REPORT OF THE

VIRGINIA COAL AND ENERGY COMMISSION

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

SENATE DOCUMENT NO. 32

COMMONWEALTH OF VIRGINIA
RICHMOND
1997

MEMBERS OF THE COMMISSION

Senator Jackson E. Reasor, Jr., Chairman
Delegate J. Paul Councill, Jr., Vice Chairman
Senator Charles J. Colgan
Senator Charles R. Hawkins
Senator H. Russell Potts, Jr.
Senator William C. Wampler, Jr.
Delegate Watkins M. Abbitt, Jr.
Delegate James F. Almand
Delegate George W. Grayson
Delegate Harry J. Parrish
Delegate Jackie T. Stump
Delegate A. Victor Thomas
Delegate John Watkins
H. Kim Anderson
Donald B. Baker
Ronald J. Des Roches
Laura Bateman
W. Thomas Hudson
Lloyd Robinette
Richard A. Wolfe, Ph.D.

STAFF

DIVISION OF LEGISLATIVE SERVICES

Nicole R. Beyer, Staff Attorney
Arlen K. Bolstad, Senior Attorney
Carol S. Agee, Senior Operations Staff Assistant

SENATE COMMITTEE OPERATIONS

Thomas C. Gilman, Jr., Chief Committee Clerk

Table of Contents

Report of the
Virginia Coal and Energy Commission
to
The Governor and the
General Assembly of Virginia
Richmond, Virginia
1997

TO: The Honorable George F. Allen, Governor,
and
The General Assembly of Virginia

The Virginia Coal and Energy Commission, established in 1979, is a permanent legislative commission consisting of five senators, eight delegates and seven citizens appointed from the Commonwealth at large by the Governor, including representatives of industry, government and groups or organizations identified with production and conservation of coal, natural gas, and energy. The purpose of the Commission is to "study all aspects of coal as an energy resource and endeavor to stimulate, encourage, promote, and assist in the development of renewable and alternative energy resources other than petroleum." (Code § 9-145.1.)

The full Commission had one meeting during the interim, just prior to the 1997 Session of the General Assembly, at which time Senator Jackson E. Reasor, Jr., was elected as chairman and Delegate Paul Councill, Jr., was elected as vice chairman. At that meeting, the Commission was presented with information on thin seam coal mining technology and an update on Virginia's weatherization assistance program. Two of the Commission's four subcommittees, the Coal Subcommittee and Oil and Gas Subcommittee, each met once. The Coal Subcommittee's meeting focused on Clean Air Act and deregulation implications for the electric power and fuel production industries. The Oil and Gas Subcommittee's meeting focused on legislative proposals offered by the Virginia Oil and Gas Association.

I. THE COAL SUBCOMMITTEE

The Coal Subcommittee met in July in Richlands at Southwest Virginia Community College. The meeting was held in conjunction with the 1996 Richlands Coal Show. The subcommittee heard testimony on Clean Air Act issues, electric power industry restructuring, and Virginia Tech's Powell River Project.

THE CLEAN AIR POWER INITIATIVE

Sam Napolitano of the United States Environmental Protection Agency's Office of Atmospheric Programs discussed EPA's Clean Air Power Initiative (CAPI), which he described as an effort to rationalize the agency's approach to regulating utilities under the Clean Air Act Amendments of 1990. He stated that EPA decided to prioritize its activities with regard to electric utilities because the agency recognized the following interrelated factors:

1. The electric power industry is a major contributor to many types of air pollution, including ozone, sulfur oxides (for which the industry is 70% responsible), nitrogen oxides (for which the industry is 30% responsible), toxic trace metals, and particulate matter.

2. The Clean Air Act requires EPA to complete ten to fifteen different tasks over next fifteen years with regard to electric utilities.

3. The industry is experiencing significant pressures due to deregulation.

The purposes of CAPI are to identify cost-effective approaches to pollution control and to give electric sector and fuel suppliers early signals as to the regulatory approaches EPA will employ, so that they can plan with EPA to meet the Clean Air Act's goals. Within CAPI, EPA is working with utilities, fuel suppliers, states and coal labor unions to analyze different options. Napolitano emphasized that CAPI is a process-oriented initiative and that it is not a substitute for EPA's separate effort to set air quality standards. Rather, CAPI is tasked with determining how those standards will best be met.

Early in the process, nitrogen oxides (also known as NO_x) and particulate matter were identified as the most worrisome air pollutants emitted by power plants. No_x is a precursor to ozone, which is a primary component of smog and, when it exists at ground level, is detrimental to human respiratory health. Fine particles in the air also cause respiratory problems. Other major sources of NO_x, automobiles and "area sources" such as drycleaners and paint shops, are addressed by other EPA programs. Reducing the presence of particulate matter, Napolitano explained, can best be accomplished by controlling emissions of sulfur oxides (SO_x), as sulfates are the fine particles that are the most detrimental to human health. Because sulfur oxides are also responsible for acid rain, they are also regulated under EPA's acid rain program under Title IV of the Clean Air Act. Pollutants the agency has chosen not to focus on include mercury and carbon. Napolitano noted, however, that incidental reductions in emissions of these pollutants are likely to result from controls on other pollutants.

Napolitano summarized CAPI fuel use projections. Notwithstanding impending deregulation of the electric utility industry, coal is expected to continue as the dominant fuel for electric power generation over the next 15 years, providing approximately 55-60% of electricity generated. Due to combined-cycle technology and low gas prices, natural gas use will probably grow to meet increasing electricity demands, but it is not expected that many coal-fired units will switch to gas. Nuclear power generation is likely to decline and hydroelectric power generation and use of renewable fuels will remain steady.

Based on these fuel use projections, CAPI has prepared emissions forecasts for SO_x and NO_x. See Appendix A. Using the forecasts, two different methods of reducing SO_x and NO_x were evaluated: a traditional emission rate limitation approach, and a trading and banking approach. The trading and banking approach is currently employed by EPA under Title IV of the Clean Air Act. Title IV mandated a nationwide cap on SO_x emissions of 10 million tons annually nationwide, a portion of which has been allocated to each emitter of SO_x for the emitter to use, bank (save for later) or trade (sell). This approach is widely held to be cost-effective in practice and to have fostered innovation. Napolitano noted that SO_x emissions are planned to decrease in the year 2000 because of controls imposed under the acid rain program.

Three trading and banking NO_x control options which assumed the imposition of a nationwide cap in 2005 and a constant level of SO_x emissions (reduced to 50 percent of the current 2010 cap) were analyzed. See Appendix B. The least stringent of these, which would achieve an average emissions reduction of .15 pounds of NO_x per million BTUs of fossil fuels used, was compared to a rate-based approach for NO_x under which a summer season emission rate cap on all fossil units of .15 pounds of NO_x per million BTUs per boiler would be imposed, starting in 2005. (It was also assumed that under the rate-based approach, in the year 2010, the Title IV SO_x cap would be reduced by half and only trading (not banking) of SO_x emissions credits would then be allowed.) While the cost of the trading and banking approach is projected to slightly exceed the cost of the traditional approach in the year 2000, the trading and banking option will cost significantly less than the traditional approach in 2005, and more than five billion dollars less in 2010. See Appendix C. Options which included a more aggressive trading and banking scheme for SO_x were also analyzed, but they failed to produce significant emissions reductions and were predicted to be quite expensive to implement. See Appendix D.

In addition to the emissions reductions and costs associated with the various options, the options' other impacts were also investigated, including those on carbon and mercury emissions, fuel use, electricity costs and employment. Carbon and mercury are emitted from plants that use coal. Between now and 2000, coal use would not be significantly affected by any of the options. By 2010, coal switching is expected to result in a 5 - 7 percent reduction in carbon and a 10 - 15 percent reduction in mercury. Changes in coal demand are likely to affect eastern coal first

as plants switch to lower-sulfur western coal. As scrubbers are installed, eastern coal would again be used. Preliminary calculations indicate that the most expensive option analyzed would increase the cost of electric power by .6 percent in the year 2000 and by 1 -2 percent in 2010, although it is difficult know how deregulation of the industry will affect these numbers. CAPI's employment analysis shows a net increase in jobs, but there will be a decrease in some sectors, particularly the mining sector. New jobs will include those in pollution control equipment installation and operation and natural gas exploration and production. Decreases in coal mining jobs will result from decreased demand for coal, but also from the independent factor of improvements in mining productivity. Napolitano cautioned that these employment projections are preliminary and that EPA is seeking input on its employment analysis from the United Mine Workers, industry representatives, and others.

