas vehicles.

Mr. Papayoti addressed the charge that natural gas is an import technology. He cited data indicating a 60-year supply of available domestic reserves. Assuming improvements in exploration, he projected that domestic supplies would last well over 100 years.

Mr. Papayoti stated that Enron first became interested in natural gas vehicles in early 1988. Enron's preliminary assessment indicated that natural gas vehicles had only a few obstacles to overcome. Enron subsequently became involved in the natural gas industry's efforts to convince major auto manufacturers that natural gas is a legitimate motor fuel alternative. Enron also began working to support fuel-neutral legislation and regulations to establish a level playing field in the motor fuels market.

After the CAAA were passed, Enron entered directly into the natural gas vehicle market in the Houston area. Enfuels, an Enron subsidiary, was created with the primary mission of building compressed natural gas fueling stations in the Houston metropolitan area. The first such station will open in May or June 1992, with five more expected to be in operation by the end of the year. Enfuels plans to add 6-10 stations a year as demand grows. Almost all compressed natural gas pumps will be at existing gasoline retail stations.

To ensure that there will be a demand for compressed natural gas, Enron has become involved in other activities to support natural gas vehicles:

- In July, Enron will open a state-of-the-art technology conversion center, where customers can convert gasoline vehicles into natural gas vehicles.
- Enron plans to open a series of service and maintenance centers for natural gas vehicles.
- Enron has formed liaison relationships with local dealers to sell factory-made compressed natural gas vehicles.

Mr. Papayoti emphasized that Enron's endeavor is not cross-subsidized by rate increases for any of its other natural gas customers.

Enron's target customers are in the fleet vehicle market. Mr. Papayoti cited several compressed natural gas vehicles that recently have become available:

- GMC has introduced a Sierra-class pickup truck featuring the first in a new generation of electronic fueling systems for natural gas;
- Chrysler is producing a full-sized compressed natural gas van, which utilizes what Chrysler claims is the cleanest internal combustion engine available; and
- Stewart-Stevenson Corp. is producing conversion vehicles, featuring gaseous fuel injection technology, that approach factory standards for performance, emissions, and reliability.

Mr. Papayoti described the emissions characteristics of natural gas vehicles:

- They produce fewer of the precursors to ozone and smog formation;
- They eliminate evaporative hydrocarbons, both when the engine is running and when it is filling;
- They produce just 5% of the carbon monoxide produced by gasoline engines;
- They achieve very low cold start emissions; and
- When replacing diesel fuel vehicles, they eliminate particulate emissions.

All emissions results, Mr. Papayoti stated, have been achieved with engines and catalysts designed primarily for gasoline. Impending developments in internal engine and catalyst design, Mr. Papayoti anticipates, will improve the emissions characteristics of natural gas vehicles.

Mr. Papayoti concluded by discussing some of the challenges still facing natural gas vehicles as they are introduced to the market:

- Lack of fueling stations: Programs to develop fueling infrastructure are being undertaken in major cities around the country. New stations are opening at a rate of 2-3 per week.

Mr. Papayoti noted that the infrastructure needed to bring natural gas to filling stations already exists. Converting available natural gas into a motor fuel requires only the installation of compressors.

- On-board storage: Even when compressed at 3,000 pounds per square inch, natural gas has a low energy density, which reduces driving range.

- Cost and weight of fuel tanks: The development of lightweight, low-cost tanks for compressed natural gas is a priority. Tanks currently being developed, Mr. Papayoti stated, are 33% less expensive and 50% lighter than available tanks made of aluminum and steel.

- Engine technology: Compressed natural gas-specific fuel injection systems, catalysts, and engines will be required to meet the emissions requirements of the late 1990s.

- Emissions trading program: Mr. Papayoti advocated unrestricted trading of emissions credits among mobile and stationary sources.

- Public perceptions of vehicle safety: Mr. Papayoti stated some people have the unfounded perception that natural gas vehicles are unsafe. The natural gas industry plans to correct this perception through education programs and the maintenance of high safety standards.

QUESTIONS AND ANSWERS

How difficult is it to convince gasoline stations to sell a competing product?

Mr. Papayoti replied that it hasn't been easy. Enron has approached the leaders of the retail motor fuels market at the corporate level. Approximately half of the retailers, he said, realize that while they run the risk of displacing existing products, they also have an opportunity to take business away from their competitors.

Mr. Lewis said that methanol fueling facilities cost much less than other alternatives, such as natural gas, in part because methanol is compatible with existing steel tanks. Sunoco has agreed to provide methanol pumps to any location where there are 200 or more methanol vehicles. Sunoco's attitude, he said, is that they're in the transportation fuel business, not the gasoline business. In California, the seven major retailers have agreed to put in methanol pumps at existing stations. The flex-fuel vehicle, he added, will help ease the transition to methanol fueling.

Mr. Trunek stated that ARCO is participating in the voluntary methanol program in California and is planning to open a total of 25 methanol stations. He noted, however, that some stations where methanol already is available have had a difficult time keeping methanol pumps primed.

Who are the first customers for Ford's electric vehicle demonstration program?

Dr. Nichols replied that the vehicles will be delivered to five locations in the U.S. and three locations in Europe. Most of the initial customers are electric utilities. She also said that Ford has been very careful in testing its electric vehicles to ensure that its first customers are left with a favorable impression of the new technology.

How do features such as air conditioning, heating, and power steering and brakes, affect the range and acceleration of electric vehicles?

Dr. Nichols stated that air conditioning does decrease the range, to some extent. The effect of heating, she added, depends on whether an electric resistive heater or fuel-fired heater is used. Ford is developing data on the fuel-fired heater, which does not affect range, so that it can be permitted for use in zero emission vehicles.

Is it accurate to say that petroleum is no more heavily imported than natural gas? What impact will use of natural gas as a transportation fuel have on price of gas used for home heating.

Mr. Lewis stated that natural gas currently is 76% domestic and 95% North American. Petroleum is roughly 50-55% domestic.

Mr. Papayoti stated that over 95% of natural gas comes from domestic sources. He added that the U.S. is the world's leader is exploration and production technology. Mr. Papayoti stated that the most optimistic projections for use of natural gas as a motor fuel would increase total gas consumption by just 5% by 2005. This would help distribute the fixed costs of natural gas infrastructure over more users.

Mr. Lewis stated that subsidizing the development of compressed natural gas fueling infrastructure by rate-basing has a bigger potential impact to residential consumers than the increased demand for natural gas.

Mr. Papayoti pointed out that the difficulty of transporting natural gas makes large volume imports unlikely. One concern, he stated, is that growth in the demand for methanol could provide an incentive for other countries to convert their natural gas into methanol, which could then be exported to the U.S. as a liquid.

Mr. Lewis replied that if excise taxes on natural gas and methanol were equalized on a BTU basis, domestically produced methanol would be less expensive than imported methanol.

What is the most optimistic estimate for the penetration of methanol in the motor fuels market?

Mr. Lewis replied that there are too many variables to make a realistic estimate at this time. The potential, however, is very large. Increased use of methanol, he added, will merely supplement the increased demand for automotive fuels as a whole. Methanol growth therefore will not be at the expense of existing petroleum capacity.

What assumptions were made in the study cited by Mr. Trunek, which compared the life cycle costs of various alternative fuels?

Mr. Trunek replied that the study was based on a range of figures that were obtained through literature surveys to ensure fairness and consistency. The narrowing differential between methanol and gasoline costs, he added, is based on the assumption that gasoline prices will rise, not that methanol prices will go down.

Mr. Papayoti added that Enron believes that reformulated gasoline will retain most of retail fuel market; Enron expects that natural gas will achieve 5% of the Houston motor fuel market by 2005 or 2010.

Mr. Lewis stated that transportation costs account for most of the price of methanol. The use of pipelines for methanol, which has been tested successfully, will reduce these transportation costs considerably.

What volume of electric vehicle sales will be required to bring their average cost down?

Dr. Nichols stated that electric vehicle cost is a function of time more than of sales volume. She expects that by 2003, when the 10% requirement for zero-emission vehicles goes into effect, electric vehicles will be competitive. During their introduction period, however, electric vehicles may require some kind of subsidy.

What about liquified natural gas?

Mr. Papayoti stated that liquified natural gas is the alternative fuel of choice for diesel buses in Houston, in part because it allows greater range.

Mr. Lewis pointed out that methanol vehicles had not been approved as an alternative fuel in Texas when liquified natural gas was chosen for transit buses in Houston.

Where would the panelists like their respective fuels to be in 5 to 10 years? What should government do to help?

Dr. Nichols stated that because inexpensive energy is a barrier to change, she would like to see an increase in the gasoline tax. Electric vehicles, she added, will require some incentives overcome the initial high cost of batteries.

Mr. Trunek stated that he expects reformulated gasoline to be the dominant fuel on the market. Government, he added, should merely set standards and get out of the way, rather than attempt to pick winners in the fuels market.

Mr. Papayoti stated that he expects compressed natural gas to establish a niche in the fleet vehicle motor fuels market. Government should maintain a level playing field in the market for motor fuels.

Mr. Lewis stated that government should equalize the tax treatment of natural gas in all of its derivative forms: compressed natural gas, MTBE, and methanol. Government help for methanol should be in the form of a "jump start" to offset infrastructure costs rather than an ongoing subsidy. Government also should continue to buy fleets of methanol vehicles and allow trading between mobile and stationary sources of air pollution.

SESSION 2--PANEL C
Alternative Transportation Modes
April 22, 1992, 2:30 p.m. - 5:00 p.m.

INTRODUCTION

Ross Capon, Executive Director of the National Association of Railroad Passengers, moderated the meeting. He introduced the session by stating that the general purpose of the conference is to get users and suppliers of clean air services together. For this panel, the definition of users should be interpreted loosely to include individual members of the public whose transportation behavior we are attempting to influence.

Mr. Capon explained that we would hear presentations from two speakers who are responsible for strategic planning, and from two who deal with relieving congested roadways. He introduced the panel speakers and gave a brief description of their educational and career backgrounds.

PRESENTATIONS

Michael K. Sheldrick, Director of Automotive Business Development, ETAK Corporation, gave the first presentation on Intelligent Vehicle Highway Systems (IVHS). IVHS is a way of integrating the traveller, the infrastructure, and the vehicle in a system, much in the way air traffic and harbor traffic is controlled. The key to this system is information. With the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) last fall, IVHS is now a broader-based concept. Perhaps a better name would be Intelligent Transportation Systems, commented Mr. Sheldrick, to emphasize that it is not just for automobiles but also has multi-modal applications. IVHS was originally begun to alleviate traffic congestion. With real-time information, highway authorities can identify an incident, route traffic around it, and remove the problem before it causes a major traffic backup. In addition, IVHS makes car travel safer.

Mr. Sheldrick presented an overhead showing the current relationship between the driver, the automobile, and the road as points of a triangle. Connecting the driver and the automobile is the action of steering; connecting the driver and the road is the driver's sight which receives information from signs; and connecting the automobile and the road is the traction of the tires. With IVHS, the links that connect the three points are enhanced. Between the driver and the automobile are features such as safety warnings, traffic updates, route guidance, and information about the vehicle's condition. In the near future we may have cars with "intelligent cruise control," where the car will be able to sense that it is too close to the car ahead and automatically apply the brakes. Between the driver and the road are sensory enhancements. Information about the vehicle's destination, condition, and speed can be passed from the automobile to the road; information about traffic conditions and hazards can be passed from the road to the vehicle.

The current surface transportation system has many problems: congestion, accidents with fatalities numbering around 40,000, low efficiency, limited mobility for economically disadvantaged people, high energy consumption, and pollution. Surface transportation systems are years behind air and water traffic control systems. At this point any IVHS-related actions we take will lead to a large improvement in our surface transportation system.

IVHS defies simple analysis because the variety of technologies it involves. For convenience, the technology is grouped into three main functional areas:

- ATMS - Advanced Traffic Management System, responsible for obtaining real-time information;
- ATIS - Advanced Traveller Information System, through which information will be disseminated, either in vehicle or on a kiosk; and
- AVCS - Advanced Vehicle Control System, which incorporates the idea of intelligent cruise control.

IVHS has applications beyond the vehicle driven by a single person. The Federal Transit Administration is interested in its applications for buses. Mr. Sheldrick spoke of a "smart bus" that would permit its command center to know its location, and pass that information to people waiting at a stop. Other features would be a farebox or "smart card" reader that would count passengers.

IVHS and a computer system can be used to make carpooling more efficient, by configuring a "dynamic carpool" so that a driver would get a daily schedule of people to pick up. Fleet management could also be improved: for example, a soda distributer would be able to move his product around more efficiently by reconfiguring his fleet as it is out in the field.

Currently, there are approximately 30 field tests being conducted for these technologies. Mr. Sheldrick concluded by stating that IVHS provides many transportation policy options, for example:

- Pricing of roads so that toll rates will be based on the hour and distance of travel;
- Real-time emissions monitoring;
- Enhancement of public transit;
- Promotion of intermodal options; and
- Dynamic car- and van-pooling.

These policy options can help us achieve the goal of cleaner air.

* * *

G.B. Arrington, Jr., Director of Strategic and Long-Range Planning, Tri-Met, Portland, OR, gave his presentation on Portland's transit system. Portland has been the subject of national attention for its work over the last two decades in successfully integrating transportation and land use. Portland has a light rail and bus transit system, a compact downtown that has grown by more than 50% with no congestion increase, and an improved air quality. Portland's 15-mile rail line moves 24,500 people per day. The system is operating at capacity, and a new 12-mile extension is under construction. It is important to remember that Portland is a western, low-density, auto-oriented region with a tight-knit, conservative business community, and thus its success story is relevant to other cities across the United States.

In 1970, Portland's downtown was dying. Political leaders were determined to turn things around, but took a long-term view. They saw transit as a key part of a strategy to achieve downtown growth without the negatives of more cars and more highway lanes. A combination of an excellent transit system and a mature land use planning program with the force of law have made a critical difference. Oregon

plans land use state-wide, but the key here is transit's partnership with local government. Each partner has expectations of the other. Tri-Met has asked local governments to take action to make development physically more dependent upon transit, and in return, Tri-Met is expected to provide the necessary service to accommodate growth. In effect, this has shifted the major part of the cost of growth to transit.

All new growth in the downtown area of Portland is directly related to transit. New office buildings in the downtown area have a limit on parking. Zoning is tailored around the rail lines, and in fact the zoning was in place four years before the rail line opened. Rather than widening the freeways, local government has put money towards light rail, which transports a number of people equivalent to two new lanes on every arterial entering the downtown. An urban growth boundary controls development, so that Portland will avoid the suburban land use pattern typified by Tyson's Corner. Mr. Arrington thought it ironic that the Clean Air Marketplace Conference was held in a location where the land use pattern guarantees that clean air is unattainable.

The presence of the rail line has accelerated the restoration of historic buildings, and influenced the design of new office buildings. Major developments are still to be seen, as another group of office towers undergo construction, all but one of them adjacent to light rail. Several projects illustrate the success of Portland's light rail line:

- The Rouse Company is building a $180 million retail/office/hotel complex in the heart of downtown Portland. Transit surrounds the project on three sides, with two light rail stations and the Portland Transit Mall. The easiest way to get to the Rouse Project will be by light rail. For the developer, light rail means a lower parking ratio and lower development costs, a location advantage over the competition, and access to a broader retail market.

- The Oregon Convention Center was completed in 1990. The presence of light rail was a critical factor in the decision to locate the convention center across the Willamette River outside of the downtown. Light rail is the spine to connect hotels, the convention center, and the downtown together.

- A $100 million, 800,000 square foot suburban mall is being built right over and incorporated directly into the light rail line. Like the downtown project, light rail will be the most convenient way to arrive. For Tri-Met, the mall means increased ridership and a long-term cash flow for the system to make it self-sustaining within seven to eight years after the center opens.

Mr. Arrington concluded by stating that light rail is a strategy to control growth. This strategy is most effective when all the parts of the puzzle are in place: limitations on parking, zoning to concentrate growth around the rail lines, an urban growth border, an extensive bus service, and an emphasis on pedestrian walkways. Portland had a head-start because it already had an effective bus system before the light rail line was built; nevertheless, Portland's transit and land use policies can provide an example to other western cities.

* * *

Kenneth P. Philmus, Program Director for Interstate Transportation Department of the Port Authority Bus Terminal, New York, NY, gave his presentation on transit in the New York/New Jersey

metropolitan area. In dealing with the Clean Air Act, the New York/New Jersey area has much to offer other parts of the country, and also has much to learn.

There are many interwoven agencies to contend with the transportation issues in the area. An enormous volume of goods and people are moving across the two states. Currently, 80% of the people who work in Manhattan get there by transit, and yet there still has been an increase in the number of cars in the city. The area has two tunnels, many bridges, the most travelled highways in the nation, the most extensive mass transit system in the nation, three major airports, the northeast corridor of Amtrak, merchant marine ports, and Interstate 95 running through it. The infrastructure is interwoven so completely that a lack of cooperation would result in chaos. New York and New Jersey agencies are spending billions of dollars to develop policies and improve linkages to make the connections between the two states, over the bridges, and through the tunnels, as seamless as possible. To reduce traffic congestion, agencies in New York and New Jersey are looking at IVHS and electronic toll collection. Other regions have pioneered both of these technologies, but they will used much more extensively and linked much more closely in the New York area than anywhere else in the country.

IVHS can be applied to incident management. During the time Mr. Philmus served as manager of the George Washington Bridge, he learned that the real manager of the bridge was the Cross Bronx Expressway. Just one car stopped on the highway caused a backup on the bridge, and it happened on a regular basis. An information delay existed: it was often a half-hour before the problem could be found and dealt with. The primary goal of using IVHS in the metropolitan region is to reduce congestion, with cleaner air an added benefit. IVHS is not without its difficulties, as information needs to be coordinated between two states, two police forces, and 14 government and toll collection agencies. The two states created Transcom, which acts as a hub for information. It collects and relays real-time information to all of the other transportation agencies, including rail lines, subways, and bus drivers, because traffic and transit system incidents have spill-over effects on other routes.

The other technology that will help make transitions seamless is electronic toll collection, or ETC. ETC already exists in Dallas, Louisiana, and Oklahoma. ETC for the New York region requires the coordination of seven agencies, including the Pennsylvania Turnpike; together, these seven agencies handle almost 40% of the toll transactions in the nation. The technology for ETC has not yet been firmly decided upon, but most likely it will take the form of an electronic tag on a car. As the car passes through the toll reader, the amount of the toll will be recorded and the driver will be receive a bill for the total number of tolls at the end of the month. Mr. Philmus reported than even if only a quarter of the vehicles have it, ETC will reduce CO and hydrocarbon emissions by 30%. Another possible application of ETC would be to use tagged vehicles to monitor traffic flow. Tagged vehicles could signal an operations center to problems.

The Port Authority plays a central role in implementing IVHS and ETC. It has a unique interstate position and responsibility for road, rail, air, and port facilities. The new technologies offer benefits so compelling that agencies have begun to cooperate towards the goal of a seamless trip for motorists and shippers. Better service through new technology is key in building support for more government action to bring motor vehicles into compliance with CAA standards. Mr. Philmus concluded by stating that the future is on rubber tires as well as steel, and both elements must be focused on to reach the goal of cleaner air.

* * *

Peter Benjamin, Director, Office of Planning, Washington Metro, Washington, DC, began the final presentation by asking, how does transit become attractive? The answer, he indicated, lies in significant policy, land use, and lifestyle changes, all of which require an enlightened leadership. However, Mr. Benjamin expressed disappointment in current leadership and used the Clean Air Marketplace Conference itself as an example of how practice differs from the policy. He pointed to the fact that the DC area has 80 miles of underground rail lines, 70 Metro stations, and a large number of hotels accessible on the system, and yet the conference was held in a hotel almost inaccessible by transit. This was a choice made, remarked Mr. Benjamin, by an agency that is trying to get people to pollute less.

Mr. Benjamin felt that the focus of the Clean Air Marketplace conference is on what he termed, "technological gimmicks" -- devices that will let America run business as usual without any significant lifestyle change. This particular session is called "Alternative Transportation Modes," making it clear that the auto is the prime mode and others are alternatives. And despite the title, half of the speakers at this session gave presentations about cars. Mr. Benjamin thought that IVHS has no significant applications to mass transit, and described it as a means of getting more cars on the road, thereby increasing the amount of air pollution, not reducing it.

America's 50-year history of automobile use has resulted in policies and lifestyles that accommodate the auto. For example, the government has made it a policy to subsidize parking, but not transit. Only recently has the IRS allowed a $21 per month transit deduction, but it allows the full amount spent on parking to be deducted. EPA itself subsidizes parking but not transit. According to Mr. Benjamin, Metro has even given EPA the opportunity to let EPA personnel use Metro at cost, and EPA declined the offer. Our land use pattern makes transportation extremely difficult without a car. Even the mortgage deduction on federal taxes indirectly tilts transportation choices in favor of the car, because it makes a suburban, automobile-dependent house more attractive than a transit-accessible apartment. Without a shift in transportation mode, cleaner air will be a difficult goal to achieve.

