SJR

28

STATE OF ALASKA
1989 LEGISLATIVE SESSION

BILL VERSION : SJR 28
PUBLISH DATE : 2/28/89

FISCAL NOTE

REQUEST:

Revision Date: 2/24/89

Title: Relating to oil & gas exploration,development, and production within the Artic National Wildlife refuge.

Sponsor: Uehling,Kelly,Halford,Faiks,Frank,Pearce, Coghill,Fischer,Jones,Zharoff and Rodey

Requestor: Senate Resources

Agency Affected: Natural Resources

BRU: Management and Administration

Components: Commissioners Office

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94
PERSONAL SERVICES						
TRAVEL						
CONTRACTUAL						
SUPPLIES						
EQUIPMENT						
LAND&STRUCTURES						
GRANTS,CLAIMS						
MISCELLANEOUS						
TOTAL OPERATING	0.0	0.0	0.0	0.0	0.0	0.0
CAPITAL						
REVENUE						

FUNDING: (Thousands of Dollars)

GENERAL FUND						
FEDERAL FUNDS						
OTHER						
TOTAL	0.0					

POSITIONS:

FULL-TIME						
PART-TIME						
TEMPORARY						

ANALYSIS: (Attach a separate page if necessary)

Prepared by: Carol Wilson
Phone : 465-2400
Division: Commissioner's Office
Date : 24-Feb-89

Approved by Commissioner: Lennie Gorsuch
Date: 24-Feb-89
Agency: Department of Natural Resources

Distribution (by preparer) :
- Legislative Finance
- Legislative Sponsor
- Requestor
- Office of Management and Budget
- Impacted Agency(ies)

Senator Rick Uehling

Downtown, Elmendorf, Northeast Anchorage

Co-Chairman, Senate Finance Committee
International Trade & Tourism Committee
State Affairs Committee

MEMORANDUM

To: Representative Curt Menard
Representative Cliff Davidson
Co-Chairmen, House Resources Committee

From: Senator Rick Uehling
Co-Chairman, Senate Finance Committee

Subject: SJR 28, relating to oil and gas exploration, development and production within the Arctic National Wildlife Refuge

Date: March 6, 1989

I would appreciate your scheduling SJR 28 for a hearing before the House Resources Committee at the earliest possible time.

Senate Joint Resolution 28 will reaffirm the Alaska Legislature's strong support of President Bush's intention to see ANWR's Coastal Plain opened to oil and gas activity.

Discovery of oil could mean a tremendous boost to the Alaska economy. Even the pre-lease and exploration activity would generate revenue for the state and jobs and economic activity for Alaska workers and businesses.

Dangerously high U.S. oil import levels mandate an aggressive domestic exploration policy. ANWR's Coastal Plain is widely regarded as America's best chance to find very large quantities of crude oil.

The U.S. Department of the Interior conducted one of the most rigorous series of environmental studies on the Coastal Plain and determined that oil and gas activity would not significantly impact the wildlife populations of the area.

I have enclosed backup material for your committee files.

RU/ma

attachments

P.O. BOX V, JUNEAU, AK 99811 (907) 465-4821 • 3111 ST. #515, ANCHORAGE, AK 99503 (907) 561-7613

Attachments:

A. Reference Map of Northern Alaska
(Source: Coastal Plain Resource Assessment)

B. Summary of U.S. Department of the Interior Report and Recommendation to the Congress/Final Environmental Impact Statement