Napolitano summarized CAPI's initial key findings as follows. National trading and banking approaches for NO_x and SO_x seem to be capable of providing large emissions reduction throughout the U.S., while also producing an ancillary benefit of reductions in carbon and mercury by the year 2010. The costs of the options range from one to 2.6 billion dollars in 2005 and 2.7 to 4.4 billion dollars in 2010, although technology improvements may reduce these costs. In addition to its cost advantages, the trading and banking approach offers greater compliance flexibility: electricity generators may install pollution control technologies, choose cleaner fuels, add cleaner generation units, make early "bankable" reductions, and/or purchase allowances. Modest increases in electricity prices are expected to result from the CAPI options, and some industrial sectors could face large production cost increases. There are likely to be employment gains in some areas and employment losses in others, and more analysis is needed on this issue. Napolitano concluded by stating that a major accomplishment of CAPI has been getting stakeholders (states, environmentalists, fuel suppliers, utility industry and labor) around the table and building consensus.

OTAG CONCERNS

John Paul, Vice President of Center for Energy and Economic Development, (CEED) provided the subcommittee with his organizations' perspective on Ozone Transport Assessment Group (OTAG)-proposed restrictions on NO_x emissions east of the Mississippi. CEED, a nonprofit organization dedicated to promoting coal as an energy source, had made presentations on the activities of OTAG to both the full Commission and its Energy Preparedness subcommittee during the 1995 interim. OTAG is an EPA-coordinated organization of 37 eastern state environmental protection agencies.

Paul explained that ground-level ozone is the result of a reaction between NO_x and volatile organic compounds (VOCs). VOCs are emitted by mobile sources such as cars, area sources and trees, but not by power plants. The reactions between NO_x and VOCs occur mostly in the summer because of increased sunlight and heat. Paul contended that existing Clean Air Act programs will result in very large NO_x reductions and that further improvements in air quality will result from non-regulatory events, such as the roll-over of the car fleet, which takes about 20 years.

CEED is concerned that the OTAG process will result in controls being forced on the utility industry in the 37-state area before they are proven by modeling studies currently underway to be necessary or worth their high cost. CEED also questions the science on which proposed NO_x restrictions are based. An Energy Ventures Analysis, Inc. study has concluded that if a 75% reduction in NO_x emissions were required in all 37 OTAG states, the cost to utilities would be between 18 and 27 billion dollars. Such reductions would directly result in the loss of 308,000 to 400,000 jobs, but would not result in attainment of the ozone air quality standard in the twelve-state Ozone Transport Region. The model employed in this study shows that if the region were divided into 16,000 cells, only 42 of them would go from above to below the standard.

UTILITY DEREGULATION

Dan Carson, Virginia and Tennessee president of American Electric Power, spoke to the subcommittee about electric utility industry deregulation and its expected impact on the use of coal as an energy source. His view was that the implications of deregulation are positive for utilities and uncertain for coal. The industry learned from its experience with deregulation of the wholesale power market in the early 1990's that price is of paramount importance to the customer. The effect of deregulation of the retail power market on fuel choice, then, will be that the plants that will operate will be the ones that can do so at the lowest cost, regardless of present service areas. Carson also predicted that the 1999 sunset on Virginia's coal tax credit will affect coal buying choices by utilities. American Electric Power supports retail competition and consumer choice and believes that they should be pursued both aggressively and carefully. Carson emphasized the importance of a level playing field among investor-owned, government-owned and government-subsidized power suppliers.

THE POWELL RIVER PROJECT

Carl Zipper, Associate Director of the Powell River Project (PRP), briefed the subcommittee on the activities of the PRP. Subjects of PRP research include re-mining abandoned mine lands, disposal and uses of fly ash, and reforestation

during mine reclamation. PRP is also working on identifying reasons for the lack of "value added" forest product businesses in the coalfields and actions available to economic development leaders that will stimulate wood-products business activity. Another initiative will seek to quantify economically mineable coal reserves remaining in southwest Virginia, southern West Virginia and eastern Kentucky. The Project is also responsible for a series of reclamation guidelines to be published by Virginia Cooperative Extension. The first of these, dealing with coal refuse reclamation, has been completed, and several more are in progress. These will address mine soil replacement, revegetation, wetland construction, mined land development, and fly ash management. See Appendix E.

II. THE OIL AND GAS SUBCOMMITTEE

The Oil and Gas Subcommittee met just prior to the 1997 Session in order to consider some legislative proposals of the Virginia Oil and Gas Association (VOGA). These included two resolutions designed to encourage the use of Virginia fuel sources by state government facilities. The first, which passed the 1997 Session of the General Assembly as Senate Joint Resolution 347, expresses the sense of the General Assembly that coal, coalbed methane, natural gas, or other Virginia-produced or Virginia-refined energy stocks should be considered for use in existing state facilities, and that, during the renovation or construction of state facilities, coal or gas should be given primary consideration for generating heat, steam, or air conditioning. The second, which passed as Senate Joint Resolution 348, requests the Department of Corrections to use Virginia-produced coal, coalbed methane or natural gas or other Virginia-produced or Virginia-refined energy stocks for its raw energy source at all future correctional facilities. VOGA recommended this resolution because a 1988 resolution (SJR 31), which requested the Department of Corrections to use coal for its raw energy source at all future correctional facilities, failed to mention other fuels produced in Virginia.

A number of VOGA's other proposals were enacted by the General Assembly as Senate Bill 1108. That legislation:

1. Provides that appeals of orders and decisions of the Gas and Oil Board shall be heard de novo whenever a gas owner or operator or storage field operator is a party to the appeal. Under current law, such appeals are heard de novo only when a coal owner or coal operator is a party. According to VOGA representatives, this change will equalize appeal rights among all owners of mineral rights.

2. Decreases the statewide well spacing requirement for oil wells from 1,320 to 1,250. VOGA representatives asserted that this change would provide consistency with subdivision A 2 of § 45.1-361.17 of the Code of Virginia. The well spacing

requirement for gas wells was reduced from 2,640 to 2,500 feet during the 1996 Session of the General Assembly.

3. Provides that appeals of well permits which were objected to by gas storage field operators shall stay the permit except for oil, gas or coalbed methane wells completed more than 100 feet above the cap rock above the storage stratum. Such a stay is provided by existing law when a coal owner has objected to a permit.

4. Adds a well spacing requirement that applies to storage wells within gas storage fields. (The General Assembly limited the applicability of this provision to gas storage fields certificated by the State Corporation Commission prior to January 1, 1997.)

5. Adds gas storage field operators to the list of persons to whom notice must be given concerning applications for the establishment of field rules or drilling units or for applications for pooling orders for conventional or coalbed methane wells.

6. Provides that the signed consent from nearby coal operators required for coalbed methane gas well permits shall be deemed to be granted for any tract where title to the coal is held by multiple owners if the applicant has obtained consent to stimulate from the co-tenants holding majority interest in the tract and none of the coal co-tenants has leased the tract for coal development.

VOGA also presented proposals that were not included in SB 1108. One proposal attempted to clarify State Corporation Commission (SCC) and Department of Mines, Minerals and Energy (DMME) jurisdiction over gas storage fields. The SCC, which has the responsibility of certificating storage wells, has expertise in pipeline safety, rates, and other utility issues, but does not employ any geologists. DMME has expertise in geology and has jurisdiction over the mines that might be affected by the operation of a gas storage field. Another proposal was that the General Assembly conduct a study of the coal estate owner's ability to veto stimulation of a coalbed methane well. VOGA representatives asserted that no other state in the Appalachian basin provides this veto power to coal owners without giving the owner of the coalbed methane a right to appeal to the jurisdictional agency the coal owner's refusal to cooperate.

III. THE FULL COAL AND ENERGY COMMISSION

During the full Commission's only meeting, Dr. Malcom McPherson, Director of the Virginia Center for Coal and Energy Research, made a presentation about thin seam mining technology. An update on Virginia's weatherization assistance program was also provided to the Commission.

THIN SEAM MINING TECHNOLOGY

McPherson began by reminding the Commission of some of the statistics on which the Commission's endorsement of Virginia's coalfield employment tax credit was presumably based. The coal mining industry employs 9,000 people in southwest Virginia, and 35,000 jobs are directly related to the coal industry. These jobs together generate about one billion dollars in personal income and account for about 40 percent of personal income in the seven coal-producing counties. Most of the coal in the region that existed in thicker seams has been extracted, but high-quality coal remains in the thinner seams. The tax credit has, by increasing the profitability of extracting thin-seam coal, allowed the industry to extend the period before which steep declines in production are likely to occur. Dr. McPherson asserted that after this period, mining, jobs and financing of economic development in southwest Virginia will decline rapidly unless thin seam mining technology is developed.