Mr. Benjamin suggested two policies that would alter the public's choice of transportation modes:

- The first policy is land use planning. Government should make a decision to build new malls and offices without acres of parking available. In addition, new road and highway lanes should not be built, allowing congestion to increase to the point where people will take transit.

- The second is to force people to see the cost of car transportation, thereby creating a level playing field between the car and transit. Car transportation is heavily subsidized. There are hidden costs that travellers do not consider, such as the costs of highway construction and maintenance, the police forces that monitor traffic, the fire departments and ambulance services that respond to accidents, and the court systems occupied by suits for traffic accidents. The Federal Highway Administration estimates that car travel costs between 42 and 45 cents per mile. These costs are not paid for by gasoline taxes; they are paid for by local taxes and in effect amount to a large subsidy. The traveller considers only the marginal cost of a car trip -- money spent on gasoline and parking. Gas costs only six cents per mile. These two expenses should be taxed to reflect the true cost of automobile travel.

Given that choices are made based on prices, Mr. Benjamin concluded clean air will only be achieved when a level playing field is created. Government is generally adverse to subsidizing transit

because it is an obvious subsidy, unlike the subsidies for automobiles. Transit has a difficult time competing against the heavily subsidized automobile, and if government intends cleaner air, it needs to make transit relatively cheaper than car travel. Thus, we will not see a major change in the public's transportation choice until automobile travel is made more congested and expensive, and our land use pattern is changed. Mr. Benjamin challenged the EPA to show the leadership needed to make those changes.

QUESTIONS AND ANSWERS

After the panelists had given their presentations, Mr. Capon opened the floor for questions.

The CAA requires major employers to reduce the number of single drivers in certain cities. Have any of your agencies taken measures to cooperate with employers?

Mr. Arrington responded that in Portland, they've tried to interest commuters in carpooling, because the private sector wanted it. Transit is subsidized and commuters can take advantage of the subsidy by carpooling. Every major employer in the area has carpool matching and subsidizes transit passes.

Mr. Benjamin remarked that the largest single employer in the DC metropolitan area is the Federal government, and that 96% of the Federal parking spaces downtown are subsidized, with half of them being free. When one of the presidents tried to change that, he failed. Mr. Benjamin wondered if the president could not reduce the subsidy for his own work force, how would the CAA make it happen?

Mr. Capon suggested it that it would happen if the penalty was the withholding of Federal Highway funds.

This session has focused on alternative modes of transportation that are "high tech." But walking and biking should not be overlooked.

Mr. Arrington agreed with that comment. He added that in Portland, they at first measured the success of their system by ridership, but decided the relevant indicator of success is mobility. The question to ask is, can people get around? The light rail lines are supported with wide sidewalks and pedestrian connections to ease walking. Mr. Arrington also added that we should not be looking at our systems as highways versus transit -- the two need to work together.

Mr. Philmus supported this cooperative view. For example, artificially high tolls of $4 and $5 financially support the PATH trains and re-route commuters to them; the PATH trains cost $3.50 per rider but are priced at $1.00. Tolls are a pricing method which can force people to other alternatives, as long as they exist. Intersuburban trips are starting to grow, and there are no transportation alternatives to the car.

Mr. Capon related the results of a survey taken in San Diego of 145 bike locker users. Bike lockers were used by each person on the average of three to four days a week, and 67% of those surveyed would drive to work alone if bike storage facilities were not available. Mr. Capon noted that the East Falls Church Metro station has bike trails and bike lockers, and that the cost of

providing bike parking is much less than providing parking for cars. In addition, bikes have a more favorable environmental impact.

Mr. Sheldrick questioned the notion that after 50 years of automobile use, could we really "force" people out of their cars? He also added that IVHS lends itself to a range of applications; it doesn't necessarily favor highway solutions.

Intersuburban transit is what suburban dwellers need. Did you encounter resentment among suburban residents whose money is directed to transit in the city areas?

Mr. Arrington answered that in Portland, the suburbs do not oppose building more transit in the city. The suburbs and the city are not in competition.

Mr. Benjamin responded that the quickest growing type of trip is the intersuburban trip; 45% of commercial development in the suburbs has occurred within walking distance of Metro. The suburban areas of Silver Spring, MD, Bethesda, MD, Ballston, VA, and Clarendon, VA, have undergone large growth in part because they are accessible by Metro. Most suburban dwellers have two reasons for supporting Metro: first, someday they may want to ride it; and second, it unclogs the roads.

Mr. Capon added that the problem with transit in the suburban DC area is not a lack of density. Metro needs to be safe and accessible.

What is the current status of transportation subsidies?

Mr. Benjamin answered that almost every transit authority in the country supported a provision in the tax bill that included a $60 transit subsidy, however, the bill was ultimately vetoed. Currently, an employer can give an employee $21 per month, tax free, for transportation. But anything over that and the full amount is taxable.

Mr. Capon added that there was no controversy over this issue: that both the President and Congress agreed to a $60 tax-exempt subsidy. They also agreed to impose a tax on parking worth more than $160. The very day the bill was vetoed, Congress made the effort to push the non-controversial parts of the bill through. As of a few weeks prior to the conference, Mr. Capon reported, Congress tried to attach the transit subsidy to an energy bill.

There are two problems with biking: first, the paths are not "user friendly," and can be dangerous. How can more money be directed towards bike paths? Second, those who walk or bike get no subsidy. If the goal is to get people out of their cars, then walkers and bikers should be subsidized, too.

Mr. Arrington emphasized again that the goal should be moving people, not necessarily increased transit ridership. Tri-Met and the city of Portland are pushing a general transportation voucher for all employees. If a commuter decides to park, he or she will lose money despite the voucher; if he decides to take light rail, he will break even; and if he decides to walk or bike, he will get to keep the voucher and thus make money. Portland spends one percent of highway funds for bikes. More people interested in biking need to be present at the planning table, so that more money will be diverted to bike paths.

Mr. Benjamin stated that the Washington Metro supports bikers with a comprehensive set of bike paths and bike lockers at most of their stations.

How have the suburbs reacted to being linked with the downtown city area?

Mr. Arrington replied that Portland borders three counties, and everyone pays the same amount for transit. The suburbs want more service. Light rail has a 96% acceptance rate. Property taxes for the new line were supported by 73% of the people in the three counties. Even the county not directly benefiting from the new line was in 65% in favor of property taxes for it. This was the same vote where people voted to reduce property taxes. Other than the construction of the new line, light rail is primarily funded through a business income tax.

Mr. Benjamin replied that Metro links the city with suburbs from two states. He concurred with Mr. Arrington that the suburbs want more service.

Is the Portland light rail line profitable?

Mr. Arrington responded that the rail line covers 51% and the buses cover 26% of their costs through the farebox. If it seems like a small figure, compare it to the money spent on the construction of highways, and consider the additional benefit of clean air.

Mr. Benjamin said that Washington's Metro trains cover about 80%, the buses 54% of their costs. But why is it that no one asks if automobiles cover their costs, he wondered. The automobile only covers roughly 12% of its total costs. Do the police make a profit? Do fire departments make a profit?

Do you have any security problems?

MAX (the light rail line) subcontracts with the police, according to Mr. Arrington, and they do not employ videocameras. There is not much crime in Portland, therefore not much on Portland's transit.

Mr. Benjamin said that in D.C., the Metro is perceived as being safer than the community.

Recently, there has been a substitution away from carpooling back to single vehicles. Have there been any studies done on the substitution from carpooling to transit?

Mr. Arrington replied that in Portland, they've combined transit with carpooling. This was controversial because they want people on the bus rather than in cars. However, they've changed their definition of success to include anyone diverted from a single occupancy vehicle. MAX sends direct mail to people who have recently changed employers and residents. People are more willing to change transportation modes when they are making other changes.

Carpooling and transit go hand-in-hand, remarked Mr. Benjamin. Transit is a backup for carpools when the rider can't conform to the carpool schedule.

An audience member replied that transit was also a backup for bikers during bad weather.

There's a limit to the amount of you can change people's lifestyles. Businesses need to be responsible for modes of transportation.

> Mr. Sheldrick responded that IVHS America provides a forum to discuss these and other issues; for example: does IVHS increase demand for automobile travel? Does it create or abate pollution?

Mr. Capon reported that in Philadelphia, several traffic signals have been replaced with four-way stop signs. Many traffic engineers believe the four-way stop/yield, and the traffic circle are safer than traffic lights. He commented that where there is a perceived danger, drivers tend to be more cautious. Green and yellow lights are an invitation to speed. The traffic light is a railroad signal that was translated to the automobile.

> Mr. Arrington added that in Portland, the controversial decision was made to take back the roads for pedestrian use. This was done by putting circles in the middle of streets, and making streets narrower. In his opinion, transportation should be designed for people, not for cars, which is the problem with IVHS. The idea should be to slow cars down, using "low tech" solutions.
>
> Mr. Philmus said that New Jersey has plans to use IVHS to improve the traffic light process to get better flow.

Are employers giving their employees the incentive to work at home? Are the various agencies incorporating this idea?

> Mr. Philmus said the New York/New Jersey transit center was working with employers to understand the subsidy, but not specifically the idea of working at home.
>
> Mr. Capon answered that many people in San Francisco are preferring to work at home since the last earthquake. Technology like the fax machine and the modem make this idea a reality.

Mr. Capon asked if the Portland parking lid forced business out of the city?

> Growth of suburban office space is slower than in the city, and the downtown is thriving, was Mr. Arrington's reply.

SESSION 2 -- PANEL D
Heavy Vehicle Control Technologies
April 22, 1992, 2:30 p.m. - 5:00 p.m.

INTRODUCTION

Steven Howards, President of Environmental Strategies and the panel moderator, welcomed the audience to a discussion of the innovative roles manufacturers are playing in developing cleaner operating diesel (heavy-duty) vehicles. Mr. Howards, a former director of the air pollution control planning agency for Denver, discussed his experience addressing the pollution caused by diesel vehicles:

- Metro Denver's biggest air pollution problems were carbon monoxide violations, ozone pollution, and visibility pollution, a layer of smog so thick that is was known locally as the "Brown Cloud."

- To address these problems, the Denver Metropolitan Air Quality Council instituted a wide variety of programs to reduce emissions from stationary and mobile sources. The program most keenly demanded by the public was the control of particulate emissions from heavy-duty vehicles, which largely were being ignored while regulators concentrated on gasoline-powered vehicles.

- For years the perception that diesel vehicles were supposed to smoke horrendously kept the vehicles virtually out of the realm of regulation. The public and the media felt that the time had come to regulate and enforce more stringent heavy-duty vehicle emissions standards. Diesel fuel quality had deteriorated over the previous few years. Higher sulfur content and higher aromatic content resulted in higher emissions.

- The public was especially concerned about the large amount of particulates emitted per mile by heavy-duty vehicles compared to the amount emitted by gasoline-powered vehicles. Particulates provide an avenue for toxins to piggyback their way into the lungs. In addition, the types of particulates emitted by diesel trucks, sulfates and carbon, are very efficient at reflecting and absorbing light to effectively obstruct visibility.

Mr. Howards then outlined the council's recommendations to the local and state governments to address these issues:

- The council urged the public school district to convert its fleet to natural gas.

- The Regional Transportation District was encouraged to purchase lower sulfur diesel fuel for its 950-vehicle fleet, as well as purchase one of the first high-altitude methanol vehicles in the country, garnering quite a bit of publicity.

- The region enacted one of the first diesel inspection/ maintenance programs in the country, comparable to the programs for gasoline-powered vehicles.

Mr. Howards ended his comments by noting that metro Denver's demand for cleaner heavy-duty vehicles matched the rest of the nation's; this concern was reflected in the passage of the Clean Air Act

Amendments. When the Act was passed, many people found the prospect of tough new standards for diesel vehicles daunting, but both the public and private sectors have responded well to the challenge.

PRESENTATIONS

Christine Vujovich, Vice President of Product Planning and Environmental Management at Cummins Engine, Inc., discussed the impacts of the Clean Air Act on the company's and the industry's products, and some of the new technologies being developed in response to the Act:

- Ms. Vujovich began by enumerating the characteristics that customers want and expect from an engine manufacturer's products: performance or power, i.e., enough torque to run a big truck; ease of installation; fuel economy; reliability; and durability. To a lesser extent, customers consider the engine's weight, electronics, price, image, and serviceability. Noise and emissions are not high on the list of priorities, yet these elements have had the greatest impact on engine technology since the passage of the Clean Air Act amendments. Thus, the heavy-duty vehicle industry has had to accept certain trade-offs to meet the new requirements while providing qualities that are important to the end-user.

- The emissions standards are not the only element of compliance with the requirements of the EPA and state agencies; companies must also submit to selective enforcement audits and comply with the requirement to maintain emissions within the prescribed limits for 290,000 miles. Therefore, when designing an engine, a company should leave room for variability in testing, manufacture, and development. All products must meet the standards for 290,000 miles.

- In 1991, the regulations made a significant jump from the previous year, lowering the limits on particulate and NO_x emissions. Ms. Vujovich stated that these are the standards that Cummins engines are currently meeting. In 1994 and again in 1998, the Clean Air Act amendments will reduce allowable emissions for particulate and NO_x. Although these regulations reach into 1998, with new technology the public and the regulators will probably require companies to reduce their products' emissions even further in the future.

- Companies will also have to comply with even more complicated Clean Air Act regulations, such as the Clean Fuel Vehicle Program. Owners will have a difficult time administering these complicated standards in their fleets. Checks and balances will have to be established within companies to ensure compliance. People who have had no previous involvement in the environmental control arena will have to participate.

Ms. Vujovich pointed out that technology will have to change to keep pace with the regulations. Existing markets will expand and new markets will be created to make heavy-duty engines run cleaner:

- In 1991, engine suppliers had few avenues for achieving the new emissions standards. Much activity focused on combustion development work. Most of the work done in 1991 to meet emissions standards involved in-cylinder technology. The big trade-off came in fuel economy. An engine cannot get a ten percent improvement in fuel economy, which is a vital need in the heavy-duty vehicle industry, while controlling NO_x at required levels. An improvement of three to five percent is huge at the present time, whereas in the 1970s and 1980s, a ten percent improvement was considered status quo.

- Taking this kind of technology into 1994, when the new standards go into effect, will be difficult without making significant changes. In addition to after-treatment devices, engine manufacturers could adapt their products to alternative fuels such as natural gas or methanol, which the EPA and some states have encouraged for use in bus fleets. Cummins introduced a 10-liter natural gas engine for the transit industry in 1991, a product that the industry will see much more of throughout the 1990s. Other manufacturers focused on methanol; there is no conclusive evidence as to which is preferable.

Engine modifications are opening up industry markets and creating opportunities as companies were forced to make major engine-related changes in 1991 and will have to do so again in 1994 and 1998 as new emissions standards go into effect. Ms. Vujovich stated that air handling systems, fuel handling systems, and combustion chamber design will all experience fundamental changes in technology:

- For air handling systems, turbo charger technology had to be improved. More ceramics are being used in the areas of the engine that get very hot, which are the high-durability areas of the engine. One component of particulate emissions is lubrication oil, which heavy-duty engines use in large quantities. A way to reduce emissions through the combustion process is to decrease lubrication oil, but then durability is risked.

- Fuel handling systems represent the fastest growing area in the heavy-duty vehicle industry now because of emissions control regulations. Fuel systems of the 1980s and early 1990s will not achieve 1998 particulate and NO_x emissions standards. Companies will have to completely refurbish the fuel system capability in heavy-duty products.

- Timing control will force companies into using electronic components to control NO_x emissions over the entire duty cycle of the engine. The 1994 standards will effect tremendous growth in this area of business.

- There will be a lot of work on combustion chamber design. As injection pressure is increased on a fuel system, the mixing in the chamber will be modified so the shape of the piston will have to be changed, optimizing the swirl (the mixing of fuel and air in the combustion chamber) and lubrication, controlling the oil in the system.

Looking toward 1994, companies will have to decide whether to purchase emerging advanced technology or stay with their current technology and decide what to do with it:

- Although most would rather not have to revamp their products for emissions compliance, companies would probably be able to meet emission standards with as simple a change as a catalytic converter, a proven technology. Engineers have worked hard to make the catalyst as passive an add-on as possible, keeping it inside the exhaust system so that it fits conveniently inside the product. This in-cylinder device catalyzes hydrocarbons from the exhaust stream into water and carbon dioxide. The technology does have some negative impacts, however, including back pressure and costs in fuel economy.

- Manufacturers interested in more advanced technology may turn to a more complex after-treatment device, the particulate trap. The ceramic trap collects particulates from the

exhaust stream and, through an oxidation process, burns them off. This technology is still in development, and will undoubtedly affect the marketplace and the economy in a positive way.

Ms. Vujovich noted that there is a lot of room for new technology in the reformulation of fuel:

- The petroleum industry has made significant strides in the late 1980s and early 1990s in controlling particulate emissions. The sulfur content in diesel fuel has gone from 0.3 - 0.5 percent down to 0.1 percent; 1993 regulations will require them to reduce the amount even further. The petroleum industry still needs to work on the cetane index to help with NO_x control and aromatic content, a need that presents business opportunities as well.

- There is a raging debate in the heavy-duty vehicle industry regarding alternative fuel options and the relative merits of natural gas and methanol. Ms. Vujovich explained that Cummins has established an active gaseous fuel engine development program. The company is pursuing a lean-burn or spark-ignited technology, which is a radical departure from traditional diesel engine technology. The well known injection technology has been modified with coils and spark plugs.

- The conversion to spark-ignition technology makes a big difference, representing a challenging application for buses as well as component manufacturers. This technology is an area that will require extensive development in the 1990s. If these new technologies are needed for clean air, suppliers of components must join the party. No one is presently working on state-of-the-art spark ignition technology for diesel engines of 11-liter size. When engine manufacturers go to component suppliers to collaborate on developing a coil or some needed part, most balk at spending their limited research and development dollars on a part for a product for which there is very little demand.

- The engine manufacturers must collaborate with the component suppliers on research to develop components for the heavy-duty industry at a level that will achieve the performance, emissions, and durability that is required. So far there has been more notable progress with manufacturers of devices like catalytic converters and particulate traps.

Ms. Vujovich concluded that Cummins and other companies are able to achieve emissions lower than the 1998 EPA emission standards on heavy-duty engines using alternative fuels and advanced technology, but emissions levels are not the only consideration in this industry. Manufacturers must design engines and engine components that will operate for 290,000 miles. The products designed for alternative fuels do not have the typical diesel durability that customers want. The customers are accustomed to driving 500,000 miles before overhauling the engine, a standard that natural gas and methanol engines cannot yet achieve.

* * *

Jeff Johnson, Chief Equipment Engineer for the Southern California Rapid Transit District (SCRTD), spoke on the SCRTD's experiments with alternative fuels and advanced technology to control emissions from its fleet of transit buses. Presently, the SCRTD runs some methanol buses, but is looking at other alternatives before choosing a technology. Mr. Johnson stated that the central transit

maintenance facility in Los Angeles has state-of-the-art heavy-duty engine emissions testing. Mr. Johnson also indicated that:

- The SCRTD bus fleet includes ten Flexible buses with Cummins engines that run on compressed natural gas. The buses have been in service for about a year and have performed well. They are part of a research and development program that has experienced some problems in the transit infrastructure, namely the fueling facilities, not the vehicles. There are six tanks on a compressed natural gas bus, which become a problem when refueling: they take too long to fill. Los Angeles buses are on the road 15-16 hours per day, limiting the time allowed for refueling. Otherwise compressed natural gas is a good option for transit buses.

- The fleet has 30 neat methanol buses built by TMC, a manufacturing company in Roswell, New Mexico. The buses had been driven more than two million miles in the Roswell area.

- The SCRTD procured 12 GMC RTS buses that run on methanol avocet. The transit district rebuilt the mechanical engines themselves to accommodate the fuel. Avocet increases the high octane, low cetane properties of methanol, allowing the methanol to combust. The buses can thus be converted from diesel fuel to methanol avocet.

- For the past two years the SCRTD had a retrofit program using Donaldson/Owens Corning and Donaldson/3M particulate traps. Thirty-three Flexible buses were recently purchased and put into service with the Donaldson/3M system.

Mr. Johnson then briefly enumerated other programs that the SCRTD is researching for Los Angeles:

- The SCRTD is looking into electric trolley buses that are built with a more sophisticated technology than those commonly found in other cities such as San Francisco.

- The government has funded a grant for research and development on fuel cells and hybrid technology that the SCRTD is conducting with Georgetown University.

- The transit district has also established a research program with an aerospace company to develop a lightweight bus with traction motors in which all four wheels run on a low combustion internal engine.

- The SCRTD is also considering liquified natural gas, which seems more practical than compressed natural gas because it takes less time to refuel. Another drawback to compressed natural gas is that it adds 3,000 pounds to buses that are already overweight; the excess weight affects performance and damages the roads.

- Orange County, California is working with a manufacturer on a catalyst program that has had favorable results in lowering emissions.

After listing these alternatives, Mr. Johnson explained that the transit district chose to order 303 methanol buses from TMC in Roswell because they have the most experience with methanol. In 1991,

California laws mandated that methanol engines are the only certified engines that an urban transit authority may purchase. Engine manufacturers such as Cummins are confident that particulate trap diesel engines will also be certified by this summer; the SCRTD intends to purchase buses with these engines.