Traditional underground mining methods are limited in effectiveness by seam height. McPherson listed characteristics that will be required of any new technology that would make thin seam mining productive. Such mining systems must be flexible in their ability to handle variations in geology, seam structure, depth, and previous mining of seams above and below the one being mined. They must protect safety and health of the miners with respect to air flow, dust and methane (which most likely will be accomplished through automation of the face operations). Such systems must be simple and reliable with respect to maintenance and monitoring. They must minimize or eliminate subsidence, acid mine drainage, methane emissions, and they will, ideally, allow mined openings to be used for long-term safe storage of all the waste generated at the mine, and perhaps even waste generated elsewhere.

McPherson used diagrams to describe some of the technologies under consideration, including a 24 inch auger and an underground highwall miner. See Appendix F. He compared the costs associated with the use of these technologies to the costs associated with a traditional three-foot continuous miner, and found that the use of these technologies appeared economically feasible. See Appendix E.
He also described technology being explored that would eliminate the need for the kinds of surface coal preparation facilities that create negative environmental impacts. It may be possible for coal to be cleaned underground, perhaps with the use of slurry pipelines. Such a system may even be capable of accepting municipal or industrial waste from outside of the mine. See Appendix H.

McPherson explained that a three-phase approach over about an eight-year period (the window of opportunity provided by the tax credit) is necessary to incorporate these technologies into the Virginia coal mining industry. In Phase One, which is currently underway, the inventory of Virginia coal seams must be

updated with respect to extent, thickness and quality. Currently there is a team at Virginia Tech that is doing this work for seams greater than 24 inches. The ratio of research and development investment to benefits for the industry should also be examined as part of Phase One. Phase Two will be a series of feasibility studies with regard to the new technologies, including studies on mining system development, equipment development, capital and operating costs, marketing, transportation of waste and coal, environmental benefits, financing and socio-economic impacts. In Phase Three, engineering studies will lead to a pilot operation at a surface mine and ultimately underground installation of the technologies. McPherson emphasized that this three-phase approach will require the support of all interested parties, including coal operating companies, land holding companies, electric utilities, railroads, the Virginia Port Authority, mining machinery manufacturers, academia, and the Commonwealth. He suggested that the Commonwealth should lead the effort. When asked what this approach would cost to implement, McPherson estimated that Phase Two would require $3 million dollars per year over a two-year period. Phase Three would require that $5 million per year for another three years.

WEATHERIZATION ASSISTANCE PROGRAM

Each year, the Energy Preparedness Subcommittee receives reports concerning programs providing home heating fuel and weatherization assistance to low income individuals and families. During the 1995 interim, the subcommittee examined provisions in federal law permitting the allocation of federal fuel assistance funds to home weatherization programs. Legislation requiring such reallocations was recommended by the subcommittee to the full Commission and was endorsed by the Commission. The recommendation was enacted by the 1996 Session of the General Assembly as House Bill 675.

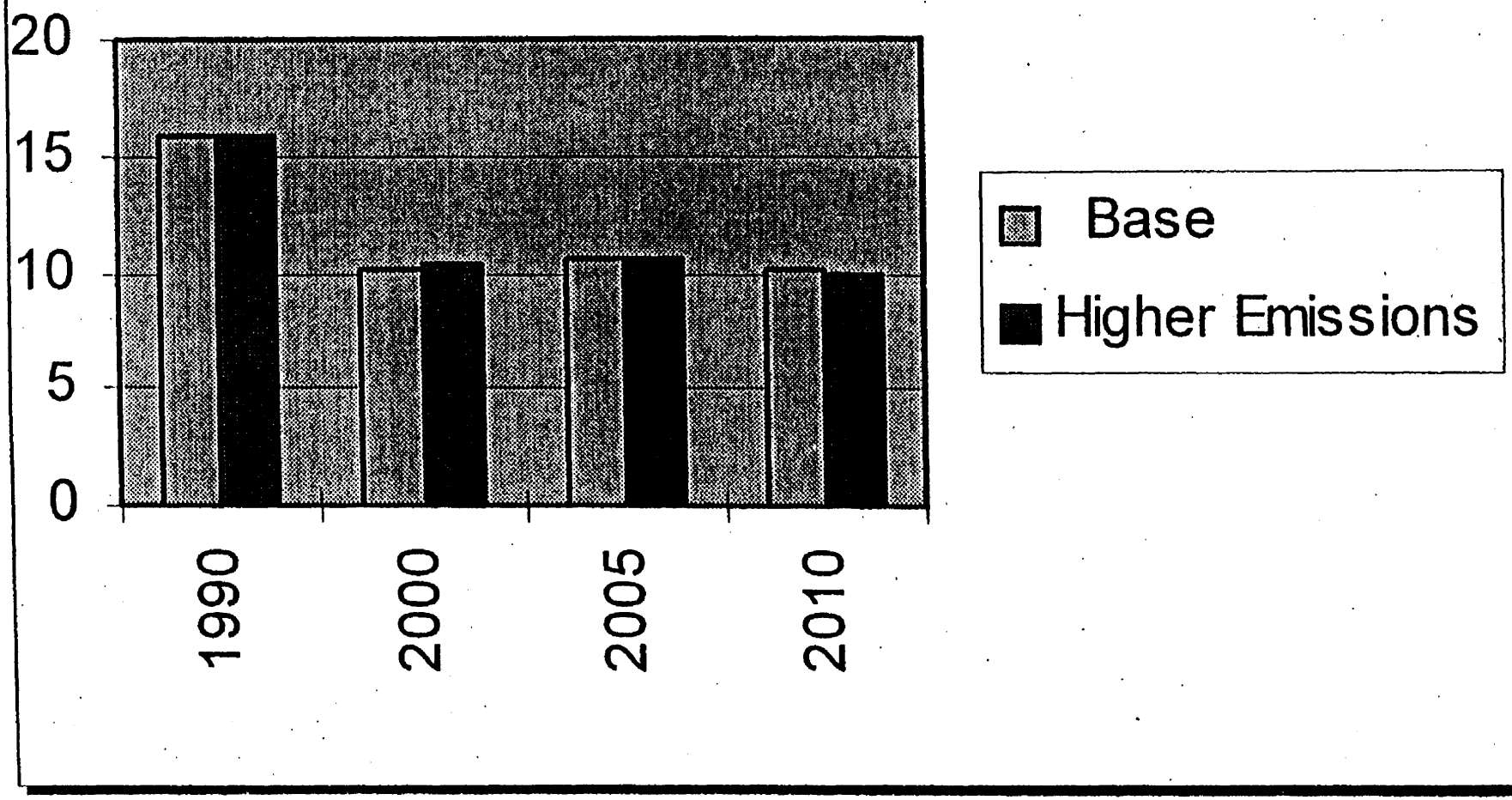
Bill Beachy is the Program Administrator for the Weatherization Assistance Program in the Department of Housing and Community Development (DHCD). He told the Commission that in order to implement HB 675, DHCD entered into an interagency agreement with the Department of Social Services (DSS), under which 1.4 million dollars of the federal Low Income Home Energy Assistance Program (LIHEAP) grant has been allocated to Virginia's weatherization assistance program. The agreement is effective from November 1, 1996, through June 30th, 1997. Seven hundred and fifty weatherization units can be completed with the reallocated money. At the time of the meeting 100 units had been completed. The weatherization program had a waiting list at the time of the meeting of 3000 households, with an average waiting period of 28 months.

For the three past years, another interagency agreement between DHCD and DSS has allowed a portion of the LIHEAP grant to be allocated to a crisis assistance

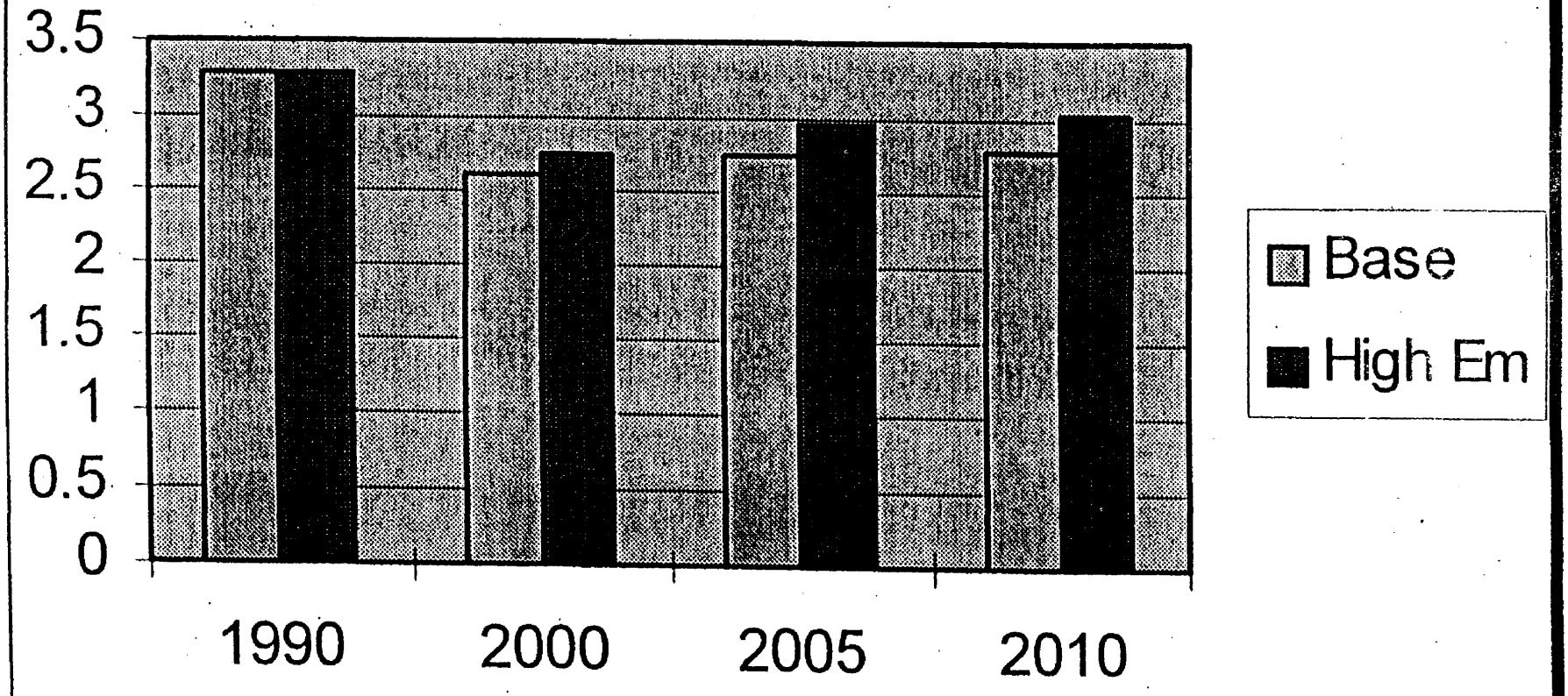
program used for emergency heating equipment repairs. With this amount of money, about 2500 households per year have received emergency assistance from weatherization contractors. This program was eliminated in 1996. Beachy estimated that as a result of the elimination of the crisis assistance program, 37 percent of people who were referred to the weatherization program and reported emergency repair needs were not assisted. Proponents of the weatherization program told the Commission that the elimination of this program in the same year as the reallocation of LIHEAP funds to the weatherization program was contrary to the intent of HB 675 because it will prevent needy persons from receiving weatherization assistance on an emergency basis. The result of the elimination of the program, they contended, is that people with no heat or with dangerous heating systems may now be forced to wait for months before receiving assistance. Under the crisis assistance program, assistance was usually available within 48 hours. The Commission voted to express support for general fund support for the weatherization program. The 1997 budget bill provided an increase in general fund support for the program of $150,000.

APPENDICES

Annual SOx Emissions Forecast (million tons)



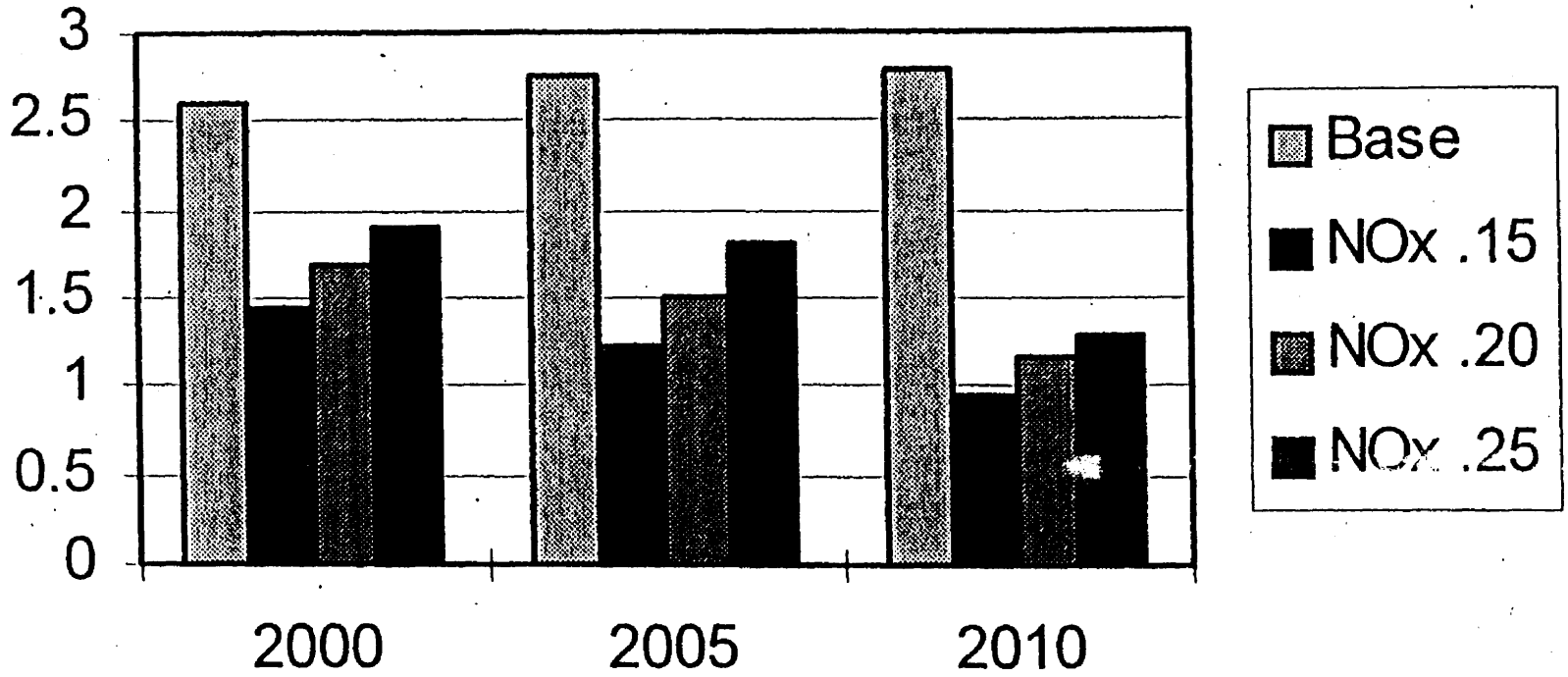
Summer NOx Emissions (million tons)



Trading/Banking Options that Are NOx-Driven

- **Options Varying NOx Levels While Holding SOx Control Level Constant**
  - Examined Lowering Summer Emissions Cap Based on NOx Emission Rates of:
    - » .15 of NOx per Million Btus of Fossil Fuel Used
    - » .20 of NOx per Million Btus of Fossil Fuel Used
    - » .25 of NOx per Million Btus of Fossil Fuel Used
- **There Is a Reduction of the 2010 SOx Cap by 50% for All Three Options**