Mr. Johnson went on to discuss some of the opportunities presented by, or related to, the Clean Air Act:

- Favorable rulings by the public utilities commission in California have brought down the price of natural gas.

- Chicago's Board of Trade has authorized the trading of sulfur dioxide credits.

- Similarly, the Air Quality Management District in Los Angeles approved a pilot program to trade in NO_x credits. At the moment, mobile sources are not allowed in the program, but there is some aggressive lobbying to include them because they cause 80 percent of the pollution in Los Angeles. NO_x credits could actually pay for the cost of running methanol buses, which is about $45-50,000 per bus annually.

- The transit district's emissions testing facility went on-line last April and so far has generated approximately $100,000 in revenue. The district charges $20,000 for a company to test its engine's new technology for emissions. Revenues will increase substantially as more testing is needed.

- California's transportation infrastructure has limitations that can be viewed as business opportunities. Currently there is not enough crude oil or production capability to make enough reformulated or alternative fuel to serve everyone who would need it under the new law. In addition, there are very few facilities that sell methanol or natural gas for vehicles that have been converted to alternative fuels. The private sector needs to develop such facilities.

Mr. Johnson concluded that the proposed 1996 California emissions standards, if passed, will effectively outlaw diesel engines, at least for transit buses. Methanol is the only fuel currently meeting the proposed standards; natural gas may be capable of meeting the standards with some development.

* * *

Alan Smith, a consultant for Brooklyn Union Gas Company, traced the evolution of the first full-size transit buses in North America originally designed to run on natural gas, as opposed to converted buses. Brooklyn Union introduced these buses in New York City. Mr. Smith considered this experiment a great learning process resulting in an excellent machine. He described the process of commissioning this new technology:

- Approximately 6,000 buses operate on the streets of New York City every day. As diesel fuel was found to be as unhealthy as it is unpleasant, Mayor Koch was eager to find a cleaner fuel for the transit bus fleet, which, unlike trucks that generally pass through the city, emit their entire exhaust on the busiest streets of New York.

- The city had been given six methanol buses as a settlement of an environmental group's lawsuit against GM for emissions violations on one of the cars it produced. However, Brooklyn Union thought that rather than using methanol, it would be more cost effective and efficient to use natural gas directly. Although several studies in the 1960s concluded that natural gas was a declining resource, more recent reports found evidence that it is in fact abundant, so much so that natural gas prices have decreased.

- In 1986, Brooklyn Union commissioned two buses as a research and development project to demonstrate the technical, environmental, and economic feasibility of using compressed natural gas buses in New York City.

- There were some initial obstacles to building the buses: no engines had ever been built for natural gas buses, no company had ever built such a bus, and no company had ever operated one. One company near Toronto had experience adapting engines for natural gas, however. They redesigned two GM 454 spark-ignited, turbo-charged engines to use in the buses, and one for emissions testing. The test results at an independent laboratory showed emissions levels so low they were suspect, and the engines were retested. The results were validated, and after another test at the EPA, the engines were certified.

- Bus Industries of America agreed to build the buses and Command Bus Company, a private transit company subsidized by the city of New York, agreed to operate them, as they still do.

- In January 1987, Bus Industries of America signed a contract to deliver the two buses June 1st. When the engines were installed in the buses and tested, they practically glowed in the dark. The heat buildup was so intense that ignition wires and hoses melted; oil temperatures reached 240 degrees Fahrenheit. Thus, the entire engine compartment had to be redesigned. As a result, the buses were delivered 15 months behind schedule.

- Once the buses arrived in Brooklyn and were approved by the state and city departments of transportation, there were regulatory obstacles. The Port Authority of New York and New Jersey and the Tri-Borough Bridge and Tunnel Authority, which, between the two, have jurisdiction over all interstate and intercity bridges and tunnels in the New York area, both had regulations against carrying compressed gas through tunnels or on the lower level of bridges. The New York State Research and Development Administration was then asked to conduct a study to determine the safety credentials of compressed natural gas. It concluded that a bus with the requisite nine tanks of natural gas was safer than a passenger car with 15 gallons of gasoline; the buses were approved for tunnel and bridge travel.

- A fundamental change in design came after a freak accident in which a reckless driver drove under one of the buses, which is where the fuel tanks are located. The tanks are built to withstand a dynamite blast and suffered no damage, but the manifolds connecting them were severed and the gas from all nine tanks escaped. The tanks and manifolds were then moved to the roof of the bus. Regulations clearly state, however, that fuel tanks on buses must be placed below the passenger compartment to protect passengers from leakage, a rule obviously not written for a fuel that rises. After many months, the company was able to obtain a dispensation.

- Another adjustment was made when it was discovered that the natural gas engines were not heavy enough to run a 40-foot bus. Cummins had begun to produce high quality natural gas engines, so in May and August 1990, the two buses were removed from service, Cummins L10 engines were installed, and the fuel tanks moved to the roof.

Mr. Smith reported that the buses were back in service, averaging miles per gallon equivalent to diesel engines, but consuming about 70 percent less oil than diesels. The buses average about 942 miles per quart of oil. The emissions continue to be extremely low. Another benefit concerns the placement of the fuel tanks. Locating the tanks on the roof and eliminating the transmission means the buses can sit lower to the ground. Steps are no longer needed, so passengers can step from the street right onto the bus, and wheelchairs need no special devices to board. Travel will be faster since less time is needed to load the bus.

The four-year pilot program ends July 1st. Whereas there were no natural gas buses in existence five years ago, today they are a growth industry. Out of 2,000 alternative fuel transit buses on order through the Federal Transit Administration, two thirds are natural gas. The next stage of design is already in development. Ontario Bus Industries is building a hybrid that uses half as much natural gas and emits approximately one fifth of the best pollution results now achievable. A new Orion bus will have a natural gas engine of only 75 horsepower that will operate at a constant speed, charging or discharging power as needed to batteries that will operate electric motors in all four wheels.

* * *

Julian Imes, Product Manager for Donaldson Corporation, discussed his company's exhaust after-treatment products. The company manufactures heavy-duty filtration equipment, and is a component supplier to mobile equipment manufacturers and diesel manufacturers. Donaldson became more heavily involved in product development in this field as a result of the 1985 EPA heavy-duty vehicle emissions regulations. Mr. Imes focused his presentation on diesel particulate control systems, namely particulate trap oxidizers, catalytic converter mufflers, and replaceable/cleanable filters. He went into the most detail about trap systems:

- A trap system consists of a filter to capture the particulates emitted, a means of regeneration to burn off or clean the particulates periodically, and a control to sense when the regeneration should occur.

- A number of filtration methods are used. Popular models include the wall-flow monolith, fairly efficient ceramic device in which the particulates flow through porous walls and are collected.

- Filter regeneration systems include electrical heating, the use of diesel fuel burners, catalysts, throttling, or combinations of these. Mr. Imes noted that after investigating all of these methods, Donaldson has settled on electrical regeneration as its primary approach.

- Donaldson has the most experience with the ceramic wall-flow monolith trap with electrical regeneration. The company has approximately 550 systems in use, mostly in the U.S., but the number is growing constantly. The company is working on optimizing the design and the components of the system for reliability, while trying to reduce the

complexity of the technology. These trap systems can be installed on new vehicles or retrofitted to vehicles with conventional diesel technology.

- In addition to the wall-flow monolith traps, the company uses the multiple cartridge approach. The primary advantage to this technology is its capacity to fit easily into an engine compartment with limited space, sometimes in a space vacated by a muffler. This system is still in the early field testing stage, however, and the company has had difficulty optimizing its design and performance.

- Another type of after-treatment, the catalytic converter muffler, integrates emissions and noise control.

Mr. Imes pointed out that particulate trap systems have moved beyond the development stage and are well into commercialization. The company's understanding of reliability and durability issues grows rapidly as the primary operating fleet in New York City and smaller fleets in the Southern California Rapid Transit District and elsewhere accumulate fleet miles. As of January 1, 1992, the combined fleets had a total of 11 million miles accumulated; the vehicles add an estimated 200,000 miles per week. In addition, Donaldson has exported this technology to Europe and Japan.

Mr. Imes also explained the importance of feedback models in the New York City fleet that provide the company with data for enhancements to the components. Already, the next generation of particulate traps is in the design stage. As allowable emissions levels continue to fall as a result of 1994 Clean Air Act regulations, the company is evaluating new models to achieve lower costs, simplified designs, and enhanced reliability and durability. In conclusion, Mr. Imes noted that:

- Particulate trap technology is widely available on a commercial basis.

- The technology is rapidly improving in terms of reliability.

- Trap systems are cost effective, and prices will decrease further as demand for them grows and the technology is simplified.

- Overall, trap systems are an effective means to achieve clean diesel engine performance. There is a bright future for this product both in the U.S. and abroad..

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QUESTIONS AND ANSWERS

At the end of the panel discussion, Mr. Howards opened up the floor to questions.

A member of the audience asked why the regulatory agencies and the industry were promoting alternative fuels so aggressively when studies have shown that diesel fuel can be cleaned up significantly to lower emissions.

Ms. Vujovich explained that the heavy-duty vehicle industry suffers from a lack of volume, that petroleum companies and component suppliers' research and development priorities are with gasoline-powered vehicles. Diesel engines are indeed meeting current emissions standards with

existing technology and in some cases with additional after-treatment devices. The question is whether current diesel technology, componentry, and fuel systems will be able to meet the more stringent standards in a few years. With cooperation from the petroleum industry, there is reason to hope that diesel technology will be adequate.

Another person asked what would be the most cost effective way to meet the low emissions requirements in California: alternative fuels, electronic controls, or after-treatment devices?

Ms. Vujovich maintained that conventional diesel technology, with technical advancements applied to it, will probably meet the standards. Alternative fuels are capable of meeting them as well, but the main concern with alternative fuels is how little is known about them. Manufacturers have decades of experience with diesel technology, but know too little about the reliability and durability of alternative fuel engines. These kinds of changes do not happen on an industry-wide basis overnight. For example, it took approximately 15 years for heavy-duty vehicles to switch from gasoline to diesel fuel. It took almost five years to lower the sulfur content in fuel.

Mr. Johnson indicated that the next generation of heavy-duty vehicles would be the solution to cleaner air. The industry allowed diesel vehicles to grow increasingly heavier without attempting to reverse this trend. The advanced technology now in development will produce lightweight vehicles with no transmission and traction motors on all wheels, so that each wheel steers. These vehicles could potentially run on diesel since they are lighter. The technological changes are strapped onto existing 40-foot buses for the time being, but the next stage of evolution is not far off.

Another member of the audience asked about enforcement -- California is leading the country in this regard, but what is happening elsewhere?

Ms. Vujovich mentioned that although many states have regulations for roadside checks for smoke and emissions, probably only half a dozen will actually enforce them. Mr. Howards pointed out that these regulations put a substantial burden on already overburdened police departments. Policemen require training to learn to read smoke and to develop an understanding of heavy-duty vehicle operation. State and local governments can provide financial incentives to bring local police departments into the enforcement fold, i.e., allowing the department to keep a percentage of the revenue from fines collected. In addition, the EPA is developing an in-service testing procedure across the country. Trucks will be taken off the road while in service to a testing facility to assess compliance efforts.

SESSION 3 -- PANEL A
Services For Controlling Utility Emissions
April 23, 1992, 8:30 a.m. - 10:30 a.m.

INTRODUCTION

Robert Brenner, Director, Office of Policy Analysis and Review, Office of Air and Radiation, U.S. EPA, and panel moderator, opened the session with some remarks about the current state of development of market-based approaches in the acid rain program. Mr. Brenner described the continuing difficulties associated with educating the public about the benefits of using a market-based system as well as the system's limitations in solving pollution and other social problems. Nonetheless, Mr. Brenner stated, the acid rain program is progressing well: proposed rules governing the trading program will be issued during the summer of 1992; the number of acid rain control technologies have increased significantly in the last few years; and costs of technologies have been much lower than expected.

Mr. Brenner provided the focus of the panel concluding that, due to this progress, it is now possible to discuss the details of implementation, i.e., the problems and opportunities associated with an allowance trading system. Mr. Brenner stated that the panel would address two key issues:

- How does the existence of a market-based trading system affect the choices of acid rain compliance strategies? and
- How can the regulatory processes already in place be improved upon and used to better aid the compliance process?

PRESENTATIONS

John S. Palmisano, President, AER-X Corporation, began his presentation by providing some background on market-based approaches, saying that market approaches to pollution control first appeared in the Clean Air Act Amendments (CAAA) of 1977. Mr. Palmisano emphasized that since that time market-based approaches to environmental control have existed in reality, not just in theory:

- Since 1977, when market-based regulations were incorporated into the Clean Air Act, there have been over 3000 market transactions, of which approximately 500 were third-party transactions.
- One program in California, the McLean Program, promotes the market-based system and will yield approximately 1 to 2 transactions a day within the next few years.

Mr. Palmisano stated that the market-based approach, which would grant companies SO_2 "allowances" that may be saved for later years, used immediately, or sold, would continue to grow in importance, eventually becoming the cornerstone of the Clean Air Act. Mr. Palmisano stated that such an allowance system is an appropriate complement of a "command and control" program of permitting and enforcement. The allowance system will allow engineers to develop a cost-effective, relatively risk-free compliance strategy.

Mr. Palmisano noted, however, that since there is no perfectly risk-free method of compliance, there are problems with an allowance system, such as disallowances in prudency reviews, changing regulations, and changing technology. Therefore, companies rely on risk minimizing compliance strategies which affect the choice of technology. Mr. Palmisano stated that companies seem to be primarily choosing the well-tested wet scrubbing systems to reduce emissions rather than new options such as clean coal technologies or natural gas.

Similarly, Mr. Palmisano stated, companies are waiting to see if other companies already participating in the market are successful before joining in as well. Consequently, Mr. Palmisano stated that the use of allowance trading will diffuse slowly while companies become accustomed to and confident with the system. Because allowance trading is in everyone's best interest economically, it will be a successful program. The market-based systems will marshal everyone's self-interest towards a favorable social outcome.

Mr. Palmisano discussed the forces, or complements and substitutes, that will affect the cost of SO_2 allowances. Mr. Palmisano named various substitutes for allowances: low sulfur coal, natural gas, modular nuclear facilities, and importation of power from Canada. Mr. Palmisano stated that the primary complement affecting the cost of allowances would be potential regulatory changes (particularly changes in regulations on coal and greenhouse gases.) All of these issues will affect supply and demand of allowances and thus the price of allowances.

Mr. Palmisano concluded his remarks by stating that the future of trading is promising. Mr. Palmisano stated that even the countries comprising the former Soviet Union are developing a market-based approach to environmental control. Mr. Palmisano further believes that a market-based approach will be the cornerstone of forthcoming greenhouse legislation.

* * *

Dr. Morris Trichon, Vice President, Environmental Services Technology Division, Research-Cottrell Corporation, spoke on the importance of Continuous Emissions Monitoring Systems (CEMS) in a reliable market-based system. Dr. Trichon stated that good CEMS served four primary functions in a market-based system:

- Provide the "gold standard": In market-based system, Dr. Trichon stated, there must be a an immediate, reliable system against which to measure the success of emission control. A good CEM system will allow a company to protect investments by maximizing the value of the plant and equipment as well as improving its public and private sector credibility.

- Expand the applicability of market incentives: Dr. Trichon stated that CEMs not only helped meet the requirements specified under Title IV of the Clean Air Act, they also applied to Title I, Title III, Title V, and Title VII, as well as other environments statutes.

- "Added value" to traditionally non-productive systems: Traditionally, before market-based systems, CEMs were non-productive investments. Companies bought the cheapest system available to meet the requirements. However, under a market-based system, firms will start buying the most productive, rather than the cheapest, system to meet their needs. Firms will try to minimize liability and maximize productivity. Integration of CEMS may also maximize the production process and extend process equipment life.

- Force technology development: CEMS will propel market-based strategies, help verify the accuracy of emissions equipment, and enhance the return on investment in emissions control equipment because a company will more accurately know its position in trading. Market-based strategies will drive CEM development.

* * *

Joseph W. Messick, Jr., Senior Vice President and Chief Engineering and Construction Officer, PSI Energy, Inc., provided a buyer's perspective of the market. Mr. Messick spoke of the three stages necessary to implement a Clean Air Act compliance plan. First, however, Mr. Messick provided background on PSI's efforts to meet the Phase I requirements:

- On April 13, 1992, PSI filed its proposed Phase I compliance plan with the Indiana Regulatory Commission. The state of Indiana provides the opportunity for pre-approval on compliance plan measures before the plan is filed with EPA. Mr. Messick praised this pre-approval program as it gives the utility company guidance and informs the state about the utility company's strategy to reduce emissions. Final hearings on PSI's proposed plan will be held by the state in August.

- 80% of PSI's units are affected by Phase I requirements. Emissions must be reduced by 170,000 tons of SO_2 a year in Phase I. Emissions were 500,000 tons in 1981.

Mr. Messick then outlined PSI's Phase I compliance plan (1991 - 1994), the costs associated with the plan, and the considerations used to develop the plan:

- PSI has already begun to install a wet limestone scrubber on a major unit. PSI is moving toward the burning of lower sulfur coal at stations that are not scrubbed until precipitator break points are reached. PSI will also add flue gas conditioning to help in lowering sulfur emissions and capturing particulates, and upgrade two precipitators. Finally PSI will install low-NOX burners.

- The projected cost of the program between the years 1991 and 1994 is $420 million including $170 million for a scrubber, $23 million for flue gas conditioning equipment, $120 million for a precipitatory replacement or upgrade, $60 million for low NOX burners, and $25 million for CEMS.

- Options in developing a plan were demand side management and conservation, scrubber technology, use of lower sulfur coal, purchase of emission allowances, power purchasers, and clean coal technologies. Mr. Messick stated that average costing as well as marginal costing of next increment removal were considered in order to choose a least-cost, reliable compliance plan.

Mr. Messick next outlined the future Phase II compliance plan which will probably be submitted to the Indiana Regulatory Commission in mid-1994. PSI plans to add more scrubbers, and use more coal blending (western and mid-western). (Today, PSI's coal predominantly comes from the Illinois basin.) Mr. Messick believes that emission allowances will offer more options in Phase II of compliance.

In closing, Mr. Messick listed several operational considerations that should be addressed if a market-based system is to be successful:

- Mr. Messick questioned how emission allowances would be handed in conjunction with interchange transactions among utilities, e.g., if a utility arranges with another utility to provide emergency power, how will the excess emissions of the utility providing the power be counted? How is this accounted for in emission trading?

- A method for establishing a reserve margin or banking level to offset unforeseen contingencies must be established. Would this be a percentage of emissions? Mr. Messick said that PSI had suggested about 20 to 30 thousand tons in its Phase I plan.

- A reliable tracking system is necessary so that a company may have a good idea regarding how much is being emitted over the course of the year.

- Several regulatory and taxation issues should be resolved: who owns excess allowances, how will income from excess allowances be treated, and will a utility be able to purchase allowances for a compliance plan in 1994 that will be in affect in Phase II if the price agreed to on the allowances are higher than the market in phase II? A give and take is needed from regulatory stand-point.

- Purchasing of allowances will not be suitable for every utility.

- The success of the marketing program and of the CAA in general depends absolutely on a reliable monitoring system.

* * *

Stanely I. Garnett, Vice President, Finance, Allegheny Power System, Inc., provided a perspective on the market-based system from the standpoint of a small utility company. Mr. Garnett first supplied some background on Allegheny, its compliance efforts, and projected costs of compliance:

- Mr. Garnett stated that Allegheny is a large but poor utility company. The Allegheny Power System serves five states but no major cities and currently ranks 25th among the country's powerplants in sales revenue. Consequently, the costs of the CAA could be prohibitive. Mr. Garnett stated that the market-based system could be extremely important to a company such as Allegheny as a small plant can reduce its emissions relatively quickly and increase revenue from the sale of excess emission rights.

- Allegheny has gone through prudency reviews in each of its jurisdictions. Currently its compliance plan as been approved by four of the five states in which the plan operates. Three of the plant's jurisdictions have provided current cash recovery.

- Allegheny, one of the first companies to construct a scrubber, spent $40 million on this first scrubber. This year the company has budgeted $200 for a scrubber system with the total cost of the scrubber system projected it to be $762 million.

Mr. Garnett praised the CAA of 1990 because it allows companies to individually tailor plans to meet their requirements. Mr. Garnett, however, identified two major problems with the current functioning of the market-based system:

- Federal law has not yet been implemented on a state level, i.e., although theoretically emissions trading can occur, technicalities in state laws make it illegal. The market will not play an important part in Phase I of implementation due to problems on the state level.

- The federal income tax code will tax revenues from the sale of emission rights as a capital gain. The federal tax code must be adapted to accommodate emissions trading or many companies will decide trading is not profitable.

QUESTIONS AND ANSWERS

After the panelists had each given their 15-minute presentations, Mr. Brenner opened the session up to questions from the floor.

Mr. Brenner began the questioning by asking whether present-day CEMs provide good monitoring and why is there so much opposition from utilities to developing more accurate CEMs?