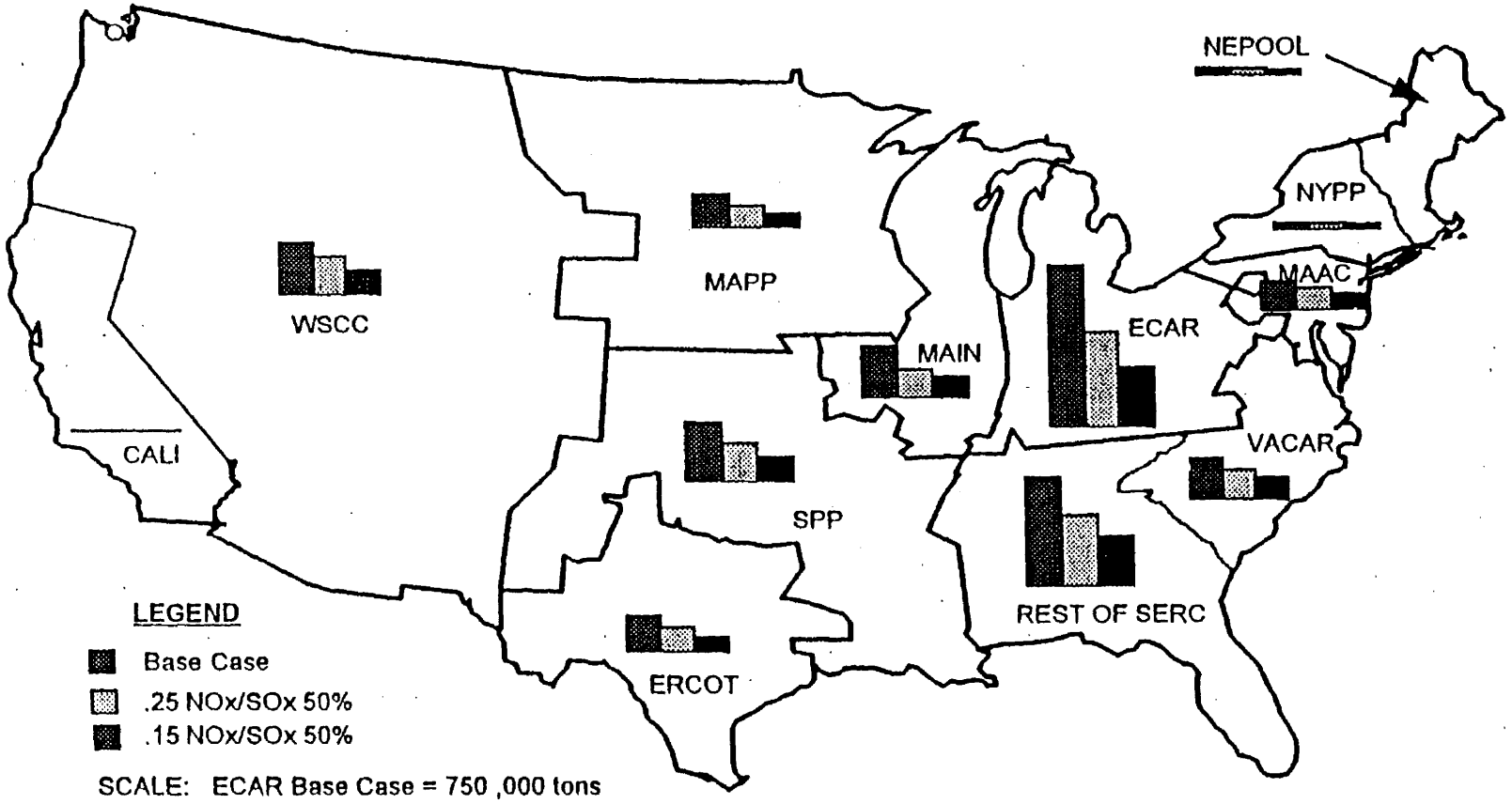
Summer NOx Emissions with Options - (million tons)



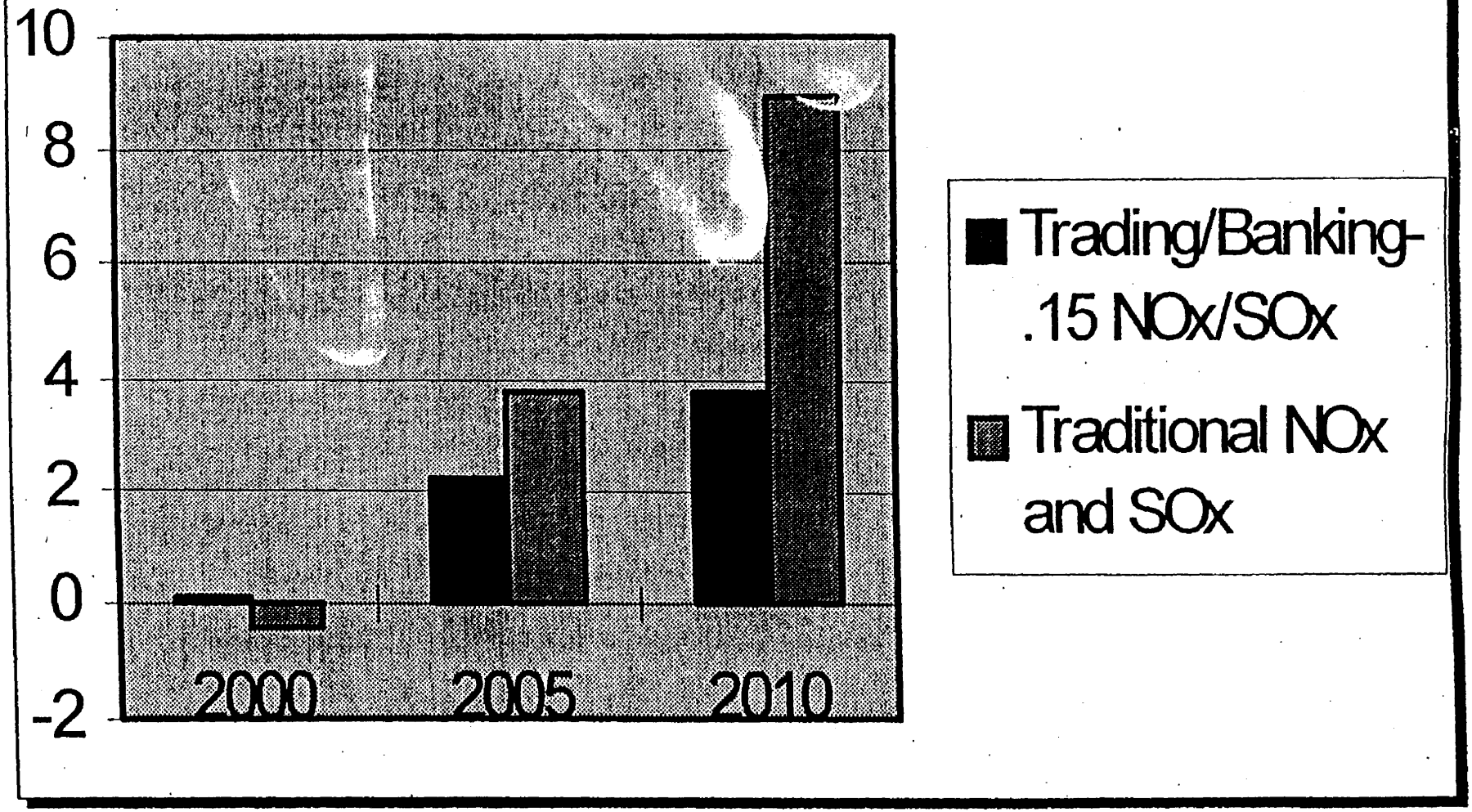
Annual Costs for NOx-Driven Options - (Billions $)

Option	2000	2005	2010
NOx .15	1	2.2	3.7
NOx .20	0.7	1.5	2.9
NOx .25	0.4	1	2.7

Comparison of Summer NOx Emissions in 2005 for .15 and .25 Options

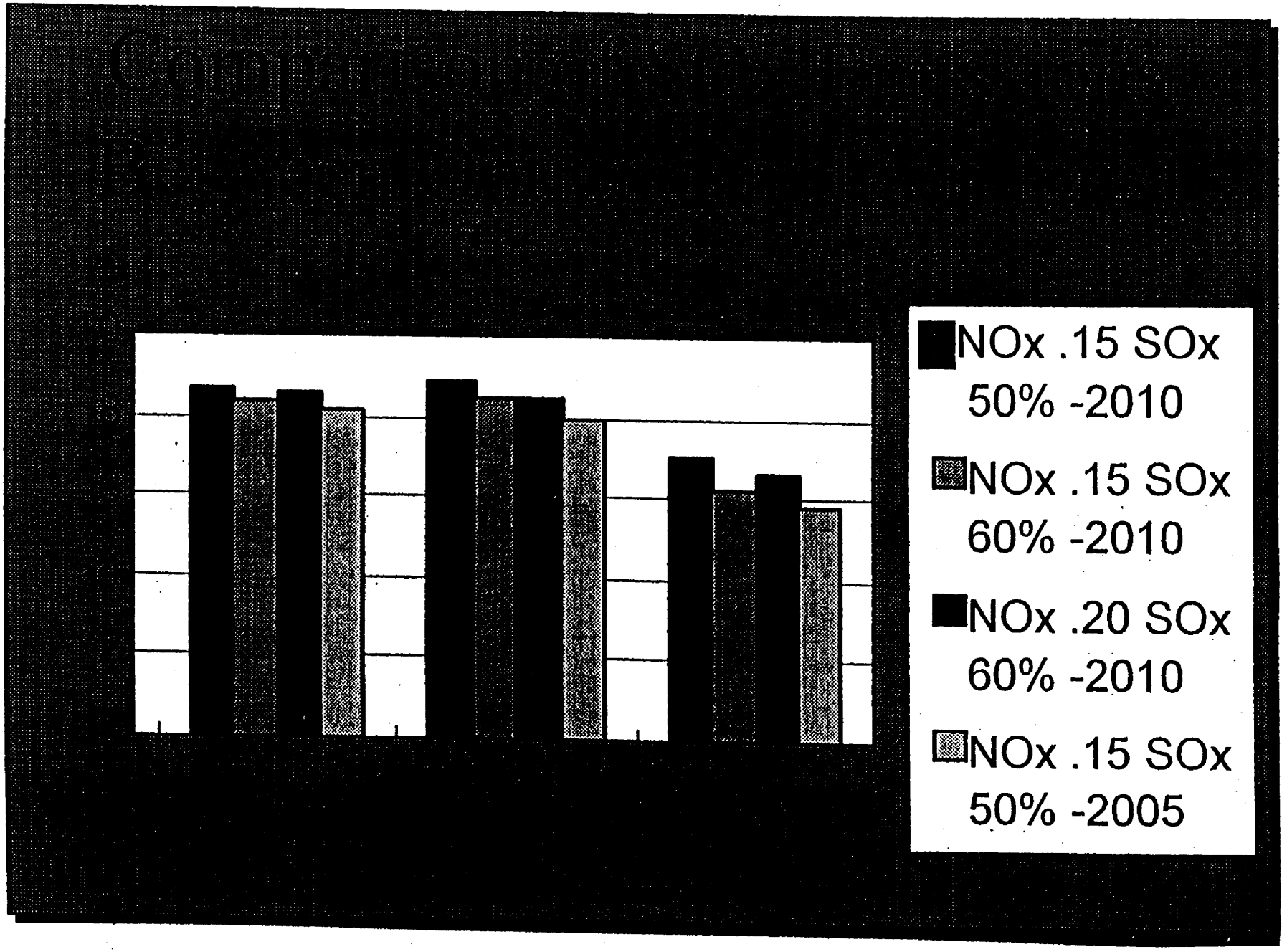


Costs of Traditional vs Trading/Banking Approaches to NOx and SOx ($Billions)



More Aggressive Trading/ Banking Options for SOx

- **Examined Three More Aggressive Trading and Banking Options for Reducing SOx Emissions. They vary by:**
  - Setting a Lower Summer NOx Cap Based on .15 lbs/MMBtu in 2005. Reducing the 2010 Title IV SOx cap by 60 % in 2010.
  - Setting a Lower Summer NOx Cap Based on .20 lbs/MMBtu in 2005. Reducing the 2010 Title IV SOx Cap by 60 % in 2010.
  - Setting a Lower Summer NOx Cap Based on .15 lbs/MMBtu in 2005. Reducing the 2010 Title IV SOx Cap by 50 % in 2005.


NOx .15 SOx
50% -2010
NOx .15 SOx
60% -2010
NOx .20 SOx
60% -2010
NOx .15 SOx
50% -2005

Comparative Costs (Billions $)

.15 NOx/SOx 50 % in 2010	1.0	2.2	3.7
.20 NOx/SOx 50 % in 2010	0.7	1.5	2.9
.15 NOx/SOx 60 % in 2010	1.1	2.4	4.4
.20 NOx/SOx 60 % in 2010	0.8	1.8	3.4
.15 NOx/SOx 50 % in 2005	1.3	2.6	4.7

Powell River Project: Current Activities and Initiatives

Carl E. Zipper, Associate Director

Richlands Coal Show. July 17, 1996.

Powell River Project Mission: PRP conducts research and education programs to benefit communities and businesses in southwestern Virginia's coalfield region. PRP is a cooperative effort of Virginia Tech and southwestern Virginia industry.

Review of 1995-96 Activities, With Reference to December, 1995, Plan of Work

Research:

Re-Mining: Continue cooperative effort to establish incentives for economically viable re-mining operations to reclaim AML environmental problem areas.

- Active participants in working group established by Virginia Department of Mines, Minerals and Energy (DMME) to advance Virginia re-mining initiative. Virginia DMME is a leader among state agencies seeking to stimulate re-mining.
- Open to establishing one or more research projects at re-mining sites to address site-specific or general re-mining concerns.

Reforestation: Continue research to develop better methods of hardwood reforestation during mine reclamation (cost-effective, increased timber productivity). Work with VDMME to assist implementation of recommended practices in a manner consistent with OSMRE policies.

- Jim Burger's research to develop better methods of hardwood reforestation during mine reclamation is continuing; experimental plots are being established in VA, WV, and KY.
- Virginia DMME regulatory program amendment, which defines allowable reforestation husbandry practices that are consistent with PRP reforestation guidelines, has been approved by U.S. OSMRE.
- Working with Kentucky Department of Surface Mining Kentucky reforestation group to encourage PRP reforestation practices in Kentucky.
- Seeking opportunities to work with mining operators to implement improved reforestation practices on an operational basis at several locations.

Fly Ash: Continue research on use of fly ash as an amendment to improve revegetation of acid mine soils, and on methods of placing fly-ash in coal-refuse fills so as to prevent acid mine drainage.

- Continuing support Lee Daniels' research on refuse/fly ash co-disposal, other ash management options.

Economic Development: Continue research which seeks to (i) identify reasons for lack of "value added" forest-product businesses in coafield area, and (ii) identify actions available to economic development leaders that will stimulate wood-products business activity.

- Harold Wisdom's research is addressing issues associated with "value added" industry, including an investigation of the "wood products' industrial park" concept: the potential to establish a dry kiln as a locus for hardwood-product manufacturing facilities.
- Initiating a new research (Robert Smith, Forest Products) that will quantify wood "waste" byproducts as potential resource to attract new industry.

On-Site Waste Disposal: Support research to establish household-scale experimental prototypes of alternative on-site wastewater disposal technologies on reclaimed mine areas, or other innovative technologies that will help alleviate existing sanitation problems in one or more coalfield communities.

- Planning conference to address sewage disposal options for small, isolated coalfield communities (anticipated date: late August; co-sponsored by Virginia Water Project) .

Water Supplies: Support research to develop strategies for dealing with water supply needs of outlying communities in coalfield area.

- Research led by John Randolph provides overview of regional water supply issues. Final report of this two-year study should be available shortly.
- Open to sponsoring new research, if appropriate issue is identified.

Education:

Public Schools: Continue to provide education programs at PRP Education Center, work with teachers to integrate those programs with science curricula.

- Education programs are continuing under leadership provided by Jon Rockett. Over 1000 students from southwestern Virginia schools participate in education programs at PRP Education Center annually. Current emphasis is working with teachers to integrate PRP activities at PRP Education Center site into classroom curriculum.

Field Demonstrations: Maintain field demonstrations of reclaimed land uses (turf, horticultural crops, Christmas trees, commercial forestry, livestock) at Education Center; these demonstrations are important components of education programs.

Area Colleges: Continue working with area colleges to assist environmental science education and recruitment.