Mr. Trichon replied that in the past there was no economic return for CEMs; money was invested in them but no money was made from them. Under a market-based system, however, CEMs will have real economic value. Thus, the effectiveness of CEMs will evolve with the market place but probably would not develop independently.

Mr. Messick added that in past testing was done through the analysis of coal. In the future the accuracy of the monitor will be crucial. Mr. Messick noted that utility companies would be conservative when choosing monitoring in order to avoid redundancy in systems.

A member of the audience from the Pennsylvania Electric Co. stated that frequently management procedures rather than the actual monitoring device determine how well the monitor functions. Redundancy can also be eliminated by good management.

A second person asked exactly what the future prices of SO_2 allowances might be?

Mr. Garnett replied that although, theoretically, prices will be coming down because companies are becoming more self-sufficient (e.g., buying low sulfur coal), in reality, in 1995 there will be more buyers than sellers of allowances which may lead to inflated prices.

Trichon stated that certain technologies (e.g., wet scrubbing) may be precluded in certain states, which may affect the cost of allowances and ability to trade.

Mr. Palmisano stated that it would be difficult to predict actual prices because of technology may change greatly in the next few years and existing companies offering similar technologies, such as companies manufacturing scrubbers, will consolidate. Further, future greenhouse regulations will greatly effect coal.

Mr. Brenner offered an actual number, projecting a cost of $600 to $700 a ton in Phase II. Prices may be 20% lower than these projections.

Mr. Messick added that how the public will react to emission trading across states, i.e., how the public will react when its local power plant buys the ability to emit more, might affect the feasibility and price of trade.

Mr. Palmisano addressed this comment saying that non-contiguous state trades would be unlikely. Only safe trades will occur at first; however, Mr. Palmisano predicted that within five years trades would be occurring between the United States and Canada as people get used to the system.

A third person asked whether the participation of third-parties in emissions trading would be advantageous.

Mr. Garnett responded that there are three problems with using third-parties: new tax laws make it no longer advantageous to use third-parties, leasing is difficult because most emission control equipment is custom-made, and investors request huge lease indemnifications.

Mr. Messick pointed out that third-parties would raise a problem of responsibility.

Another member of the audience asked whether their would be problems with "pooling."

Mr. Palmisano and Mr. Garnett agreed that pooling will have advantages because of tax benefits and that, in the future, most transactions will take place through pooling.

One member of the audience asked when spending on emissions control would begin?

Mr. Messick stated that, in Indiana, spending had to begin before IRUC approval. For instance, in his Indiana company, a scrubber is already being installed.

Mr. Garnett added that because many regulations have not been finalized companies are tentative about spending money until all regulations are known.

SESSION 3 -- PANEL B
Services for Controlling Vehicular Emissions
April 23, 1992, 8:30 a.m. - 10:30 a.m.

INTRODUCTION

Richard D. Wilson, Director of EPA's Office of Mobile Sources served as moderator. EPA considers the services required to control vehicle emissions critical to the goals of the new Clean Air Act Amendments. Inspection and Maintenance (I/M) programs can be found in 154 cities across the country, and 74 now are required to have enhanced programs.

- EPA estimates that 4,000 to 12,000 new jobs will be created in the vehicle testing and repair sectors of the economy and $500,000,000 will be added in new auto repair business.

- I/M programs lower the overall cost of clean air because these programs are estimated to clean the air at $500/ton, a savings of $1.6 billion per year over more expensive methods. In addition, I/M programs also stimulate the scrapping of high-pollution cars.

PRESENTATIONS

Bill Watson, Manager of the Vehicle Emissions Section in the Arizona Department of Environmental Quality (DEQ), was introduced as running one of the best I/M programs in the country.

In the early 1970s, Arizona started to study vehicle emissions. These studies showed that a centralized program would be most effective for Arizona and would remove a conflict of interest for inspectors and repairers. In 1974, a Request For Proposals (RFP) went out to initiate the first program. The RFP required that owners be within 5 miles of a test facility; testing of diesels, motorcycles, and all vehicles 13 years of age or newer; and included dynamometers. In the first 15 years, Arizona has added light load testing, a tampering program to test for catalytic converters, and new testing for lead in the tailpipe. Arizona's program is credited with removing 300 tons of carbon monoxide (CO) per day in metropolitan Phoenix. Mr. Watson described the current and future I/M system in Arizona:

- Gordon Darby, Inc. now conducts the Arizona emission tests for $5.60 in 52 test lanes at 12 stations from 8-7 Monday-Friday and Saturdays 8-3:30. A hotline is available to let customers know the waiting times at any station. In addition, a new report card system ranks effectiveness of repairs for retested vehicles. The questionnaire asks what repairs were performed, what these repairs cost, and the subsequent pass or fail. A list of service shops in the Phoenix and Tucson areas shows the percentage of passes by repaired cars from each repair service supplier. Arizona currently is testing two million vehicles at a failure rate of 20 percent. All government vehicles must be tested, including police and fire vehicles. Color-coded license tags are used to deter registration outside of the I/M testing areas.

- The state offers an I/M training program at a total cost of $25.00 (the cost of the booklet) for a 16 hour enhanced or 8 hour basic course. Participants pass with a score of 80 percent.

- Oxygenated fuels recently were introduced in Arizona during the months of October through March, and the Arizona DEQ has seen a 20 percent reduction of CO at the tailpipe with either ethanol or MTBE — no methanol is in use. Next year, Arizona plans to drop the tailpipe lead test and incorporate a gas cap test to check for ability to hold pressure. Diesels are now run with a loaded dynamometer test at 80 percent of throttle to check opacity. A snap acceleration test will soon be incorporated since the alternative test showed a very low failure rate.

- Sixty-five to seventy percent of Arizonans surveyed want a vehicle emission test. Arizona's air violations in 1976-77 occurred during approximately 80 days and this has decreased recently to one or two per year, even with increases in vehicle miles traveled.

* * *

Larry Taylor, Vice President of Sales and Marketing for Hamilton Test Systems, began his presentation by reviewing the new business opportunities in inspection and quality control services. The market for vehicle inspection, maintenance, and repair services will include 60-70 million vehicles subject to enhanced I/M and 10-20 million subject to basic I/M.

Most opportunities will flow from weaknesses in current programs. Many of the tests used today fail to identify 40% of excess emissions from the worst emitters, so-called "super emitters". Evaporative emissions have been shown to account for 50% of hydrocarbon emissions. Repair work is not always as effective as possible because vehicles are tuned to meet I/M test standards and not the best emission results attainable by the vehicle. Some of the techniques used to beat the I/M programs include tampering, "consumer shopping" to identify lenient stations that get vehicles passed, and registration of vehicles outside of metropolitan areas in states that operate programs in limited geographical areas.

Good equipment and better access to information will greatly enhance the ability of mechanics and inspection stations to diagnose emissions problems and keep vehicles in compliance. Mr. Taylor offered his view of future I/M programs:

- High tech test-only inspection: This inspection program is designed to identify super emitters under load testing, should test for evaporative losses, and should incorporate NOx testing. The technician will have greater access to emission data and fault code readings from high tech I/M machines. Nationally, he expects an increase in vehicles tested from the current 15 million to 30-45 million. A program of this type will require 2,000 high-volume lanes testing 17,000-20,000 vehicles per lane per year at 500-1,000 inspection stations. The increase in jobs will be substantial and some of these new jobs include program administration (700) and station management (1,000-2,000). He also predicts $750 million in construction and land purchases and 4,500 man years of construction jobs. Testing equipment will account for another $300 million.

- On-road testing program: Testing in-between inspection cycles should deter tampering, and identify vehicles avoiding I/M tests by registering elsewhere. On-road testing may include random pullovers or include new remote sensing techniques. Opportunities exist for the private sector to provide these services with police during pullovers. States are using the private sector to provide quality control of their decentralized programs (e.g.,

California) to check calibration of analyzers and verify that inspection procedures are accurately implemented.

- Mechanics training and repair: Mr. Taylor spoke of the critical need to upgrade skill levels and left this discussion to the other speakers.

* * *

Ken Thomas, Product Manager of Sun Electric (Crystal Lake, IL), spoke about three issues: basic diagnostic equipment, enhanced I/M equipment, and training. Sun produces a complete line of I/M equipment in addition to a line of mobile recovery systems for CFC markets, a hand-held scanner (Tech 1) that gathers diagnostic messages from the vehicle and displays them, a PC-based shop management system (Shopmax), and safety and inspection system equipment such as front-end aligners. Mr. Thomas reviewed in detail some of the products that Sun Electric will provide to I/M programs, and outlined the role Sun foresees for industry participation:

- Basic diagnostic equipment opportunities: The MCA 3000 is a PC-based analyzer that performs "four gas analysis" and is capable of supplying the mechanic with technical service bulletins. Sun's Interrogator and MEA are more basic models.

- Enhance I/M equipment opportunities: Exhaust gas analyzers now are as accurate and stable as most laboratory-grade instruments. Sun's MGA 9000 bar analyzer is a 286/386 based system with sufficiently large memory for data management (40 megs minimum, expandable to 550 megs). While this analyzer can measure exhaust emissions, it also can communicate with other computers. Available options include a barcode reader, vehicle on-board computer interface, advanced diagnostic software, PC option to retrieve technical service bulletins, CD-ROM mass storage unit of 500 megs (e.g., recall notices, Mitchell On Demand), on-line communications by modem (currently used in Florida to register information with the State), and the MGA 9000 is adaptable to incorporate a NOx analyzer, opacity test, and dynamometer. A newly introduced option based on the Clean Air Act Amendments is the POD. Connected between the Sun analyzer and the cable to the vehicle's on-board computer, the POD obtains real-time data and additional maintenance data. Other future options include evaporative pressure and canister purge tests.

- Training: In the 1990s, Sun began to implement a major thrust to upgrade the basic mechanic to a true technician, capable of using the analyzing equipment as a diagnostic and maintenance tool. Sun believes that customer relations is an integral part of any training program and should take on a greater emphasis in future training programs. Inspector training also is important as inspection becomes separated from the repair shop in centralized programs. Training resources should be spent to integrate a number of resources including manufacturers, colleges, and vocational schools.

* * *

Dave Van Sickle, Director of Automotive Engineering and Consumer Programs at the American Automobile Association (AAA), presented AAA's history in automotive care and a view of future I/M programs.

AAA is a federation of 147 independent clubs with 33 million members. AAA provides road and travel related services, insurance, and technical services, including diagnostic centers to perform emission and safety analyses. Mr. Van Sickle presented his view of the role AAA may play in their continuing efforts to increase public awareness and to support government and industry efforts to address the need for automobile maintenance and better trained technicians:

- AAA has performed 126,000 free vehicle emission and safety inspections and holds a unique position in performing unbiased vehicle evaluations. His organization has contracted with the state of Indiana to perform outreach through the Fuel Saver Program, to convince the motorist that an efficient vehicle saves money and is good for the environment.

- AAA member cars have been shown to have 33 percent fewer defects, partially due to AAA car care clinics, AAA magazine articles, and other information services. However, in spite of technology advances and testing programs, most car owners still do not adequately maintain their vehicles.

- AAA's Approved Auto Repair program approves facilities that follow minimum standards and that also allow AAA to arbitrate consumer complaints. To promote repair expertise, AAA tests 8,000 high school students in automotive knowledge. These students still are lacking some of the basics necessary for future automotive technicians. Because instructors may not always have the best information; AAA has started a high-tech instructor course. The course text and over 240 slides are used for training, and subsequently are given to the trained students who, in turn, are better able to train others. Four hundred instructors and 950 technicians have been trained and the curriculum is continuously updated.

- AAA also resolves disputes between five major automotive manufacturers and consumers, with a dispute resolution mechanism certified in ten states.

Industry now is challenged to reduce emissions, and alternate fuels create new challenges to educate motorists and technicians. AAA is in a unique position to act as a driving force and assist national programs that might include standardized technician training, emission and fuel testing, facility certification, and inspection station audits.

* * *

Nick Positano, Technical Training Manager of the New York State Department of Motor Vehicles, reviewed in-service technician training as it affects the future of I/M programs in the 1990s.

Over 37 I/M programs are implemented across the U.S., but many have fallen short of their objectives. Mr. Positano addressed the following questions: What are the new technologies and what impact could they have on training programs? What should we, as representatives of government and industry, do to incorporate new changes into I/M training programs?

- What are the new technologies? In 1991, there were 450 car models from 40 manufacturers. Maintenance on these vehicles is an increasingly complex challenge. In 1965, a car mechanic needed to understand 5,000 pages of information to fix most

automobiles. Now, with increases in electronics, it requires the equivalent of 250 city phone books to adequately understand the universe of car repair. Hotlines, diagnostic centers, and "reality-based" training are key sources of information that future technicians will require. He suggested 40 hours per year of college level training plus one-hour per day of additional reading for future technician training.

Technicians also will spend as much time at a computer as under the hood. Increasing shortages in trained technicians will create a growing demand for certified technicians.

- What should we do? Update training that will affect the largest vehicle population. Technician training needs to begin now before larger shortages occur. We need to recognize that independent repair shops account for 75-80% of repairs (in New York). Training courses need to be generic, short in duration (i.e., need-to-know as opposed to nice-to-know information), at local centers and at convenient times, performed by instructors well-trained in both content and delivery, and balanced between text and hands-on training.

  Mr. Positano stated that government alone cannot achieve these goals. A network of public training in association with private suppliers, manufacturers, book publishers, and audio visual material suppliers will be required. In New York, the automotive technician training courses consist of 96 hours of training (four 24-hour courses) starting with electricity.

  The public also needs to be able to identify facilities that meet minimum levels of training. In New York, the Sign of Automotive Excellence is displayed at service facilities where at least one technician has taken all four courses, half have taken half of the courses, and all technicians must complete all four course within two years. This program presently is voluntary, but New York is looking to make it mandatory.

Mr. Positano believes that the solutions are not simple, but nothing is impossible. Technician training should be given a high priority and coordinated in close partnership with all affected interests.

QUESTIONS AND ANSWERS

Dick Wilson began the discussion by asking the panel how to get the "cream of the crop"?

Mr. Positano replied that, in New York, all of their community colleges produce 2,000 technicians, yet there remains a 5,000 technician shortage. He believes that consumers must be educated as to what auto technicians actually are doing in their positions. He also believes that there is a need to train consumers to know where to go to get appropriate service.

A member of the audience asked how auto dealers might work with future I/M programs?

In some states, all vehicles sold by a dealer must pass a vehicle emission test. If an organization has more than 25 vehicles, the state allows them to perform their own inspections and performs quality control at the testing facilities. In some states, new vehicles are tested only after they have been sold, and the new owner must register the vehicle.

A follow-up question was posed: What if a state I/M program fails a car that is not required to be tested and the vehicle is under warranty? How long should the time period be before I/M is required?

> The member of the audience that posed the question stated that used car dealers would like the longest time possible before states require I/M testing. Dick Wilson stated that EPA would encourage states to make an I/M test available to individuals who believed that their vehicle, while under warranty, might fail an I/M test even though this test may not be required by the state. He reminded that audience that states will get a fair amount of leeway in setting up these programs. In the discussion it was stated that I/M failure rates increase approximately 2% for each year that a vehicle is "on the road". The general consensus was that early testing is not productive, but no consensus was reached on the appropriate amount of time that should lapse before a vehicle should be tested.

How long does testing take in Arizona?

> Mr. Watson responded that there is an average waiting time of 5 minutes given that they don't go the first or last day of the month. The test takes three to four minutes and individuals are charged $5.60, with the total fee going to the contractor.

How will educational programs work with new information needs? For example, GM is requiring royalties for its automotive information.

> Mr. Positano responded that New York State is not negotiating directly with GM; however, the supplier of the educational materials is and he expects that the on-line information services will do the same.

Is there a test to identify whether catalysts are continuing to function?

> Dick Wilson responded that this test is not readily available, but a catalyst efficiency test will be critical to continuing I/M programs. He spoke of EPA promoting on-board diagnostics that include information on a vehicle's catalysts. This technology might store this information so that a mechanic has better access to the information.

The Chairman of National Car Care Month commended the speakers for their informative presentations and stated that mechanic training is key to any new programs and these programs need to recognize that a career as a mechanic is not solely for the person who has no other options. He also criticized the dropping of vocational courses by some states.

SESSION 3 -- PANEL C
Pollution Prevention Methods and Systems
April 23, 1992, 8:30 a.m. - 10:30 a.m.

INTRODUCTION

Richard Ayres, Esq., Partner at O'Melveney & Meyers, reflected on the conference's place in the evolution of the environmental movement. He noted that over the past several years, the environmental movement has gained increased clout and a new coherence that demonstrates a growing maturity. A more cooperative spirit has evolved between environmentalists and corporate America, so that various interests are working more constructively to solve environmental problems rather than engaging solely in political arguments. This conference signifies a profound change in thinking on all sides of the issue.

Mr. Ayres noted that the panel represents the second generation of the environmental movement. When Congress initiated environmental legislation 20 years ago, it viewed solutions to pollution problems in strictly end-of-the-pipeline terms. Today, lawmakers, environmentalists, and industrialists are more sophisticated about the complexities of pollution, and they realize that prevention is vital to pollution control. Mr. Ayres asserted that pollution prevention is the cutting-edge issue of environmentalism. He then introduced the panel.

PRESENTATIONS

Donald Theissen, Director of Corporate Product Responsibility at 3M Corporation, shared the insights he has gained in overseeing 3M's longstanding corporate environmental policy. 3M believes that companies that embrace competitive environmental practices will experience higher productivity, better profitability, and greater success than their rivals. Mr. Theissen's presentation focused on environmental leadership, life-cycle review, and pollution prevention planning and implementation. He first outlined 3M's 3P and 3P+ programs:

- 3M established its 3P Program -- Pollution Prevention Pays -- in 1975. The program was designed to benefit both the environment and the company by taking positive action to reduce pollution early in the product or process development, in the facility design, and in production operations.

- Since the program's inauguration, the company has developed approximately 3,500 pollution prevention projects both domestically and internationally. These projects have saved the company an estimated $573 million and have prevented some 600,000 tons of pollution from entering the environment, representing a 50 percent reduction in pollution per unit of product produced. These figures actually represent only the first-year savings from the 3,500 pollution prevention projects; Mr. Theissen acknowledged that it would be impossible to track the cumulative, multi-year results of such a program. Thus, these figures are a conservative estimate of the benefits of pollution prevention.

- In addition, the 3M 3P+ Program has set ambitious goals for the future. The company plans to achieve the following goals:

  -- 70% reduction in air releases by 1993;

-- 35% reduction in all waste generated and a 20% reduction in energy used by 1995;

-- 50% reduction in waste generated and a 90% reduction in all releases by 2000; and

-- approaching zero pollution in the 21st Century.

Mr. Theissen then discussed the company's more recently established environmental leadership program, which was developed to complement the 3P Program:

- The leadership program aims to heighten the environmental awareness of every 3M employee, and to focus attention on each person's actions not only at work, but at home and in the community as well.

- The program emphasizes the importance of the company's environmental goals to every department, especially the research and development staff and the sales and marketing staff. Through this interdepartmental approach, everyone understands that the company's goal is to safely produce and distribute products that can be used and disposed of responsibly.

- 3M has created the Corporate Environmental Leadership Council, which includes representatives from every department in the company, to identify new ways in which to achieve its environmental goals.

- The company has also established the Chairman's Environmental Leadership Award. One of the first awards went to two employees, a married couple, who fought the bureaucracy of the Minnesota state government for five years to establish a state park. This award demonstrated 3M's commitment to the environment beyond the corporate level.

Mr. Theissen went on to explain the company's product life-cycle guidelines as they relate to pollution prevention:

- Every product is produced and used in stages: product concept, design, production process, distribution, use, and disposition.

- Although life-cycle assessment is not yet a common management tool for making design and production decisions, 3M has promoted a life-cycle model throughout the company that has been widely and effectively used. The model encourages strategic planners to focus on the product concept and design phases, and their effects on subsequent stages, in terms of pollution prevention.

Mr. Theissen then discussed pollution planning and prevention. There are a variety of methods for achieving pollution prevention and reduction. Mr. Theissen maintained that there is a hierarchy of pollution prevention methods:

- Source Reduction

  - -- Product substitution/reformulation
  - -- Toxic use reduction
  - -- Chemical conversion
  - -- Process change
  - -- Equipment modification
  - -- Housekeeping, maintenance, inventory improvements
- Reuse
- Recycle

Mr. Theissen indicated that product substitution or reformulation is the key element to the 3M environmental program. The idea is to design and develop products and packaging to improve their health, safety, and environmental characteristics, so that they can be manufactured, transported, used, and disposed of safely and responsibly. For example, 3M is a major solvent emitter. The company has worked hard over the years to develop new production processes in order to eliminate the use of solvents in many of its solvent-coating operations. In 1992, the environmental program will reduce solvent emissions by approximately 90 million pounds. Mr. Theissen cited many other examples of pollution prevention successes.