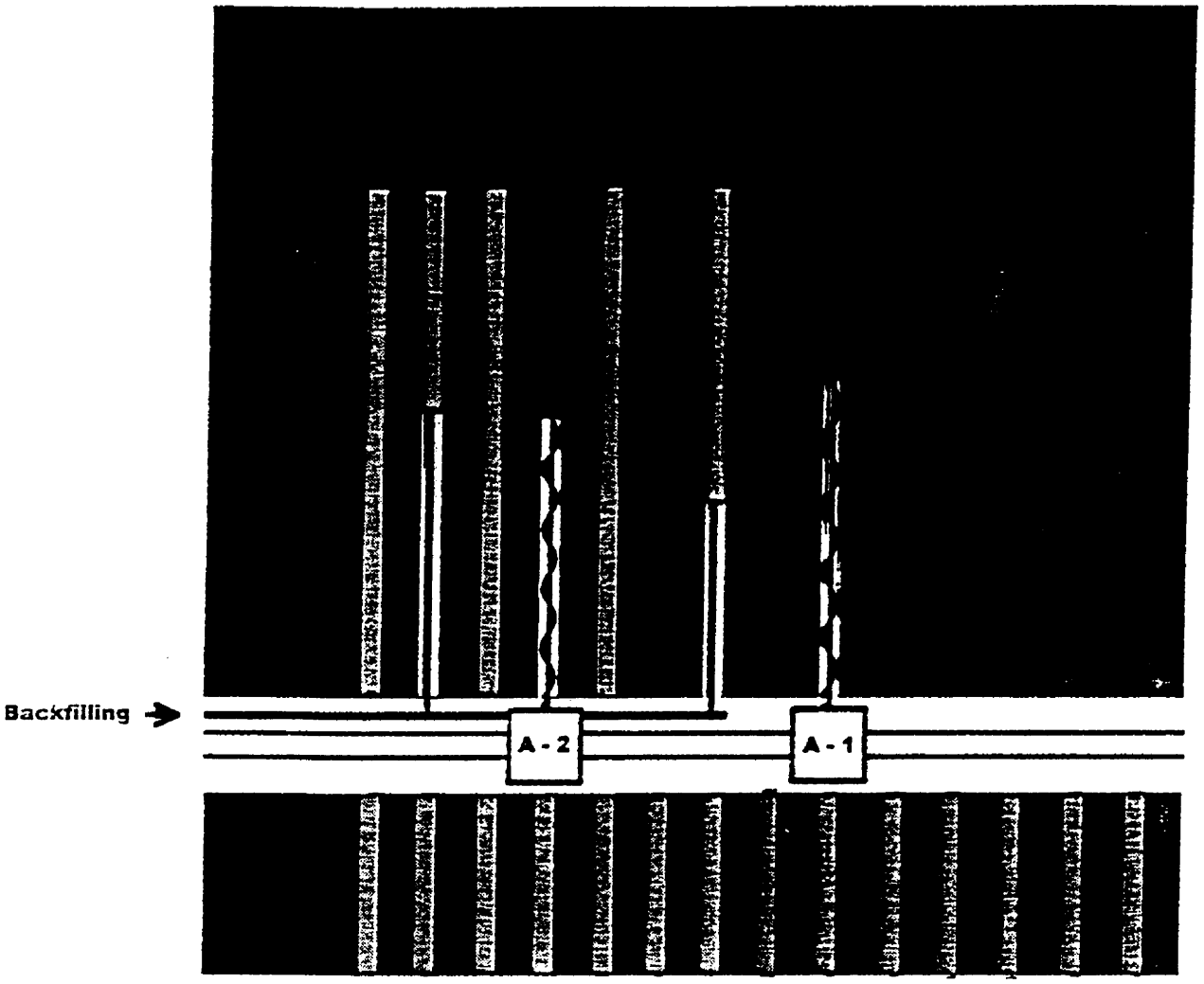
- Southwest Virginia Community College will hold Governor's School program at Education Center.
- Mountain Empire Community College students are currently working with hardwood reforestation and Christmas trees at the Education Center.

Other Initiatives

Coal Reserves: Project submitted by Department of Mining and Minerals Engineering (Chris Haycocks, Mike Karmis) will seek to quantify economically mineable coal reserves remaining in southwest Virginia, southern West Virginia, and eastern Kentucky.

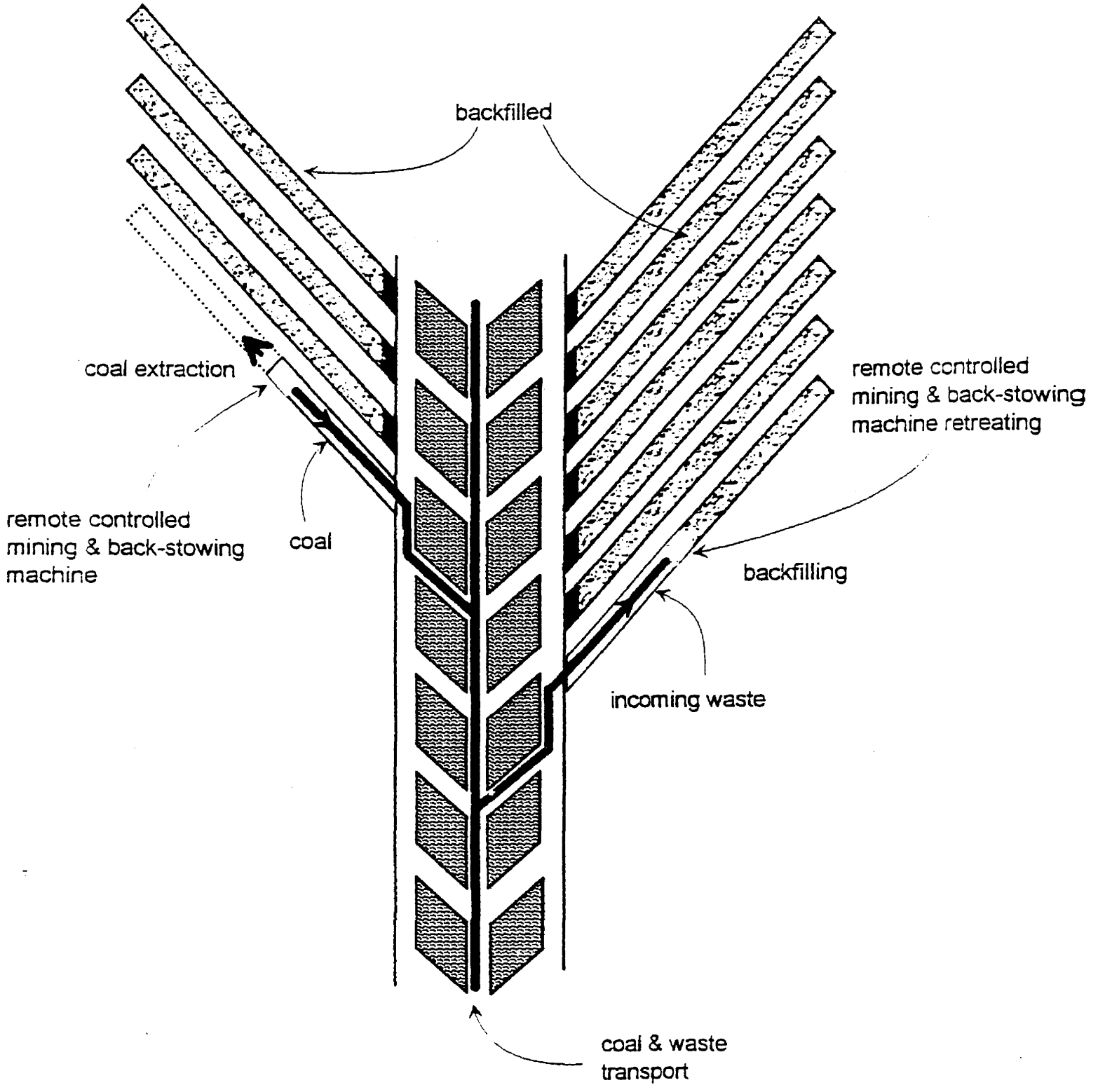
Wetlands: Powell River Project research (Rob Atkinson) documents that presence of wetlands on reclaimed mines greatly increases diversity of wildlife. U.S. OSMRE is presently negotiating with other federal agencies to exempt "voluntarily constructed" wetlands on permitted surface mines from land use restrictions.

Reclamation Guidelines: Cooperative Extension publication series that summarizes practical results of PRP research for use in reclamation practice. Coal refuse reclamation guidelines publication has been completed; mine soil placement, revegetation, wetland construction, mined land development, and fly ash management publications are currently in process.

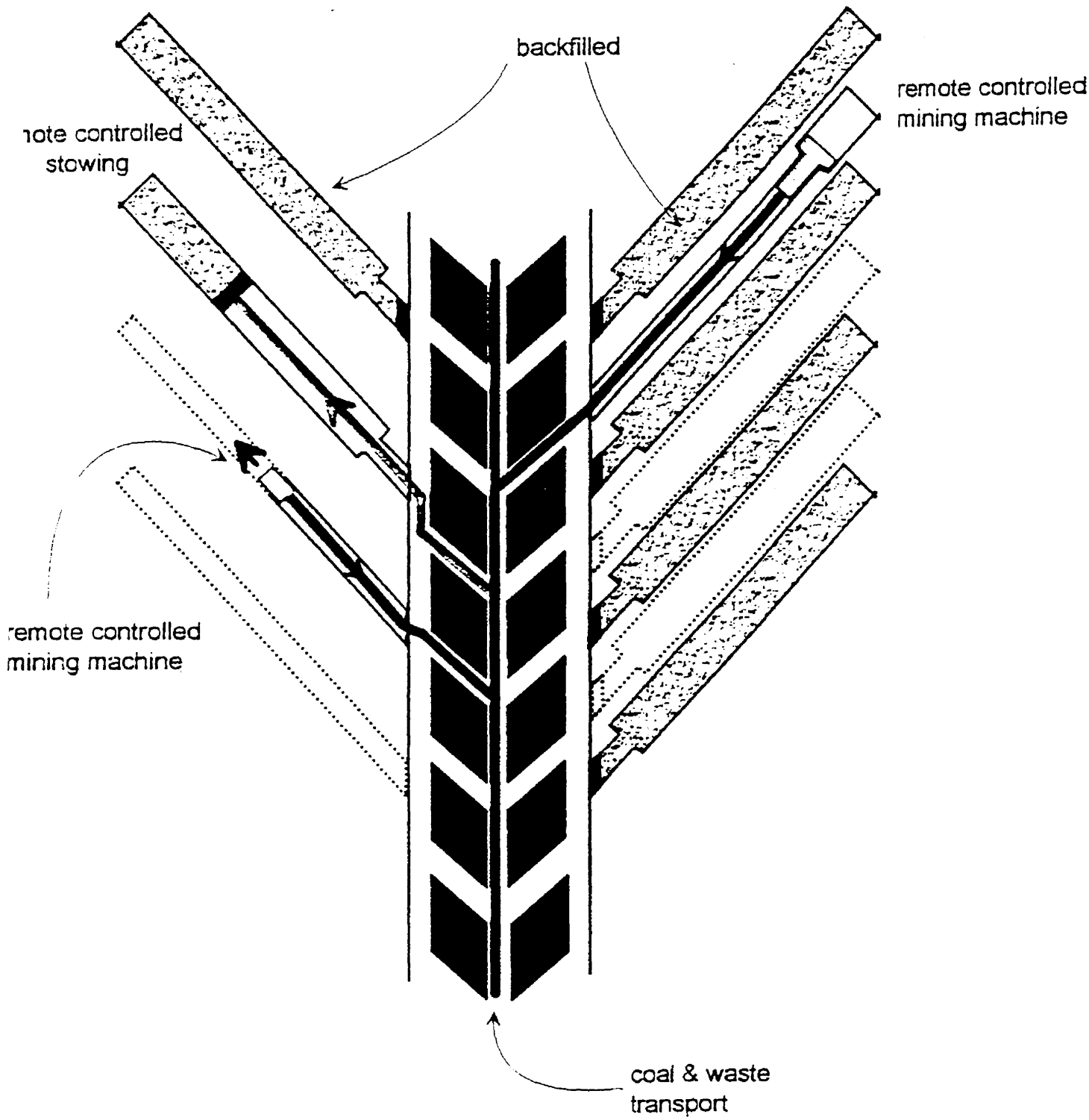


Underground Coal Augering

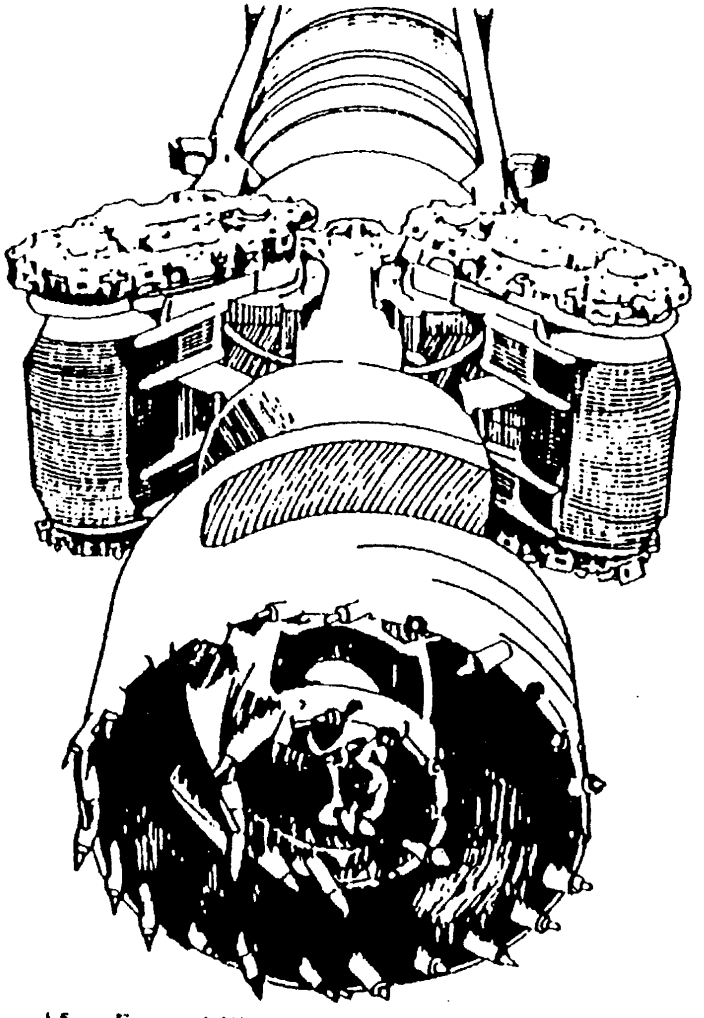
(Modified from Foreman & Shelton, 1974)



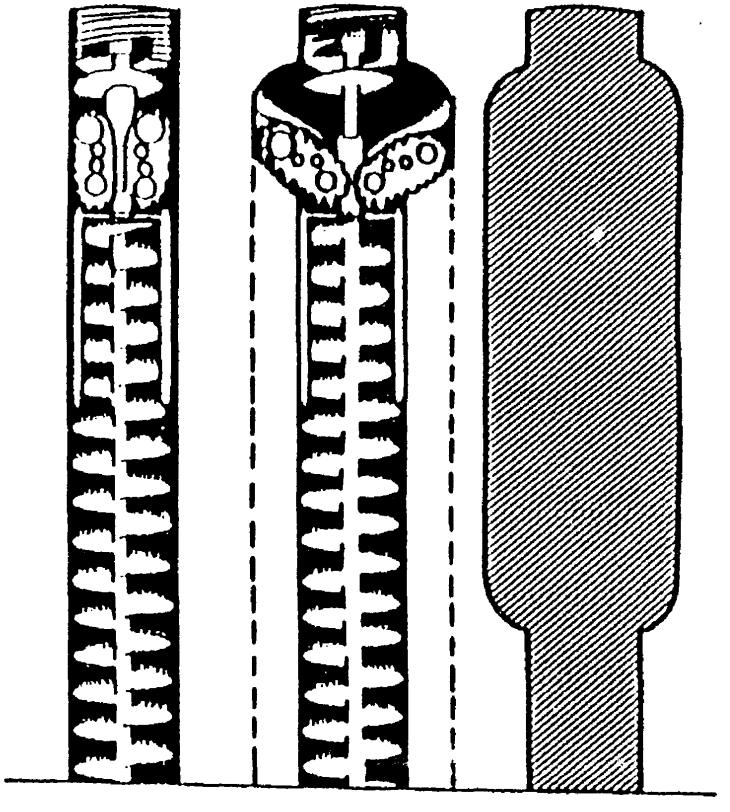
Mining & Back-Stowing by same Machine



Separate Mining & Back-Stowing Operations



15a. Frontal View with Wings Expanded for Retreat Mining



15b. Mining Cycle

Cost Comparisons

Cost Items	24" Auger	U/G H.W.Miner	C.M.(3 ft.)
Capital Cost	2,420,000	2,500,000	2,200,000
Average Investment	1,420,000	1,425,000	1,257,140
Annual Fixed Cost	653,000	585,000	520,000
Annual Op. Cost	463,500	826,000	1,390,000
Total Annual Cost	1,116,500	1,411,000	1,910,000
Production (t/sh)	390	800	600
Annual Production	195,000	400,000	300,000
Production Cost ($/t)	5,73	3,53	6.37

1. All production estimations assume 2 shift/day and 250 day/yr. operation.
2. All cost figures represent the cost of face operations only.
   They do not include the cost of development, ventilation, backfilling, etc.
3. Auger figures modified and updated from Skelly & Loy, 1981. Production is based on an average penetration rate of 10 ft/min.
4. U/G H.W. Miner figures assume 6 ft/min penetration rate.
5. Production of C.M. section is based on CONSIM. (7-men section)

System Integration