Mr. Theissen noted several barriers to product reformulation:

- The most obvious consideration is performance: if the customer does not want to buy a product that has been redesigned, then the entire effort has been wasted.
- Cost is another factor that may hinder product reformulation.
- There are also regulatory issues to consider:
  - -- Competing trade-offs means that at times an imperfect product or production substitution is better than none at all. For example, in reformulating a fabric treatment product, 3M eliminated methyl chloroform from the production process, but was unable to switch to a water-based process. As an interim step, the company replaced the methyl chloroform with a hydrocarbon solvent. Thus, the environmental issue of ozone depletion has been replaced by concerns about global warming, flammability, toxicity, and disposal hazards.
  - -- Another regulatory problem arises when a new chemical is used in the production of a new or reformulated product. The health, safety, and environmental properties may not be entirely known for a recently discovered chemical. The company therefore runs afoul of the EPA's new chemical exposure limit program, and cannot successfully reduce the use of the chemical it is trying to replace.

Mr. Theissen concluded his presentation with the following recommendations:

- Companies need to pursue risk-based chemical management approaches that result in environmentally responsible products, production processes, and packaging.

- The government should pursue regulatory initiatives that overcome narrow environmental interests and foster innovative solutions.

* * *

Robert Capaccio, Vice President and Director of Engineering at Mabbett, Capaccio & Associates, explained how his firm responds to its clients' pollution problems by analyzing their production processes. Clients can segregate solvents and reclaim them where practicable, or design some kind of end-of-pipe control system to reduce pollution. Mr. Capaccio emphasized that the current focus of pollution prevention is on in-process control. He explained the various steps of a process evaluation:

- Mabbett, begins by characterizing the client's exhaust stream. The firm examines the chemicals being used to determine potential substitutions for toxic chemicals. It must also evaluate the production equipment to assess whether it can be modified to reduce the amount of contaminants being emitted.

- For example, one client, the largest blade manufacturer in the world, emitted more than 100 pounds per year of a certain solvent to wash machine oils from the blades as they were manufactured. These emissions received public scrutiny after being disclosed under the SARA Section 313 reporting requirements; thus, the company was motivated to reduce the amount of solvent emitted, even though the emissions were within the allowable threshold. The firm suggested that the company substitute an aqueous-based cleanser for the more toxic one. Thus, the company achieved a zero discharge to the atmosphere of the original contaminant, eliminating the need for an end-of-pipe solution or an in-process reclamation system.

- Another client, a major textbook laminator, attempted to substitute a water-based adhesive for a more toxic solvent used to hold the plastic cover on a book. The new adhesive passed all factory tests for durability, but once the books were shipped to schools across the country, the lamination began to crack and separate from the books with use. Such a large number of books were shipped back to the manufacturer that the company was nearly bankrupted. The company's good intentions were ultimately vindicated, however, when it found a water-based adhesive that survived classroom use.

- In the case of one manufacturer of foam "peanuts" (the packaging material), the company was able to substitute carbon dioxide for the more harmful freon, which was used to blow the plastic resin into the shape of a peanut. This change represents an imperfect solution, since carbon dioxide contributes to global warming. The company is conducting ongoing research to replace carbon dioxide in the production process.

Mr. Capaccio explained that after the exhaust stream has been characterized and process modifications and chemical substitutions identified, the next step in a process evaluation is to identify any remaining solvent and determine its characteristics. The manufacturer should go back into the process as

closely as possible to reclaim in a useable form any such solvents. Once the solvent's characteristics have been determined, controls can be applied to composition, pressure, temperature, or humidity requirements to maximize the potential to reclaim the solvent rather than turning to an end-of-pipe solution. For example, to make Naugahyde, a synthetic leather, the manufacturer bakes a plastic compound onto cloth. The plastic is then driven off in the production process and condensed. The manufacturer reclaims it in its condensed form and sells it back to the supplier, who recycles it and sells it for reuse.

Mr. Capaccio indicated that once potential production changes have been identified, and remaining solvents have been characterized, the company must determine regulatory control requirements. There are Federal, state, and local regulations that need to be considered:

- A company must obtain the proper recycling permits for any solvent that it intends to reclaim in order to prevent its release to the environment.

- Permit regulations in some states impede this recycling process. While one state may require two years to grant a permit to install reclaim equipment and another two years to process a permit to operate the equipment, other states such as Texas can issue both permits in a mere two months. Consequently, some businesses have relocated to Texas out of frustration with regulators in other states.

- Manufacturers must also plan for future emissions requirements in order to determine their system's adaptability to stricter regulations.

Mr. Capaccio then explained the next step in a process evaluation, which is to identify technically feasible control requirements.

- A manufacturer must consider the multimedia impact of any modification to the production process. That is, it is counterproductive to tack on an air emissions control that will pollute water or create a hazardous waste problem. The most effective control will reclaim the solvent and reuse it, rather than simply dispose of it as waste material.

- The best control option is to substitute a less toxic chemical for a solvent. If this method is not feasible, a company may need to upgrade its technology. It could redesign its capture system, keeping in mind that the concentration of the solvent must be kept high enough to reclaim it, but low enough to remain within the lower explosive limit.

If a company decides to modify its production process by installing new equipment, there are several points to consider:

- The company must select a vendor to provide the equipment;

- The permitting process must be expedited;

- The system's performance will undergo adjustments;

- The staff must establish good operating and maintenance procedures; and

- The company should publicize in the community the potential benefits of the improvements, educating environmentalists and the public and involving them early in the process.

Mr. Capaccio concluded his presentation with an assessment of the potential benefits of designing a solvent recovery system:

- It benefits the environment by reducing solvent emissions levels;
- It brings the company's operations into compliance with the Clean Air Act and other regulations;
- It provides financial benefits by recovering solvent that can be reused or sold;
- It reduces the staff's exposure to contaminants in the workplace air; and
- It improves the company's relations with the community.

Mr. Capaccio added that if a manufacturer adds five percent to an invoice for reclaim technology, most customers will accept this charge, knowing that they are dealing with a reputable company that is taking responsibility for the health of the environment.

* * *

Edward Williamson, Vice President of Strategic Business Operations at Honeywell, discussed Honeywell's pollution control technology and the progress of the pollution control industry. Honeywell is perhaps best known for manufacturing thermostats, which represent roughly one third of its business today. Honeywell also produces space and aviation control systems and industrial process control systems.

Mr. Williamson emphasized that much of American industry today has established ambitious goals and developed strategic plans for pollution control. The progress that many companies have made over the last decade in improving process performance, cost effectiveness, and product quality have achieved dramatic results in the environment.

Process control technology is a fundamental solution to environmental problems common to most industries -- refineries, power generation plants, paper mills, chemical reactors, and the like. With the steady proliferation of this technology, there has evolved a dramatically more effective and cost-effective method of pollution control than the previous end-of-pipe technologies.

Mr. Williamson gave an overview of the implementation of process control technology:

- First the company examines the physical measurements of its production processes: flow, temperature, pressure, etc. It determines the optimum levels of these characteristics in which to efficiently produce the end product. This information is collected and developed into a control strategy, which is implemented and monitored through a control algorithm. Since this algorithm controls the dynamics of production, it is also the focus of environmental issues.

- The operator interface level, the eyes and ears of the plant, has seen the most dramatic change in technology over the last decade. An operator in the control room used to look out the window at the emissions from a smoke stack to judge whether the plant was running smoothly, ignoring the overwhelming process monitoring instrumentation in the control room. Today, few emissions are leaving the stack, and technology in the control room is far more practical and manageable.

- The plant network is perhaps the best illustration of technological progress in environmental control. Production process data is gathered and entered into the network where it is processed so that real-time decisions can be made concerning the effluent and the emissions. The database feeding this network has evolved to the point where sensor systems feature artificial intelligence. The sensors can control equipment to maintain its signature performance level cost-effectively to stay well within emissions requirements.

- Much attention today is focused on alarm and safety systems. The control room ensures that the plant is run safely. Accidents do occur, however, and in the event of an emergency, a logical, well thought-out shutdown procedure is absolutely vital. The system should also have automatic startup capability.

Mr. Williamson concluded that a company can successfully minimize its production processes' impact on the environment by developing a strategic plan for pollution prevention goals and a methodology for achieving those goals, by embracing the concept of in-process modification and providing the support for such change, and by a systematic approach to meeting environmental regulations.

Mr. Williamson briefly traced the evolution of pollution control: industry has gone from waste treatment, in which the problem was simply transferred from one area to another, to the present approach of waste minimization and product reformulation, to the future production of environmentally responsible products.

* * *

Bruce Smart, Senior Counsellor at the World Resource Institute, provided a broad perspective on the subject of pollution prevention. Mr. Smart's new book, Beyond Compliance: A New Industry View of the Environment, is based on a study he conducted on the environmental practices of 24 major corporations. Mr. Smart contends that the way in which industry has embraced the need to be a part of the solution to environmental problems represents a dramatic change in attitude over the last decade. Mr. Smart first addressed the advantages of a pollution prevention approach:

- Cost savings is one of the major advantages prompting corporations to adopt an environmental ethic in their corporate culture. One such cost savings is the avoidance of potential liability for pollution or hazardous waste disposal, as owners of Superfund sites are well aware.

- Pollution prevention is tied closely to product quality. Companies that have embraced quality as a central corporate value have found that the same systems that implement and manage quality control will also serve environmental goals.

- One hidden competitive advantage of a progressive approach to environmental problems is its effect on employee morale. Current employees take pride in working for a company that takes a responsible position toward the environment, and potential recruits are attracted by such a stance.

- Beyond the office, a business with a progressive environmental image has better relations with the surrounding community, is more welcome in a new community, and is attractive to investors.

- A company that stays ahead of the regulatory curve may actually influence new regulations. If a company can demonstrate an effective way of achieving environmental goals compatible with the intent of the regulations, regulators may design the law around the company's practice. Thus, the company will be in a better position than its competitors to operate at low cost under the new regime.

- There is also the advantage of knowing that the company is Doing the Right Thing. Environmentalists tend to downplay this point, but Mr. Smart asserts that senior managers have the responsibility to be a fiduciary to society. Those who work for environmentally progressive companies have the opportunity to feel a self-respect and self-worth that is harder to find in those who work only to increase their personal wealth and that of their shareholders. This kind of satisfaction translates to a competitive advantage for the company.

Mr. Smart also discussed some of the obstacles to proactive pollution prevention. He stressed that lack of technology is the least of the problem. The equipment, the consulting services, and the prevention programs exist or are readily developed. There are, however, other obstacles:

- The first problem in many companies is organizational. If the CEO is not convinced that the company needs to take a new approach to environmental problems, it is difficult for the rank and file, or indeed the next level of management, to convince him or her otherwise. Having a committed CEO is a start, but to see dramatic results, a company must change its organizational structure. The environmental ethic needs to be a line management responsibility, just as quality, cost, and human relations are.

- Resources are always a problem. Everything cannot be done first. It is difficult to justify changes when they produce no quick payoff, no immediately tangible results. It is more economical to design a process with an eye toward compliance than it is to retrofit, of course. Financial incentives for equipment upgrades and the like have not yet been developed for the most part. Tradeable permits are a step in the right direction, but eventually these costs will have to be internalized so that they figure into prices and returns on investment.

- Another obstacle that companies must face is that at present, business does not have much credibility with its critics. Both sides have been battling for decades, and environmentalists question industry's commitment to change. Companies get frustrated; management must persevere until the company's track record of performance speaks for itself.

- Liability is another drawback to innovation. The American tort law system is probably the most punitive in the world; any company with deep pockets is a target. This risk of liability hinders innovation. Staying with outdated technology is also risky, however, so in general it is better to redesign or upgrade sooner rather than later.

- Government also poses obstacles because it is not always consistent. Agencies fight among themselves, so at times regulations and permits can seem contradictory.

Mr. Smart concluded with a view toward industry's role in the future of the environmental movement:

- While the competing interests of the environment and the economy have been viewed as an ideological struggle in the past, it has become increasingly clear that science, not ideology, will dictate future environmental policy. Industry will have a central role in developing a sustainable environment for future generations; it must find a way to mitigate its impact on the world's ecosystem.

- As of yet there is no political will to aggressively pursue environmental goals. Both presidential candidates are far behind not only environmentalists, but most leading corporate executives in their thinking. In the United States, the political process has not kept pace with the developing knowledge base of environmental issues.

- Regulation has run its course. A regulatory approach was necessary 20 years ago, and has done some good, but the time has come to move beyond command-and-control. Rather than dictating how to effect change, we need to set up financial and social incentives that lead to voluntary improvement.

- The era of confrontation between business reactionaries and environmental radicals is also passing. There will be more cooperative effort between environmentally knowledgeable people and market knowledgeable people to solve these problems. Jointly, both sides must persuade the government what needs to be done.

Mr. Smith reiterated that the country's environmental agenda can be achieved without hurting the economy. The business community is going to become more holistic in its approach than it has been. For the present, business executives are understandably focused on what impact their product or service has on specific environmental issues. Ultimately, however, companies will have much broader opportunities to influence the global environment. The population explosion is directly linked to poverty, and if business will commit some of its considerable resources to the alleviation of poverty, it will do more for pollution prevention than any technological innovation in the factory ever could.

QUESTIONS AND ANSWERS

A member of the audience asked if the Clean Air Act is the last gasp of regulation in the environmental movement.

Mr. Smart answered that no, the latest round of laws is probably not the last, since much of Congress and the political lobbying community is comprised of lawyers who, by definition, like to legislate and regulate. Mr. Smart pointed out, however, that other trends are emerging. For the

first time the Clean Air Act includes market instruments such as tradeable permits. In some jurisdictions there is talk of environmental fees and taxes. The EPA has developed the 50-30 program. SARA Title III regulations, which merely require the reporting of emissions, motivate companies to examine plant operations. Although regulation will never be entirely eliminated, the environmental movement is moving away from it toward more efficient solutions.

Another member of the audience asked how a large company with operations around the world deals with different environmental cultures.

Mr. Theissen indicated that 3M maintains its own high standards in all of its facilities worldwide. The company believes that it would be unfair to expose foreign workers and communities to a different set of hazards than American workers face. Companies can no longer afford to think or act parochially when making decisions that affect the environment. Different requirements in other countries require a certain level of flexibility from management; a company must comply with local regulations even if they are not consistent with American regulations. Attitudes regarding emissions and waste remain consistent, however, regardless of cost.

One person asked what is being done to educate the public about the environmental impact of consumer products.

Mr. Theissen acknowledged that consumer products remain the last uncontrolled source of emissions. Consumers are confused by the various environmental claims in the marketplace, and some manufacturers exploit this confusion. There is a growing movement to regulate consumer products for this reason. The movement needs the backing of the EPA and the resources of American industry to disseminate accurate information.

SESSION 3--PANEL D
Auditing, Information Management and Compliance Planning
April 23, 1992, 8:30 a.m. - 10:30 a.m.

INTRODUCTION

Michael Poe, Technical Services Manager, Air and Waste Management Association, and panel moderator, opened the session by introducing the various panel members and outlining the topics of their presentations.

PRESENTATIONS

Michael Smylie, Director of Program Development, Systems Applications Inc., began his presentation by stating that the Clean Air Act Amendments (CAA) of 1990 have provided a new realm of air quality control planning for the United States by redefining many of the basic components and provisions of the original Clean Air Act in such a way as to form an entirely new air quality management program. Mr. Smylie focused his discussion upon the air toxic control requirements under Title III of the CAA. He indicated that the CAA defines control requirements for air toxic controls in two ways:

- Technology-based controls through the establishment of maximum achievable control technology (MACT) requirements.
- A requirement for EPA to develop health-based standards if, eight years after the implementation of the MACT requirements, there exists a residual risk to the community from any of the 189 air toxics defined in the CAA.

Mr. Smylie indicated that the key components of air toxic control programs developed thus far have focused on fugitive emissions. Fugitive emissions are defined as those types of uncontrolled emissions that occur at the connecting points of a source (e.g., screw fittings, pumps, flanges, or compressors). Fugitive emissions account for a majority of the emissions from refineries (90%) and petrochemical plants (40%-60%). Due to the prevalence of these types of emissions, most air quality management control programs have attempted to identify specific ways to reduce fugitive emissions. For example, the San Francisco Bay Area Air Quality Management District passed a regulation that established a leak definition for pumps, compressors, and valves at 500 ppm and a leak definition for connectors at 100 ppm. These definitions will take effect in 1993. By 1997, all sources of fugitive emissions would have to achieve a leak definition of 100 ppm. In addition, the District also established very tight time schedules for a facility to identify and repair leaks.

Mr. Smylie noted that due to the new requirements for air toxics controls, hardware systems will be required to increase both the efficiency and accuracy of fugitive emissions control programs. In addition, because of requirements for demonstrations of improvement in emissions control programs, software systems will be required for better data management and analysis to track fugitive emissions. Mr. Smylie discussed at length an example of such hardware and software development -- a collaborative effort between SAI and Shell's Deerpark, Texas Manufacturing Complex in the installation and implementation of an enhanced fugitive emissions monitoring system.

- The program involves the development of new hardware source tags that contain unique source identification numbers for each individual source. The number is assigned to the source for the lifetime of that source and allows information (e.g., manufacturer of source, location of source, leak definition, emissions history, and repair history) to be associated with a particular source identification number. The advantage of the punchhole card is that it reduces human error in attempting to identify a source.

- The program also required the development of new software to gather the information in an accurate and reliable manner in order to process the data into the facility's management system. When the source tag is passed through a card reader, the software program reads the tag number and scans a list of source numbers to see if the source has been identified as a source needing monitoring. If the source needs to be monitored, then it enters into test mode to measure concentrations from fugitive emissions. Once the appropriate measurements have been taken, the software program compares the monitored concentration against the leak definition for that source. If the monitored emission exceeds the leak definition, then the software system continues to a repair data screen that directs the operator to make a number of repairs to the source.

Mr. Smylie indicated that the advantage of the software system is that it decreases the time to locate the source, to take the proper measurement, and to make the first attempt to repair the source. In addition, software has been developed for the mainframe that centrally stores all the information on the various sources. This central storage allows for across-the-board analyses of the equipment manufacturers, location of sources, or maintenance records to determine if one of these factors may serve as a particular cause for a pattern of fugitive emissions in the facility.

In closing, Mr. Smylie indicated that this fugitive emission program is unique because it improves the accuracy of monitoring by reducing human contact with data. It eliminates data entry errors by storing all readings electronically and reduces field data entry because the source card contains much of the information on the source.

* * *

Dr. Donald C. Clagett, Manager, Process Safety, GE Plastics, addressed GE Plastics's method for meeting the standards of the Clean Air Act Amendments as well as other international environmental and safety initiatives. First, Dr. Clagett indicated that GE Plastics has adopted a policy that stipulates that facility operating practices will reflect the highest global environmental requirements. These requirements are company-driven in order to ensure the safe operation of facilities as well as to operate within 100% compliance with the environmental regulations of any foreign country in which a GE Plastics facility is located. Changes made to the operating practices of one facility due to a change in a foreign country's environmental regulations are adopted company-wide because GE Plastics is a global company. GE Plastics adopts similar standards and performance levels for all its international facilities. Thus, GE Plastics is required to audit its facilities to ascertain that the facilities are meeting GE Plastics' own internal standards as well as to ensure that GE Plastics is in compliance with government regulations. This presents a unique opportunity to firms selling auditing services. Dr. Clagett then outlined the following issues that GE Plastics would analyze in purchasing auditing services:

- The auditing firm's credentials and business references;

- The actual program in terms of philosophy, checklists, and reporting mechanisms; and

- The continuing value of the program.

Dr. Clagett indicated that the third aspect of the auditing program is particularly important to GE Plastics. GE Plastics examines how the auditing firm will involve GE Plastics' employees in the auditing process. GE Plastics wants to adopt an auditing program that provides not only a teaching benefit to its employees but also provides an awareness on the part of employees of process safety.

* * *

Robert Fensterheim, President, Regulatory Network Inc., discussed the fuels testing and registration program required under the Clean Air Act (CAA). Mr. Fensterheim noted that Section 211 of the CAA requires EPA to designate motor vehicle fuels for registration. In 1975, EPA designated gasoline and diesel fuels and additives used in gasoline and diesel fuels for registration. The CAA also required EPA to establish a program to determine what kind of environmental testing, health effects testing, and emissions control system testing would be necessary to determine the residual risks of these registered fuels. Until just recently, EPA had not established this aspect of the statutory program. Therefore, Mr. Fensterheim noted, since 1975 the U.S. had a program under which manufacturing companies only had to register, not test their fuels.

To date, 6,000 fuels and additives have been designated for registration. Mr. Fensterheim indicated that EPA is in the process of developing a new rulemaking that will expand the number of fuels to be registered to include any fuel that is used in motor vehicles. The testing program operates on the principle that once the rule is final, fuel manufacturing companies, who have registered their fuels with EPA prior to final rulemaking, will have three years to deliver testing data to EPA. If a manufacturing company has not registered its fuel, it will have to submit test data on the fuel to EPA prior to registering and selling it. Mr. Fensterheim stated that the testing requirements have focused both on evaporative and combustion emissions. Tremendous opportunities exist for companies to develop products or services that will aid fuel manufacturers in complying with the regulations.

Mr. Fensterheim stated that EPA has structured the program in such a way so as to minimize the amount of testing:

- The program allows for the grouping of fuel manufacturers so that every manufacturer does not have to test its own fuel. Fuel manufacturers can collaborate with other manufacturers of similar fuels in order to share the expense of fuel emissions testing.

- EPA has created a tiered testing program. Manufacturers are required to conduct initial screening tests and provide more definitive testing data later. Only the screening tests are required for submission to EPA within the three-year time frame.

Mr. Fensterheim then described the three tier testing process established by EPA:

- Tier 1 involves a chemical analysis of the emission. The analysis involves a detailed speciation of hydrocarbons, aldehydes, ketones, alcohols, and ethers present in the fuels. Opportunities exist for businesses to develop the necessary speciation equipment. In addition, extensive literature reviews on chemicals emitted by fuels must be conducted.

Reviews must focus on speciation, health effects, environmental effects, field studies, accident evaluations, and environmental simulation experiments. The importance of the literature search is to determine if these fuels have any potential effects that are not addressed in the rule. Finally, manufacturers must develop modeling programs that estimate the ambient exposure fuel emissions.

- Tier 2 involves conducting screening studies that will examine five health effect areas: cancer and mutagenicity, species development, reproductive effects, pulmonary effects, and neurotoxicity.

- Tier 3 testing is necessary only if the testing in tiers 1 and 2 indicates that the emissions from the fuel result in significant adverse effects. The methods for tier 3 testing have not yet been specified by EPA.

* * *

Dr. Carlos Stern, President, Carlos Stern Associates, discussed the opportunities and pitfalls for business development as a result of the Clean Air Act Amendments. Dr. Stern noted that EPA maintains that an economic boon will flow from the CAA. However, Dr. Stern maintained that the industrial heartland is presently in the midst of an economic recession that may prevent it from taking the necessary steps within the mandated timeframes to meet the requirements of the CAA. Dr. Stern identified the following pitfalls in the ideology behind the legislation:

- Failure to consider the current social and economic context of this country. The economy in the basic industrial sectors is not able to sustain the requirements mandated by the CAA. Industry is having difficulty in obtaining capital for research and development. An ideology of "technology forcing" exists based on the assumption that industry will discover a cost-effective way to meet the requirements even if it maintains that the technology necessary to achieve these requirements is currently not available. However, this assumption may not prove true for smaller firms. Many smaller firms are not able to raise the investment capital necessary to explore technologies that will aid them in meeting the requirements of the CAA.

- Need for data integration. Smaller firms in basic industries will have difficulty in assessing emissions given the extreme cost involved in gathering and monitoring emissions data. These costs will be prohibitive for smaller firms and force them out of the market. Thus, U.S. competitiveness will decrease.

- Lack of understanding on the part of financial markets of the risks involved in the environmental market. Due to the innovative nature of the CAA provisions, financial markets do not thoroughly understand the risks involved the development of programs such as the emissions trading program.

Dr. Stern indicated that EPA must consider these pitfalls when working with industry in developing solutions to reducing industrial emissions.

* * *

Mr. Peter Coyle, Director of Government Markets, Teltech Inc., discussed the concept of knowledge transfer as a promising opportunity to promote both domestic and international progress on environmental issues. Mr. Coyle indicated that knowledge transfer involves accessing other people's ingenuity and creativity in order to develop a more successful product. The inclusion of other information sources in the process of identifying problem solutions allows an individual to make better and quicker decisions with more significant conclusions. Given the high stakes associated with environmental regulation, companies which possess knowledge unavailable to their competitors or, alternatively, know how to obtain it, will succeed in the clean air marketplace. Those companies which refuse to recognize the importance of accessing knowledge will struggle or fail. More immediately, those companies which fail to respond to current environmental trends risk being forced out of business by regulation.

Mr. Coyle presented a knowledge transfer model developed by Teltech Inc. that extended outward the resources available from an individual's desk so that the individual may deal as effectively as possible with a given problem. This model allows clients to quickly access a powerful package of knowledge-based support including:

- A national network of scientists and engineers;
- A global literature searching service; and
- A vendor locating service.

Together these service components can provide government and industry with the full range of information needed to address any aspect of environmental technology. Teltech's network of experts are able to:

- Identify and contact leading scientists and engineers who can assist in resolving important technical issues;
- Search both domestic and international libraries for needed information, including materials selection, product standards, innovative technologies, and government regulations; and
- Supply a list of vendors qualified to provide a needed product or service.

Mr. Coyle also discussed Teltech's involvement in the development of the Environmental and Energy Efficient Technology Transfer Clearinghouse as a model for industry and government cooperation in knowledge transfer. The Clearinghouse is an international initiative aimed at providing developing countries and their industry with direct access to the information and knowledge they need to address local pollution issues. The Clearinghouse provides direct access to scientists and engineers with knowledge about technologies, processes, and regulatory structures which can help to alleviate a pollution problem. For this Clearinghouse, Teltech's network of experts has been supplemented by several hundred EPA and DOE scientists and engineers with a wide range of technical expertise. A user accessing the Clearinghouse via Teltech can access a federal lab scientist or engineer with extensive experience in environmental technologies. The Clearinghouse also allows users to access Teltech's interactive literature search services. This capability has been expanded to allow access to many EPA databases so that these developing countries may emulate the regulatory track of the United States. Mr. Coyle indicated that this unique program is already showing promising evidence of promoting positive environmental impacts in Mexico and will be showcased at the upcoming U.N. conference in Brazil.

Mr. Coyle concluded that the value of knowledge is relative. In the hands of individuals who do not need it, it is worthless. Yet, available to individuals in need, it is priceless. The Clean Air Act and related regulations will strain the capabilities of even the most advanced research organizations. However, to overcome these limitations, industry and government must cooperate in efforts to stimulate methods of knowledge transfer in order to ensure the success of the clean air marketplace.

QUESTIONS AND ANSWERS

After the presentations, Mr. Poe opened the session to questions from members of the audience:

One individual asked the panelists to characterize the future prospects for consultants coming into facilities to perform audits and conduct training activities.

> Dr. Clagett responded that if the consultant could provide an auditing service that focused on baseline audits followed by training programs that would instruct employees on how to conduct the audits, the package would be attractive to a company like GE Plastics.
>
> Mr. Smylie replied that companies want to maintain auditing data on-site both for legal protection and for on-site analysis. Companies want to understand the extent of their computer capability to analyze the facility data. Therefore, a contractor who could provide this type of service and training would most likely succeed in the auditing market.

Another individual asked how aggressive compliance can be incorporated into a competitive corporate strategy.

> Dr. Clagett responded that GE Plastics operates all its facilities safely to the highest environmental standard whether it is a U.S. or foreign standard. For companies involved in global operations, it does not make economic sense to operate plants differently from country to country. Therefore, a successful corporate strategy would adopt plant practices that reflect requirements required by the highest global standards.

A third individual asked whether other companies have expressed interest in the SAI, Inc. - Shell enhanced fugitive emissions monitoring system and what the costs would be to implement the system in another company.

> Mr. Smylie indicated that many companies have expressed interest in the system. However, since the system has been in place for only six months, SAI and Shell are still evaluating the benefits of the system for marketing purposes in order to provide credibility to the success of the system. Since the installation of the system, more emissions and leaks have been found. In addition, Shell and SAI have been able to determine that the repair time for these leaks has decreased dramatically. However, studies remain incomplete regarding whether the plant has achieved an overall reduction in emissions. Once these studies are completed, Mr. Smylie indicated that other companies would have the opportunity to explore the possibilities of implementing such a system in their facilities. Mr. Smylie estimated that the initial costs associated with the installation of the system would range from $14 to $20 per source.

A fourth person asked whether regulatory authorities have been hesitant to accept the electronic collection of the data.

Mr. Smylie replied that SAI and Shell have encountered no difficulties in presenting regulatory authorities both on the state and federal level with electronically collected data. In fact, Mr. Smylie noted, William Reilly is scheduled to deliver a speech to the National Press Club in the near future that will cite the Shell program as an example of one of the innovative programs industry has developed in implementing the provisions of the Clean Air Act.

SESSION 4 -- PANEL A
Financing the Clean Air Marketplace
April 23, 1992, 10:45 a.m. - 12:30 p.m.

INTRODUCTION

Donald C. Connors, Esq., Partner at Choate, Hall & Stewart, welcomed the audience to a discussion of financial issues related to clean air legislation, specifically, how companies will finance compliance with the Clean Air Act, project financing of major pollution control equipment, and methods for financing environmental companies that wish to take advantage of markets created by the Clean Air Act.

Mr. Connors explained that in addition to his position at Choate, Hall & Stewart, he is the Chairman of the Board of the Environmental Business Council, an association headquartered in Boston that is comprised of companies, universities, and government agencies in the environmental field. The association's goal is to assist the business community in understanding and exploiting opportunities both domestically and internationally that are created by environmental regulatory programs. Mr. Connors then introduced the panel.

PRESENTATIONS

Kenneth Ch'uan-K'ai Leung, Managing Partner at Smith Barney, Harris Upham & Company, gave an overview of the financial community's role in funding companies' compliance with clean air regulations both in the short-term and in the future. Mr. Leung recently took part in a study on the economic benefits and business opportunities presented by the amendments to the Clean Air Act. The report concluded that the financial community will do what it is expected of it to enable American industry to spend $50 to 70 billion between now and the year 2000 to comply with clean air regulations.

Mr. Leung indicated that the report predicted a number of related financial developments:

- A spate of acquisitions will take place as pollution control companies fill the gaps in their product lines and service offerings.
- There will be another round of mergers as companies rush to buy the pollution control specialists they need to achieve "execution capability."
- There will be more public offerings, both IPOs and secondary issues, as many privately held emission control firms go public and publicly held companies look to finance growth opportunities.
- A new financial services niche will emerge to cater to the environmental sector. An example of this new niche is the futures market for emissions allowances.

Mr. Leung explained that the built-in flexibility of the Clean Air Act Amendments invites corporate managers to pursue the lowest-cost solution to compliance:

- A company can buy an emissions control system, or lease the equipment, or pay a monthly service charge to have its stack gases cleaned.

- Some companies may replace fuels, others may change their product lines, or move offshore, or increase their energy efficiency, or even switch to a non-polluting production process.

- A few companies will simply buy emissions allowances from other firms that have over-complied in order to sell these allowances.

There are many methods for compliance, and because the decision of which avenue to pursue will be closely tied to finance, financial institutions will be a part of the decision-making process.

Mr. Leung discussed the electric power generation industry to illustrate the variety of compliance methods. The projected market for scrubbers alone, both new installations and retrofits, is expected to reach $10 to 12 billion by the year 2000. A power plant could choose to burn cheap, low-sulfur coal to avoid installing a new scrubber, but there are financial trade-offs to such an option. Assuming that a company decides to purchase a scrubber, there are several methods of financing it:

- The traditional approach is to pay for the equipment through stock issues and conventional bonds and include the investment in the utility's rate base.

- The company could also use industrial revenue bonds. There is a bill in Congress to resurrect tax-exempt pollution control bonds for equipment purchased to comply with the Clean Air Act.

- Another approach is sale-leaseback. Industry analysts expect major equipment and real estate leasing companies to offer sale-leaseback programs for large pollution control systems. The advantages to this method of financing are that companies do not have to commit their own capital to an expensive piece of equipment, and they can avoid the first year rate shock triggered by adding a significant capital investment to their rate base.

- Finally, there is the pay-as-you-go approach, an off-balance-sheet financing technique pioneered by Air Products & Chemicals at a scrubber facility it built for the Northern Indiana Public Service Company (NIPSCO). Air Products and its partners set up a project company to design, finance, and build a waste control system at NIPSCO's Bailly Station. The project company owns, operates, and guarantees the scrubber's performance. NIPSCO pays a monthly fee via a 20-year service contract.

Mr. Leung emphasized that the financing techniques he discussed for electric utilities would work equally well at chemical companies, paper mills, steel mills -- any company that must comply with the Clean Air Act. Industrial companies will increasingly seek out leasing and off-balance-sheet financing for emission control facilities because the equipment is inherently nonproductive. It does not generate a return. Financial institutions will help companies sort through the available financing options and provide the resources for companies to achieve compliance.

* * *

Martin Klepper, Partner at Skadden, Arps, Slate, Meagher & Flom, focused on the execution of one of the transactions described by Mr. Leung, the option of project financing for major pollution control equipment along the lines of the NIPSCO example. Mr. Klepper outlined the issues he would discuss concerning third-party financing: how it works, why it's attractive and important in today's clean air marketplace, and the role of lenders and equity investors in this option.

- Mr. Klepper explained the recent development of project financing in terms of the evolution of the non-utility power generation marketplace over the past 10 to 12 years. Under the Public Utility Regulatory Policy Act, entities other than public utilities were authorized to build power plants and sell power to utilities. These entities, formerly called qualified facilities and presently referred to as independent power projects, represent a $10 billion per year market. Financing transactions provide the funds to construct, own, and operate these projects.

- Today, there is virtually no marketplace for financing major pollution control equipment. A scrubber for a large power plant, one that generates 500 megawatts of energy, costs about $100-175 million, an expenditure equivalent to a new power plant. This equipment constitutes a major facility that needs to be financed, just as independent power projects are presently financed. It is Mr. Klepper's contention that a scrubber installation and its related contracts can be financed on a stand-alone, non-recourse, project finance basis.

Mr. Klepper described this type of project financing, and discussed the reasons a utility owner may be interested in it, rather than the traditional method of raising funds (e.g., putting up 45 percent equity and financing the remainder, and then trying to put the entire cost of the purchase into the utility's rate base and recover it with a rate of return over the useful life of the equipment):

- Third-party financing means some party other than the utility undertakes to build, operate, and own a scrubber facility. Ownership of the facility involves arranging its financing and taking on all of the legal, regulatory, and permitting risks associated with the project. The third party is therefore responsible for construction cost overruns, performance guarantees, personnel and operations concerns, the cost of supplies, the removal of sludge, and the financing cost risk presented by a project that has begun but will not go on the market for two years.

- In such an arrangement, the utility transfers all of the risks it would normally assume as a condition of ownership (the costs of which would be passed on to the rate payer) to the third party. The third party will also get financing at greater leverage -- probably 80 percent debt financing rather than the usual 50 to 60 percent -- which will lower the cost to the utility. This arrangement has the added advantage of freeing up the utility's balance sheet. The financing can be structured using an off-balance-sheet method, thereby ensuring that the company's capital and cash flow are available to finance more integral facets of the utility's or corporation's general business activities.

Mr. Klepper then outlined the structure of third-party financing. He indicated that the marketplace does not yet have an established group that develops third-party owned and operated pollution control equipment like the independent power generation industry does. There are, however, companies such as Air Products & Chemicals that are very interested in developing and selling this kind of product. The third party could be a contractor, an equipment supplier, a financial institution, a company

that has expertise in developing this kind of project in other markets, or, most likely, a partnership or consortium of any of these. A utility may have to actively seek out the third party, but once the lead company is identified, the major contracts supporting the project and the associated risks are as follows:

- **Turnkey Construction Contract:** The utility must assess whether the facility can be built to achieve the performance and reliability needed, at a price and within a time-frame that suits its needs. This basic premise is handled by a turnkey construction contract in which the partnership guarantees that it will build the facility for a certain price within a prescribed length of time. The third party will also guarantee a performance level to comply with Clean Air Act emissions standards. The partnership promises to pay liquidated damages if it fails to deliver the project on time or meet the stated performance standards. This agreement becomes a financeable contract; a lender will make a construction loan based on the guarantee of the builder.

- **Operating Agreement:** A reputable institution that has experience operating this kind of facility signs a long-term contract to provide the expertise, the resources, and the personnel to operate the plant for an express, agreed upon budget.

- **Fuel Contract:** In a scrubber facility, a contract is needed for additives such as limestone. Depending on the limestone market, the partnership may look for a long-term contract with price protection, i.e., a floor, ceiling, and escalation price related to the revenue stream that the partnership will receive when it sells its service to the utility.

- **Sludge Disposal Contract:** A long-term contract with a landfill, or some other means of disposing of sludge, will be needed.

- **Service Contract:** This is the key financing contract in the transaction. The contract between the scrubber owner (e.g., the third-party consortium or partnership) and the utility states that the utility will pay the scrubber owner, in accordance with stated pricing terms, for the service of cleaning its emissions to comply with the Clean Air Act. Details include:

  -- The service contract will likely have a fixed price to cover the construction of the facility and a variable price dealing with a process-per-ton service. A profit will be built into both prices.

  -- The term of the contract will probably relate to the financing term, e.g., 10, 15, or 20 years. The contract provides revenue to support the debt service.

  -- The contract must provide that the fixed payments do not get reduced if the plant is out of operation for any reason. If the developer spends the time, money, and effort to build a scrubber, it will not be willing to risk not getting paid if the plant shuts down.

  -- In addition, if the contractor performs at levels higher than required by clean air legislation, it should receive the emissions credits granted to the utility for such performance. These credits provide a significant profit or cash value that can be sold or traded in the marketplace.

Now that there is a project with appropriate contracts, it needs to be financed, Mr. Klepper explained. The project needs debt and equity:

- Developers or contractors probably do not have the 20 percent equity (probably about $20-30 million) that will be needed for the project, so they will look to the banking industry for funding.

- The banks will be looking for new project financing products in the marketplace, since financing for independent power plants, its bread and butter for the past five or so years, has begun to slow down. This third-party financing project will provide the banks with the same revenue stream as the independent power plants, making it an attractive product.

- The bank will therefore provide the developer with a construction loan that converts to a term loan when the project is complete and it passes performance tests.

- At this point equity investors step in and contribute 10-20 percent equity to the project. Equity investors are also experienced in project financing, and will undoubtedly be interested in pollution control technology financing.

Mr. Klepper emphasized that the key to the financing is to enter into a service contract that provides adequate assurance of a revenue stream to pay off the debt and provide the opportunity for some return to the equity.

Five years from now, Mr. Klepper noted, there could be an established marketplace doing $5-7 billion worth of transactions for scrubbers or similar equipment in the same vein as the project financing that worked for the development of independent power plants. This marketplace would provide competitive pricing in financing, construction, equipment sales, contract terms, and all other aspects of a project.

* * *

G. Mead Wyman, General Partner at Hambrecht & Quist, Inc., shifted the focus of the discussion from large project financing to the financing of small, entrepreneurial companies. One source of funding is venture capitalist firms:

- In the mid 1990s, Hambrecht & Quist decided to focus investment activity on the environmental arena. By 1990, the firm had raised approximately $17 million for the Environmental Technology Fund, to be invested in startup companies pursuing a broad array of environmental technologies and services.

- To date, about 60 percent of the fund has been invested in the following types of companies:

  -- a recycling company that recycles plastics and metals;

  -- a waste minimization company;

  -- an underground storage tank remediation company;

-- a company that helps other companies optimize their power distribution network;

-- a solvent recovery equipment manufacturer; and

-- a company that purifies spent acid from semiconductor fabrication processes.

The fund covers companies involved with air quality, water quality, hazardous waste, and conventional waste issues.

Mr. Wyman emphasized that venture capitalists generally invest in smaller companies with capital requirements of $10-15 million or less from the time of the initial investment to the company's first public offering or its acquisition by another company. Some of the more attractive investment opportunities in the clean air marketplace are:

- air quality monitoring;
- indoor air quality; and
- pollution control technology (on a smaller scale than the equipment used for a power plant).

Mr. Wyman noted that a major problem in the industry is that there is not enough capital to finance it. Investors in venture capital pools are driving venture capitalists in the direction of taking less risk, leading them to invest in more established companies rather than startup companies. There has been a flurry of activity in new business propositions, but the highly selective investing process has lead to few investments in environmental companies. Mr. Wyman then discussed in more detail the issues of the poor quality of most business propositions and the lack of capital for environmental companies:

- Too frequently, business plans do not properly assess the market development required to make a business successful. People assume that demand for their product is going to be very high in the short-run, making an instant success of their business, and venture capitalists know that this is not the case. The passage of the Clean Air Act, for instance, did not have the immediate effect on the marketplace that many assumed it would. Businesses need a more realistic understanding of market development requirements in order to obtain startup funding.
- Another problem weighing on business propositions is the hindrance of technology transfer. Regulatory agencies create permitting problems for businesses attempting to introduce new technology to the marketplace. The regulatory community's resistance to new technology dramatically slows down the commercialization process, causing businesses to become essentially uneconomic. Mr. Wyman noted that the government has initiated some projects to facilitate the transfer of technology, but such efforts have been the exception thus far.
- The lack of available capital to small entrepreneurial companies in this industry means that small companies must be much more persistent in raising funds. Early stage financing can be obtained from venture capitalists, individual investors (known as "angels" in industry jargon), and capital pools available from large corporations. Small companies

may want to consider strategic partnering with larger corporations, whether through the licensing of their technology, joint ventures, or outright acquisition of their company.

Mr. Wyman indicated that there are good business opportunities in the air quality marketplace for entrepreneurial companies. Mr. Wyman suggested that enhancing their chances for success would require improving the quality of business propositions by being more realistic about market development requirements, removing impediments to technology transfer or commercialization in order to reduce the associated business risk, and bringing more suitable capital to the financing of entrepreneurial business in the clean air marketplace.

QUESTIONS AND ANSWERS

After the panel discussion, Mr. Connors opened the floor to questions. He lead the session with some questions of his own, including one concerning export opportunities in the clean air marketplace.

Mr. Leung noted that many air pollution control technologies are actually based in Europe; American companies are often the licensees of such products. And while there is huge potential for growth in European markets, currency problems hinder foreign companies from entering these markets. Mr. Leung indicated that there is not much export activity among the American environmental industry at this point, and not much incentive for foreign customers to use American technology when they have their own homegrown products.

Mr. Wyman pointed out that foreign companies have been active buyers of American environmental companies, however. The foreign investors show more caution at the startup level, but do tend to get involved at later stages. Entrepreneurial companies must think globally to compete. There are also areas in which American companies originate environmental technology; small companies must find willing corporate players to make strategic alliances to enter European and Japanese marketplaces.

Mr. Klepper added that there has been a large influx of foreign capital in the independent power financing area. Foreign banks are major lenders, and foreign equipment companies and contractors are major investors and providers of credit support in these projects. This trend should continue for large pollution control equipment project financing.

A member of the audience asked Mr. Klepper about the compliance aspect of project financing such as Mr. Klepper described in his presentation. The person noted that the third-party arrangement practically amounts to contracting out the utility's compliance obligations.

Mr. Klepper emphasized that the utility in this arrangement was contracting for a service, namely cleaning its emissions in accordance with the Clean Air Act, and that the service contract would hold both the utility and the contractor responsible for this compliance. The proportion of liability held by each party, in the event of a failure to comply and subsequent enforcement action, is often a heavily negotiated point in service contracts of this kind. Although the utility pays someone else to clean up its emissions, it retains control of the overall operation and is not absolved of the responsibility for compliance with the law.

SESSION 4 -- PANEL B
Export Opportunities in Clean Air Technologies and Services
April 23, 1992, 10:45 a.m. - 12:30 p.m.

Daniel C. Esty, Deputy Assistant Administrator, Office of Policy Planning and Evaluation, and panel moderator, opened the session with some introductory remarks on the export market for environmental goods and services. Mr. Esty noted that the Organization of Economic Cooperation and Development (OECD) in Paris estimates the world market for environmental goods and services to be approximately $200 billion with the best estimate for future growth to be at 5.5 percent per year through the end of the decade. Mr. Esty stated that opportunities exist throughout the developed world (e.g., Europe and Japan) where billions of dollars per year are being invested in a variety of newly established environmental programs. Increasing environmental export opportunities are also emerging in countries with so-called "economies in transition", such as Eastern Europe and the former republics of the Soviet Union. Although financial difficulties make investments in environmental protection technologies somewhat burdensome for these countries, it has become clear to EPA through its involvement in various environmental initiatives with these countries that the patterns of environmental neglect in these countries will not be repeated in future environmental development programs. In addition, EPA has seen an enormous commitment of resources from the most advanced tier of developing countries (e.g., South Korea, Taiwan, and Mexico). In these countries, EPA estimates that there will be will tens of billions of dollars of investment in a wide range of environmental areas, particularly air pollution control. Thus, enormous opportunities do exist for American companies to sell environmental goods and services to foreign countries to meet the demand for environmental protection.

PRESENTATIONS

Carl H. Blowers, Managing Director, Corning GmbH, began his presentation by discussing Corning's non-traditional emission control export business. In the typical model of an export business, a company will first design the product and develop marketing strategies at home and then ship the product to its overseas customers. However, Corning exported its entire emissions control business to the European community. Corning sent abroad the manufacturing technology, the manufacturing, the sales, and the marketing aspects of its business to serve its European market. By exporting its entire emissions control technology business, Corning became attuned to the different needs of its foreign customers. As a result, a dynamic flow of technologies and ideas developed between Corning and the European community. Information on its foreign customers' needs flowed back to Corning headquarters. The income generated by overseas sales was then invested in developing new products to meet customer needs. This dynamic flow has:

- Increased Corning's marketing and technological expertise for its other customers:

  When the need arose for diesel particulate filters and diesel catalyzers in the U.S., Corning was prepared because Corning had already responded to a similar need in Greece, Sweden, and Germany.

- Increased Corning's competitiveness in U.S. and other foreign markets:

  Corning introduced its thin wall substrate for catalytic converters at the Society of Automobile Engineers meeting in 1990. Ironically, this substrate was initially developed to meet European vehicle manufacturer requirements.

- Stimulated innovation that is beneficial to U.S. manufacturers:

  Two months ago Corning unveiled the prototype of the new electrically heated catalyst. It has been designed to meet the cold start segment of the ultra low emission requirements. In laboratory tests, this system meets or exceeds the California 1997 ultra low emission requirements. Once again, much of the initial thinking that led to the development of this prototype was stimulated by Corning's European customers.

Mr. Blowers concluded that this dynamic flow has produced a more competitive U.S. marketplace for environmental products and services. The global effort to control emissions has spurred economic growth and development in the environmental industry for emission control products.

* * *

Vincent Middleton, President and CEO of Wahlco Environmental Systems Inc., spoke on Wahlco Environmental Systems' commitment to technological advancement to expand the scope of economically viable solutions to environmental problems. Mr. Middleton outlined the following two objectives of Wahlco Environmental Systems in relation to developing these solutions for the worldwide environmental community:

- Provide effective solutions to global air pollution control problems; and

- Develop products and services to improve power plant efficiency.

Mr. Middleton then discussed Wahlco's role in promoting these objectives worldwide. Wahlco is a member of the Environmental Technology Export Council (ETEC). ETEC is a coalition of U.S. companies and trade associations organized to develop methods for increasing exports of U.S. environmental technology. Presently, the total global market for environmental technologies is estimated to be approximately $300 billion. Yet, cross-border sales account for only 10 percent of the total global market. Of this 10 percent, the U.S. has only a 10 percent market share. In order to improve the U.S. market share, Mr. Middleton indicated that ETEC has focused its efforts in stimulating American export opportunities by undertaking the following activities:

- Studying U.S. competitiveness in world markets for environmental technology. This study will provide analyses of financing mechanisms and insurance from sources such as the World Bank, Overseas Private Investment Corporation, and European Development Corporation.

- Engaging in a campaign to increase ETEC membership.

- Conducting training programs at ETEC member facilities for foreign environmental decision-makers.

- Developing a translation service for overseas government environmental regulations.

- Providing ETEC members with on-line electronic capability to access environmental project opportunities worldwide.

- Cosponsoring with governmental agencies a conference designed to analyze support currently available to U.S. exporters of environmental technology.

Mr. Middleton also addressed the needs of the U.S. environmental business community compared to the international competition. Much of the international competition is involved in some form of government-supported consortium. Therefore, Mr. Middleton stated, the need for the government to support U.S. environmental business efforts is profound. He identified the following key steps that U.S. government can undertake in addressing the needs of the U.S. environmental business community:

- Develop a broader interpretation of the anti-trust rules: The United States is the most constrained nation in the world in terms of allowing its companies to develop partnerships with other U.S. companies in international ventures.

- Develop a broader definition of environmental versus energy efficiency technology.

- Encourage collaboration with the U.S. government to provide stability to the business community's relations with other countries.

Mr. Middleton concluded his remarks by discussing the tremendous new environmental market opening in Eastern Europe. Mr. Middleton noted that these countries have a highly advanced infrastructure; however, their economies are distinctively third world. As a result, the political priorities of these countries focus more on employment and economic development. Yet, these governments are keenly aware of the environmental issues and problems that plague them. Therefore, in order to market environmental products successfully in these countries, U.S. business ventures will have to make a commitment to helping to develop their economies.

* * *

In response to Mr. Middleton's presentation, Mr. Esty discussed the role of the U.S. Environmental Training Institute in promoting the export of U.S. environmental technology. The goal of the Institute is to bring to the United States overseas decision-makers from both the private and public sector who are facing environmental investment decisions. These decision-makers would then attend short courses at EPA and at private companies that address the technology issues that they have encountered. Each foreign decision-maker would spend time with U.S. companies that have the goods and services necessary to address the individual's environmental problem. The intent of the program is to expose foreign decision-makers to the depth of commitment and experience that American companies have in the environmental technology market.

* * *

Eileen Claussen, Director, Office of Atmospheric and Indoor Air Programs, Office of Air and Radiation, U.S. EPA, provided a perspective on the activities undertaken to implement Title VI of the Clean Air Act, the Stratospheric Ozone Protection Provisions. Ms. Claussen stated that Title VI provides unique export opportunities for American business. Ms. Claussen indicated that pursuant to Title VI EPA is promulgating a set of domestic regulations to implement a global agreement, the Montreal Protocol. Essentially, the signatories of the Montreal Protocol have agreed to undertake the same actions as the U.S. to phase out all CFCs. Thus, the technologies that the U.S. and other developed countries employ in reducing CFC levels will be marketable to other countries in the world environmental community because

they will be required to meet the same standards established by the U.S. In addition, the Montreal Protocol also has established a separate fund ($100-$200 million) through which developing countries can obtain money from developed countries to assist them in phasing out CFCs.

Ms. Claussen stated the goal of EPA has been to encourage all foreign countries to reduce their CFC levels. In order to achieve this goal, EPA has been active in promoting partnerships between lesser developed countries and the private sector. Ms. Claussen provided the following examples:

- EPA and the environmental technology industry have organized an annual international trade fair in which suppliers of alternative technologies can present and display their products to representatives of developing countries.

- EPA also formed an organization called the Industry Cooperative for Ozone Layer Protection. This cooperative promotes ozone-safe electronics cleaning technologies around the world. The cooperative involves companies such as AT&T, Boeing, Digital, Ford, General Electric, Motorola, and Texas Instruments. The cooperative received a request from South Korea to send a team of experts in refrigeration and solvent technologies to assist them in planning its CFC phase-out throughout.

- EPA also organized a Japan-Thailand-U.S. Conference at which representatives of U.S. companies spoke and then embarked upon site visits to Thai companies to discuss technology options that would be suitable in phasing out the CFCs for that site. This conference proved to be a unique method of finding market opportunities for American suppliers.

Ms. Claussen noted that all of these activities involved a cooperative effort between the U.S. government and U.S. industry. These activities indicate that U.S. government is attempting to play a very proactive role in promoting U.S. participation in the international environmental technology market. Ms. Claussen concluded that the U.S. government has taken on a very atypical role in the implementation of Title VI. Instead of simply regulating, the Agency is promoting government/industry partnerships that have a common goal of achieving a cleaner environment in the most cost-effective manner.

QUESTIONS AND ANSWERS

After the panelists had each given their 15-minute presentations, Mr. Esty opened the session up to questions from the floor.

One individual asked that, given the uncertainties in Eastern Europe and the lack of exposure of these countries to environmental regulations, is there any kind of interest in developing certification requirements for environmental service providers?

Mr. Middleton responded that a decision of this nature would be more appropriately addressed by the governments of those countries. An entity such as ETEC could not really undertake such a certification program.

Mr. Esty indicated that no system currently exists by which the U.S. government can give its approval to particular companies or technologies. He also suggested that there would be a substantial number of problems associated with developing any type of certification requirements.

A second person asked how developing countries will afford the most advanced technologies?

> Mr. Esty replied that, from the point of view the Environmental Training Institute, there is a recognition that different kinds of technologies with varying costs are available to developing countries and that these countries have to make cost-effective technology choices. A great deal of concern exists on the part of developing countries that they are going to spend a great deal of money on environmental technologies that will not ultimately solve their environmental problems. The goal of the Environmental Training Institute is to demonstrate to developing countries that there exists many good companies selling many good products to solve a particular environmental problem.
>
> Mr. Middleton replied that a whole spectrum of countries with a different set of economic circumstances are involved in the environmental technology market. The types of technologies developing countries will be able to afford will vary vastly from the technologies pursued by the most advanced countries. Therefore, these countries need to recognize the potential tradeoffs in terms of economics and effectiveness in selecting one technology over another.

A third individual inquired about EPA's role in Eastern Europe.

> Mr. Esty responded that EPA has been involved in the development of a Regional Environmental Center in Budapest, Hungary. At the center, environmental officials from the U.S., Europe and Eastern Europe participate in outreach efforts designed to promote environmental protection throughout Eastern Europe. In addition, EPA has been involved in a collaborative effort with Eastern Europe in which EPA sent environmental experts to these countries to examine their water and air pollution problems as well as their waste handling techniques.
>
> Ms. Claussen indicated that EPA also has been working with Eastern European countries in developing proposals to the World Bank to obtain loans that can be funded through the Bank's global environmental facilities.

A fourth person noted that in order for U.S. companies to export their environmental services overseas, they must have an understanding of foreign environmental regulations. Thus, this individual asked whether EPA or ETEC has developed a database that compares U.S. regulations to the regulations of other foreign countries so that a U.S. company that has developed technology geared toward a specific U.S. regulation can discover countries with similar regulations in order to determine where market opportunities may exist?

> Mr. Middleton replied that the development of a comparative environmental regulation database is one of ETEC's objectives. Unfortunately, many databases do not even have the environmental regulations of developing countries documented. Therefore, ETEC's first priority is to first document foreign environmental regulations so that U.S. companies may access them and then organize them for the purposes of comparison. Mr. Middleton did note that this type of comparison does exist for the more mature environmental markets. However, for the republics of the former Soviet Union and for Eastern Europe, no environmental regulation databases are currently available.

Mr. Blowers noted that from the vehicle emissions standpoint, many of the foreign regulations are similar to the U.S. regulations because many foreign countries simply adopted the U.S. regulations due to the feasibility of implementing these regulations to achieve desirable emission standards.

Mr. Esty responded that EPA has recently addressed the issue of comparative law and regulations. EPA recognized that this issue is an important element to reaching out and exploring new markets. EPA has undertaken one study in detail with Mexico that compared U.S. and Mexican environmental laws, regulations, and enforcement strategies. Unfortunately, a study of this magnitude is very labor intensive and costly. Thus, EPA is not able to undertake this activity in any meaningful manner across the spectrum of countries and environmental issues. In addition, the OECD has launched a variety of environmental country studies that attempt to examine the regulations of individual countries and their effectiveness.

Mr. Esty concluded the session by thanking panelists for their presentations and thanking members of the audience for attending the session.

LUNCHEON ADDRESS
The Honorable William K. Reilly
Administrator, U.S. EPA
April 23, 1992, 12:45 p.m. - 2:15 p.m.

Thank you. Well there was a time when an introduction like that by an official of the Office of Management and Budget of an EPA Administrator would destroy both their reputations. Who was it who once said, "When introducing royalty, lay it on with a trowel." I must say, I thought that when Bill began to introduce Bob. But I think that when the history of our environmental achievements in this administration are written, it will be very difficult to identify many to which Bob's leadership and creativity were not essential. So that introduction coming from him means especially alot to me and I'm very grateful to him for it. There was also a time, I think, when attitudes on the part of environmentalists toward those in economic sector were a little bit like Groucho Marx's view of actors. He said they ought to shoot fewer films and more actors. Well, I think that this assemblage of people, the energy here, the interest represented, the conjunctions of concerns about economics, the environment and cost effective, and more successful and aggressive, the environmental policies, may well help us realize our vision for this conference, which is that it become a milestone in the history of environmental policy. I look around this room and I see the veterans of our environmental wars and the contributors of so many experiences -- successful, imaginative, innovative, cutting-edge experiences -- at really trying to do it, on the ground, in the field. And I think that in formulating my thoughts for this meeting, it occurred to me that one of the things I could perhaps most usefully do is to make the case for the contribution of environmental policy and some of the laws that we have drafted, to the development of the economy, to the creation of jobs, to the improvement of our economic well being here, and also even to our international competitive position. We are bringing together environmental professionals who care about economic growth and business people who care about the environment. I think, as someone said to me recently, it's not politically correct to acknowledge that there are business leaders who are statesman-like on the environment. Well it certainly has been a vital component of our environmental policies, that there are, that there be such people, and that we figure out ways to encourage them and liberate them to do more. I think a conference like this shows how far we have come over the past two decades.

Late last January, the President asked all government agencies to pause for a moment, to review our regulations, to look for ways to do our work more efficiently, to reduce duplication, to initiate new actions -- with an eye to overcoming economic roadblocks and supporting economic growth. Next Tuesday the reports requested by the President are due. They will detail the steps each agency is taking to reduce regulatory drag on the economy. And I am proud of the actions we're taking at EPA -- and the additional steps we're contemplating in the future -- in response to the President's directive. Michael Boskin likes to refer to this regulatory review as a moment when you go to the closet and take out your clothes and see how many of them may not fit any more.

Well, at EPA we <u>did</u> pause: we have published almost 50 percent fewer regulations in the last 90 days than we did during the comparable period in 1991. We reviewed all our regulations -- in <u>all</u> program offices. We made a special effort to rethink our activities in areas of particular importance to the economy: small communities and small businesses, the use of clean fuels and natural gas, waste disposal, the development and export of innovative U.S. environmental technology and services.

Our report will include specific actions in each area, several dozen actions in all, actions that relieve regulatory burdens and give a push to the economy, while still providing the environmental

protection required by law -- and demanded by the American people. We believe these actions, taken together, will reduce annual regulatory costs by $4 to 9 billion annually when fully implemented.

Let me give you a sense of the kind of steps we're taking in one area -- reforming hazardous waste programs. We will propose to take certain low-risk wastes out of the hazardous waste management system. We will modify treatment standards for contaminated soils to better reflect health-based risks and encourage more innovative, cost-effective treatment technology. We will cut red tape for research activities. We'll streamline our permit system to facilitate cleanups. All in all, we will take about two dozen actions that will target our regulations to the highest risks, reduce red tape, encourage innovation -- and save as much as $5 billion a year in the process.

We at EPA are committed to working with the President to ensure that the economy continues to grow, economic growth after all, is fueling the engine of environmental protection, and -- I might add -- a healthy environment is a requisite for a healthy economy.

So make no mistake: EPA is pro-growth. We have listened to some of our leading economists concluding that environmental regulations have lowered real GNP by roughly 2 to 3 percent and possibly more. That is about half the federal, state, and local governments spending on education. Environmental protection is not a free ride.

However, we believe -- I believe -- environmental regulations can be tailored to minimize their costs. The same free market that supports a high standard of living can support a high quality of life. Economic growth and environmental protection are a package deal: this is a core principle of today's EPA. It is an unmistakable lesson of the past 20 years of extraordinary success on the environment. A period when we did so much to reduce the air pollution in our cities to bring back the Great Lakes and other important water bodies while we experienced roughly a 60 percent increase in our gross national product.

I think we began to put these principles into practice well before the President announced the 90-day moratorium. The President talked about economic and environmental linkages from the first days of his Administration. Those linkages were incorporated explicitly into the landmark Clean Air Act Amendments of 1990. And those linkages are the driving force behind this conference. Market-based programs, private sector involvement, and flexible yet enforceable rules are the heart and soul of the new Clean Air Act.

On the whole, the new clean air programs developed over the past 17 months are not narrowly prescriptive in the traditional sense. They are not being developed in a bureaucratic vacuum either. Instead, we are relying on an inclusive, consensus-building process that involves industry, environmentalists, state and local governments, and other interested parties. After many years fighting to uphold environmental regulations in the courts, we have learned that it is more effective, less expensive, when possible, to negotiate than to litigate.

Our approach has led to some solid results. The rules we are publishing satisfy the intent of Congress, and they are rules that all parties can live with.

Most important, we are unleashing forces that will clean up our air -- and keep it clean -- for generations to come. When fully implemented, the new law will remove -- every year -- 56 billion pounds of pollution from the air we breathe. That's 224 pounds for every man, woman, and child in the country.

Sulfur dioxide and nitrogen oxide emissions that cause acid rain will be cut virtually in half. Ozone smog and carbon monoxide will be reduced below harmful levels. The health risks posed by toxic air emissions will be cut by three-fourths.

The new law will aggressively phase out CFCs and other chemicals that are destroying the earth's protective ozone layer. And at long last, as Bill Rosenberg likes to say, we will reconcile the automobile and air quality -- a worthy achievement for a Michigander, if ever I heard of one. We'll have cleaner cars that are better maintained and that run on cleaner fuels.

We have already developed rules that, when all are finalized, will achieve two-thirds of the pollution reduction mandated in the Clean Air Act. That's 35 billion pounds out of a total of 56 billion pounds of air pollutants. Most of these rules have been issued within a month of the legislative deadline, though I suspect you all know a lot more about those that have not, so do I. I assure you that by Federal regulatory standards, we are proceeding at lightning speed. It's a regulatory record I would wager compares favorably with that of any other regulatory agency, past or present, and it's a record that we're proud of.

As we put this law into place, EPA is taking a flexible, market-based, results-oriented approach -- meeting clean air goals, but giving industry the flexibility and leeway to meet them in the most economical, practical, and innovative way. Our basic theme is E to the power of three: cleaning up the environment, supporting the economy, and conserving energy.

While we're speaking of the economy, Bill Rosenberg told you yesterday that we are encouraged by the draft results of a business opportunity study conducted for EPA by Smith Barney and ICF. The study shows that revenues and employment in the air pollution control industry will jump dramatically in the next 5 to 10 years -- as a direct result of the new clean air law and EPA's market-based clean air programs.

In the next three years, revenues in the air pollution control industry are projected to increase by $4 to 6 billion annually, and by $7 to 9 billion annually in the 5 years after that. That's a $50 to 70 billion cumulative increase by the year 2000. According to the study, profitability will increase significantly in some market segments, like NOx control equipment and the production of alternative fuels.

Now we shouldn't forget that industries footing the bill for our clean air must find ways to absorb these costs and continue to compete. Economists tell us that some may not be successful, and as a consequence our economy may experience slower growth and some job losses outside the pollution control sector.

At the same time, however, this surge in pollution control businesses is going to create a lot of jobs for American workers. The approach we sometimes see folks take to the cost of environmental regulation, to tally up the expenses without recognizing that money doesn't go into a black hole, but in fact is spent on something -- is one that we want to discourage. Past studies have shown that every billion dollar spent cleaning up the air leads to about 20 thousand new jobs. The Smith Barney/ICF study, which looks at only parts of the new Clean Air Act, suggests 20 to 40 thousand new jobs will be created by the year 2000 as a direct result of new clean air act requirements.

Now those jobs may be theoretical now, but in some places they're already moving closer to reality. I have visited a number of them around the United States. Construction is already underway in

many areas. Yesterday in Arizona, the owners of the Navajo powerplant signed a $430 million dollar contract for the construction of scrubbers. That project will create 300 to 500 construction jobs between 1995 and 1999 and, at the same time, improve and protect visibility in the Grand Canyon.

We see similar employment effects, by the way, resulting from other environmental laws. We will hold a conference this summer on "The Economic Importance of Clean Water," and we'll assess the jobs created by clean water programs. Last Monday morning I spent several hours on Boston Harbor and toured the largest public works project in the United States which is a construction of sophisticated and very substantial new wastewater cleanup capacity on Deer Island. Right now the data suggest that each one billion dollar spent on wastewater treatment creates well over 20,000 new jobs.

Jobs related to air quality protection will be good jobs, high-tech, highly-skilled, well-paying jobs -- many in the transportation sector, including motor vehicle design and engineering, the design and operation of sophisticated testing equipment, and the manufacturing and operation of monitoring equipment. New jobs will be created across American industry -- from the development of CFC substitutes to the construction of fuel additive plants -- from building scrubbers to opening low-sulfur coal mines in Appalachia and the Rocky Mountain west -- from constructing and installing monitoring equipment to expanding the use of clean natural gas in the Southwest. Those who work in these new jobs will be making cars cleaner, buses cleaner, gasoline cleaner, chemicals and electricity cleaner -- even dry cleaners will be cleaner. These workers will have a promising future -- and they will be able to take pride in the knowledge that they are adding to the American economy while improving the quality and health of American life.

Even more important, the experience we gain implementing the new Clean Air Act at home will make us more competitive in the global marketplace of the 21st century. A marketplace, I might add, that will have a huge environmental component. The OECD estimates that the international market for environmental goods and services is already more than $200 billion per year, and that it will grow at 5.5 percent a year through the end of the century. The Office of Technology Assessment suggests the international environmental market could grow to $300 billion by the turn of the century. The international market in hazardous waste management and treatment alone may reach $30 billion a year by the mid 90s. One study estimates that between 1990 and 2010 the total worldwide market for energy efficient equipment and services will be about $250 billion a year. The Japanese Minister of International Trade and Industry understands that -- as he has made clear to me on more than one occasion.

Look at the numbers in specific parts of the world: they're equally impressive. In Europe, capital investment in pollution control is expected to reach $47 billion in 1995, and $63 billion in 2000. Taiwan will spend up to $36 billion on pollution control and equipment over the next six years, while South Korea spends $2 to 3 billion per year. In Mexico, our fastest-growing export market, the total market for waste handling equipment and services is expected to grow 10 percent a year through the end of the decade and I would be surprised if it doesn't exceed that. Air and water pollution control spending there is projected to grow even faster: 15 percent per year.

Clearly, we are not talking small change here. These are big numbers, big markets, and they're getting bigger every day. How big they grow will depend on how fast environmental standards rise in different countries around the world. And if recent history in the European Community, in Japan, Mexico, and Turkey and some other countries is any indication, those standards will rise quickly.

How big a slice of this enormous pie will the United States garner? That will depend on how smart we are, how hard we work, and how well we compete. The Department of Commerce estimates that the U.S. share of the current international market in environmental goods and services is about 40 percent. Most of those sales are here in the United States, but we're getting our foot in the door overseas as well. General Motors, for example, now supplies auto exhaust catalytic converters and engine management systems to the former Soviet Union. Today, about 30 percent of GM's total production of catalytic converters is exported abroad. This market is expected to expand as other countries follow us in tightening tailpipe standards.

We have a lot more we could sell:

- The export market for clean coal technologies is expected to be especially strong in Eastern Europe, in Asia, and in many developing countries. There will also be a growing market for cleaner, low-sulfur coal.

- Advanced, high-efficiency power generation systems will be particularly marketable to countries with new or increased power demand, as will energy-efficient products like compact fluorescent lights and variable-speed motors.

- Pollution control/coal cleaning technologies are already in demand to retrofit old power plants in Eastern Europe.

- Export and market opportunities for CFC substitutes are growing as new and better alternatives are developed. Dupont and Allied Signal are among the companies looking toward large global opportunities in this area.

- The demand for waste management and land remediation technology is especially strong worldwide, and those are areas -- incidentally -- where the United States has special expertise.

- According to the OECD, we also can look for healthy growth in sales of new groundwater cleanup technologies.

- The demand for environmental services, particularly environmental engineering, monitoring, and consulting, is also expected to rise dramatically as companies worldwide try to improve efficiency and minimize waste.

- I think our growing expertise at creating economic incentives for pollution control also will find a market overseas. There is unprecedented interest at all levels of government -- particularly in Europe -- in some of the new and innovative approaches that we are taking, such as trading in our Clean Air Act. As you know, on Tuesday the Commodity Futures Trading Commission gave formal approval to the Chicago Board of Trade to set up a market in acid air pollutants. If this market works as well as I think it will, you will see a lot of countries tap into our expertise.

That's just a partial list, and I'm sure it's one that many of you could add more to.

Everyone, I think, in this room wants to see the U.S. share of the global environmental market rise. And it will, if we can take advantage of two decades of U.S. environmental leadership and experience, if we can take advantage of the market-building, technology-forcing features of the new Clean Air Act.

At EPA we believe that the health and ecological benefits of the Clean Air Act -- by themselves -- justify the costs of this new law. But we are aware of other benefits as well. And now is a good time to talk about them. We need America's environmental industry to be dynamic, growing, a place where people can find satisfying, rewarding work, especially in the current economic climate, especially in the current highly competitive global marketplace. By linking economic policy and environmental policy we will -- in the long run -- bring the best of both worlds to all Americans.

If you want to see what happens when those links are forgotten when they are not made, then look at Eastern Europe. Look at the Vistula River in Cracow, Poland, where the water is so corrosive it cannot be used even for industrial cleaning. In this country we spend about two percent of our GNP on environmental protection. Environmental minister of Poland once told me that environmental degradation -- resulting from the total absence of environmental spending - reduced Poland's GNP by an estimated 15 percent.

When I saw the Vistula, I was reminded of the comment by Gifford Pinchot: "A nation that has lost its liberty may win it. A nation divided may reunite. But a nation whose natural resources are destroyed must inevitably pay the penalty of poverty, degradation, and decay." Parts of Poland today are paying that penalty. Cracow has given up on the Vistula as a source of drinking water, which it provided for a thousand years. The United States has helped Cracow develop an alternative, a new source, in an artificially built reservoir some miles away.

Well in this country I think our vision has not failed us and it must not fail us in the future. That's why an environmental perspective is so useful in economic discussions: it keeps us from focusing exclusively on short-term results. Environmental vision -- by definition -- is long-term vision. And in a global marketplace where the ways of commerce seem to change by the minute, long-term vision is an essential perspective.

In the long term, I believe that the business opportunities presented by the new Clean Air Act will support the growth of American industry and the health of the American economy. That's good old-fashioned American ingenuity. That's American competitiveness at its very best. That is a practical way to implement President Bush's vision of reconciling the country's economic aspirations with its environmental goals in a practical and intelligent and an enduring way. That is what this conference is about. I am very pleased to see it convene and I wish you all great success.

Thank you.

SESSION 5
Role of Government in Facilitating the Clean Air Marketplace
April 23, 1992, 2:30 p.m. - 4:30 p.m.

INTRODUCTION

S. William Becker, Executive Director of State and Territorial Air Pollution Program Administrators, and panel moderator, introduced the panelists, a group of federal, state, and local regulators, stating that these regulators would be responsible for facilitating opportunities for meeting the requirements of the Clean Air Act (CAA) and ensuring that those opportunities yield the desired environmental results. Mr. Becker emphasized that, although regulators should be as flexible as possible, they still must meet certain statutory mandates.

As an example of government promotion of market-based opportunities, Mr. Becker spoke of the South Coast Air Quality Management District, which recently opened an economic development office which focuses on bringing new, emerging technologies forward to create opportunities to reduce pollution quickly and cost-effectively.

PRESENTATIONS

Dr. Edward B. Leviton, Chief Economist, High Technology Staff, U.S. Department of Commerce, outlined the federal government's role in facilitating environmental regulations. According to Dr. Leviton, the federal government should:

- Establish a viable economic climate so that environmental goals can be implemented.
- Establish environmental ground rules, i.e., use sound science to identify those areas where our environment needs to be improved or protected.
- Reduce uncertainty in the business sector. Business wants government's actions to be based on cost/benefit analyses.
- Maintain flexibility in regulation for individual states.
- Provide adequate times for industry to implement regulations.
- Establish credibility with industry and environmental communities by creating open dialogue among all parties.
- Promote market-based systems through tax policy.
- Emphasize performance standards over design standards.

Dr. Leviton offered two examples of innovative emissions trading practices which government regulations have supported:

- When a GM/Toyota joint venture was unable to construct a paint facility within the San Francisco-San Jose Volatile Organic Compounds (VOC) bubble because the facility would raise VOC levels too high within the bubble, the company paid one its suppliers to move out of the bubble. The company then was able to construct the paint facility and remain within VOC limits.

- Several companies in California, including Ford and UNICAL, paid $750 per car if owners would turn in their pre-1975 cars for scrappage. UNICAL was able to build another facility with the credits they earned from removing old cars from use. The program was funded privately.

Finally, Dr. Leviton discussed the federal government's role internationally:

- The United States should maintain a "level playing field" with trade partners. For example:

  -- The United States is participating in the Long Range Transboundary Air Pollution Convention, a European conference on air pollution, to ensure that European countries adopt air pollution controls as stringent as those in the CAA so that U.S. companies are not disadvantaged in international trade.

  -- When global CO_2 reduction levels are being set, the United States is unfairly disadvantaged because much of its energy comes from coal while Europe's energy is primarily nuclear. Therefore, the United States must be cautious before agreeing to CO_2 level reductions as great as the Europeans would like.

- The United States should help develop and implement programs to lessen Third World production of CFCs. Under the Montreal Protocol, a fund was set up to help pay the marginal cost of using ozone safe technology in less developed countries. Starting January 1, 1993, CFC products from a non-party (i.e., a country that has not signed the protocol), will be banned in trade between parties.

- The United States is the leader in creating pollution control technologies such as mobile sources, catalytic-control technology, engine-control technology, alternative and flexible fuel vehicle technology.

Dr. Leviton closed by emphasizing that the basic role of government is to set the structure and then rely on the market to achieve environmental goals in a cost-effective manner.

* * *

Robert C. Yardley, Jr., Chairman, Massachusetts Department of Public Utilities, opened his presentation stating that the requirements of the CAA form the most important issue facing utility regulators. Mr. Yardley stated that the CAA posed a huge challenge for utility regulators. Mr. Yardley described some of the difficult issues currently facing regulators:

- Due to the depressed demand for their product in the recession, many utilities are not earning their authorized return on equity. Utility regulators must determine whether or not to grant rate increases.

- At public hearings, commercial and industrial utility customers testify that they cannot stay in business if utility prices are raised. Industries threaten to move out of state, taking jobs and tax revenues with them.

- Regulators must settle cost allocation problems: who pays freight, are commercial and industrial customers subsidizing residential customers, should troubled or expanding industrial customers be given discounted rates to promote job retention and expansion?

- Utility customers want clean air but do not wish to pay higher rates for it.

Because of these issues, Mr. Yardley explained, utility regulators wish to provide a regulatory framework that will allow our nation's utilities to comply with the CAA at the lowest possible cost. Many regulators believe that an efficiently run allowance trading market would provide an opportunity to reduce compliance costs.

After providing this background, Mr. Yardley began to define the role that state and federal utility regulators will serve in facilitating the Clean Air marketplace. Mr. Yardley spoke of two recent regulatory developments:

- On March 2, 1992 the National Association of Regulatory Utility Committee (NARUC) adopted a resolution recommending principles for state regulation of utility compliance with the acid rain provisions of the CAA. NARUC explicitly endorsed the market-based system of trading emissions allowances. The resolution also emphasized the importance of establishing a set of groundrules that utilities will be expected to follow while allowing individual states to tailor their emission control programs. The report refers to other aspects of the market approach such as allowance banking, leasing, and pooling arrangements.

- The Federal Energy Regulatory Commission (FERC) has issued a proposed rulemaking, RM92-1, to establish financial accounting rules for CAA emissions allowances. The FERC rule is intended to provide uniformity in accounting by all public utilities for the allowances, while remaining neutral regarding rate making and compliance practices.

Mr. Yardley stated that state and federal regulators have met to discuss their respective roles. Mr. Yardley believes that the FERC is willing to allow state regulators to assume primary responsibility for CAA compliance. However, the regulation of compliance by multi-state holding companies regarding allowance trading is very much an open issue because environmental concerns need to be incorporated in the resource planning processes of utilities. Mr. Yardley stated that the role of state and federal regulators in the resource planning process of these utilities was already a source of friction.

In conclusion, Mr. Yardley described the current situation in New England, saying that Northeast States for Coordinated Air Use Management (NESCAUM) appears to prefer that Reasonably Available Control Technologies (RACT) requirements be implemented on a unit-by-unit basis without allowing averaging of emissions among units. In an apparent concession to utilities, NESCAUM has proposed that

utilities be permitted to use averaging on a limited basis if units are owned by a single utility within a single state. Mr. Yardley stated that, in a region with relatively small holding companies and a regional ozone problem, he would like averaging to occur across both utility and state boundaries.

* * *

Mr. Michael Bradley, Executive Director, Northeast States for Coordinated Air Use Management (NESCAUM), after stating that NESCAUM was formed in 1967 to deal with the regional nature of air pollution problems, stated that the greatest challenge facing the Northeast is meeting the requirements of Title I. Currently, an ozone problem exists from the District of Columbia to Maine. In 1988, within this region, every other day during the summer months exceeded the National Ambient Air Quality Standards. To meet the requirements of Title I, 60% of NO_X emissions and 70% of VOC emissions must be eliminated. NESCAUM works with the states to determine priorities in control measures; the primary goal is to achieve health standards within the designated timeframe.

Mr. Bradley outlined some the economic ramifications and benefits of the implementing the CAA in the Northeast. 50% of the ozone problem in the Northeast is caused by vehicle emissions. Mr. Bradley described some specific problems facing the Northeast, how NESCAUM plans to deal with these problems, and the possible economic benefits:

- Last March, NESCAUM adopted a policy that requires high-technology transient testing. Although this policy is controversial it does have definite economic benefits such as a projected $100 million increase in vehicle maintenance revenue and an estimated 3-5 thousand jobs created.

- Vehicle emissions may actually increase around 1995 because society is tending to increase its use of motor vehicles in numbers and mileage. Mr. Bradley pointed out all motor vehicle emission reduction strategies established in 1980s were offset by increased use of vehicles. For example, VMT emissions in Boston increased between 1980 and 1990 by 40% while population increased by only 4%. Therefore advanced emission control systems and on-board diagnostic systems must be developed. The Northeast is also planning on implementing requirements for a certain number of zero emission vehicles. Companies will benefit from increased demand for this technology.

- Transportation control measures must be developed to limit the number of vehicles on the road. These programs could include increased ride-share programs, increased trip-reduction programs at firms with more than 100 people, increased emphasis on expanded and better mass-transit systems.

- Other energy sources such as reformulated gasoline and natural gas. Currently 13% of the energy market in the New England area is served by natural gas. Mr. Bradley believes that this number will increase to about 25% by the turn of the century.

Mr. Bradley closed by saying that NESCAUM was committed to providing a relatively flexible regulatory climate, to encouraging innovative emission control systems, and to achieving emission reductions within attainment deadlines.

* * *

Mr. Michael H. Scheible, Deputy Executive Office, California Air Resources Board, stated that California has the biggest market for air quality control because it has the worst air quality and it has the largest economy and population base. Mr. Scheible stated that the $3 billion a year that California is currently spending on CAA implementation will probably triple in next few years.

Mr. Scheible discussed California's history of innovations in the area of emission control, saying that California has developed the three-way catalyst, on-board computers, Bar 90 analyzers, and evolved vapor recovery nozzles. He added that a number of programs in progress would provide even bigger markets. California requires that 2% of vehicles sold in 1998 be zero emission vehicles. This program will create large market opportunities for manufacturers of electric cars and their components.

These programs, Mr. Scheible stated, would certainly cost both the consumer and the manufacturer, but the money spent will benefit other industries. Mr. Scheible added that market-based systems could be applied to achieve air quality goals at a lower cost. He stated that in California, market-based systems have been employed for emission reductions on utilities and oil production operations as well as for vehicle emission reductions. Mr. Scheible stated that it is now fundamental in California's development of an environmental program to consider how a market mechanism might be integrated into the program. Mr. Scheible offered ways that a market-based system might be used to the advantage of industry:

- If a company produces more lower emissions cars than necessary one year, emissions credits may be used in later years or traded.

- An independent manufacturer of electric vehicles can sell his cars as well as sell emission credits to other companies who have chosen not to manufacture any low or zero emission vehicles.

- The Southcoast Air Quality Management District is working with EPA on a SAI program which would allow all permanent stationary sources of NO_X and hydrocarbons in the basin to reduce their emissions and sell the excess or buy excess emissions.

In conclusion, Mr. Scheible suggested six things the government could do to ensure a successful market-based system:

- Provide certainty and stability in the market; requirements must clear and sustainable.

- Develop regulations in partnership with affected groups, including public, industry and economic interests.

- Provide flexibility, i.e., set performance standards, do not dictate how to reach standards.

- Be more open to government-private sector partnerships; cooperation is essential for innovation.

- Provide a spectrum of market services; consultant services and education of public and industry.

- Be willing to employ market measures.

QUESTIONS AND ANSWERS

A member of the audience asked how well the Bar 90, an automated analyzer of car emissions, works?

> Mr. Scheible answered that the Bar 90 produces high quality data and is virtually tamper resistant. Mr. Scheible stated that fraud could occur only if a "dummy car" were substituted for the car supposedly to be tested.

Another person asked whether use of public transportation might offset the need to develop reformulated gasoline?

> Mr. Scheible replied that only 3-4% of Californians use public transportation. Therefore it is unlikely that even a doubling in the use of public transportation would significantly decrease emissions in the short-run. Mr. Scheible believes that development of reformulated gasoline could have a much greater and immediate effect. However, Mr. Scheible agreed that, in the long-run, development of an efficient public transportation system would be important.

One member of the audience whether methods of enforcement were being developed?

> Mr. Bradley stated that enforcement is a growing concern and that innovative methods of enforcement will have to be developed. Mr. Bradley believes that most enforcement measures will rely on computerized emission monitoring systems.
>
> Mr. Scheible stated that currently in California, vehicle owners must be able to prove that their cars meet emissions standards.
>
> Mr. Yardley stated the limited budgets for enforcement is another reason that market-based systems must be used.

One member of the audience asked whether these regulations would cause an increase in natural gas and nuclear power use?

> Mr. Bradley stated that nuclear plants would probably increase in importance. Regarding natural gas, Mr. Bradley stated that use of natural gas currently is limited by availability. As more and more pipelines are built this will become less of a problem.

One member of the audience asked whether multi-state NO_X emissions trades would occur?

> Mr. Bradley replied that a round-table process would introduced in the Northeast which would discuss the problems and the benefits of expanding the NO_X trading concept within the utilities, industry, stationary and non-stationary sources, and across state boundaries. One of the complex issues involved with trading between states is providing credible enforcement to ensure that actual credits are being traded.

Mr. Becker pointed out that regions less uniform than the Northeast might have problems trading. However, Mr. Becker stated that the acid rain provisions in the CAA called for wide-ranging trading.

One member asked whether stationary sources could reduce their VOC emissions any further than they already have and, if not, whether lowering VOCs would be problem?

Mr. Leviton agreed that mobile sources, not stationary sources, are now receiving the greatest attention. However, the adoption of Phase II is a much more cost-effective measure so implementing a Phase II programs for stationary sources in non-attainment areas will not be difficult. Further, the Reid Vapor Pressure of gasoline (RVP) regulations promulgated two years ago by the EPA have proven to be an extremely cost-effective way to reduce VOC emissions. Therefore, reducing VOC emissions should not be problem.

Mr. Scheible added that in California only about 20% of ozone precursors come from permitted emission sources. The rest come from mobile sources and consumer products. Therefore the bulk of emissions does not come from stationary sources.