C. Text of Remarks by the President at Anchorage, February 22, 1989

D. Excerpt from President Bush's Address to Congress, February 9, 1989

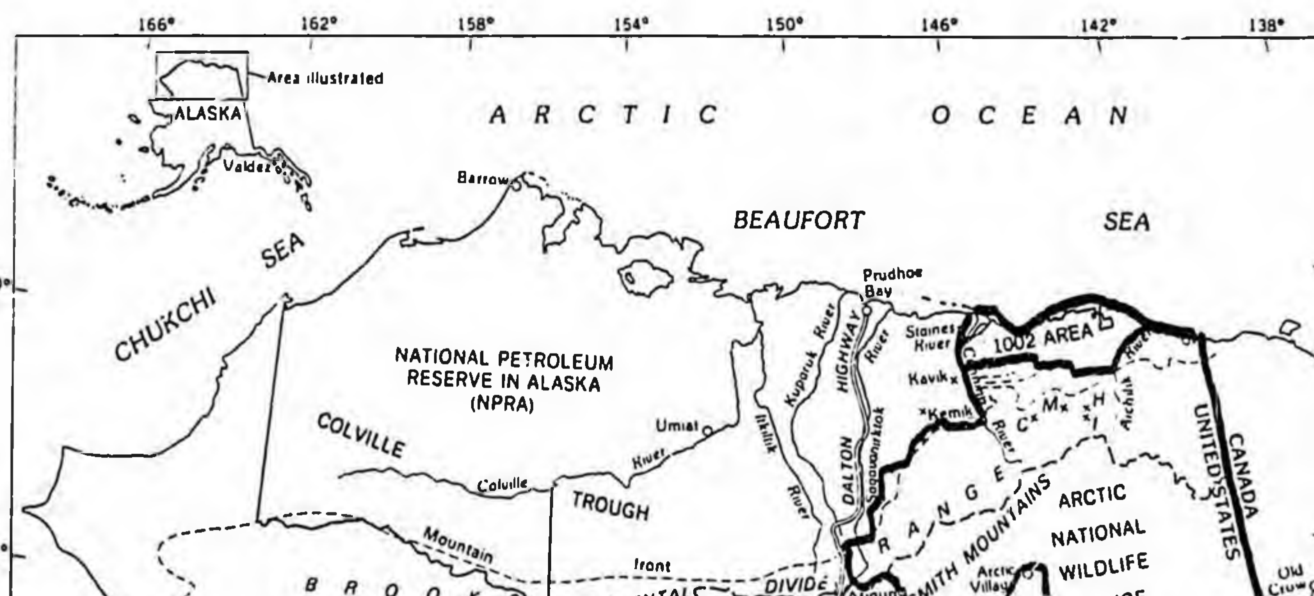

Figure I-1.—Index map of northern Alaska showing location of 1002 area in relation to the Arctic National Wildlife Refuge (Arctic Refuge), the National Petroleum Reserve in Alaska (NPRA), and Prudhoe Bay. Four highest peaks in the Brooks Range: C, Mt. Chamberlin; I, Mt. Isto; H, Mt. Hubley; M, Mt. Michelson.

SUMMARY

ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA, COASTAL PLAIN RESOURCE ASSESSMENT
Report and Recommendation to the Congress/Final Legislative Environmental Impact Statement
APRIL 1987

Prepared by the U.S. Fish and Wildlife Service, in cooperation with the U.S. Geological Survey and the Bureau of Land Management, Department of the Interior, Washington, D.C. 20240.

TYPE OF ACTION

Recommendation for legislative action concerning future management of the 1.5-million-acre coastal plain of the 19-million-acre Arctic National Wildlife Refuge (referred to herein as the "1002 area"), located in northeastern Alaska.

DESCRIPTION OF THE PROPOSED ACTION

The Secretary of the Interior recommends to the Congress of the United States that it enact legislation directing the Secretary to conduct an orderly oil and gas leasing program for the 1002 area at such pace and in such circumstances as he determines will avoid unnecessary adverse effect on the environment.

The 1002 area is the Nation's best single opportunity to increase significantly domestic oil production. It is rated by geologists as the most outstanding petroleum exploration target in the onshore United States. Data from nearby wells in the Prudhoe Bay area and in the Canadian Beaufort Sea and Mackenzie Delta, combined with promising seismic data gathered on the 1002 area, indicate extensions of producing trends and other geologic conditions exceptionally favorable for discovery of one or more supergiant fields (larger than 500 million barrels).

There is a 19-percent chance that economically recoverable oil occurs on the 1002 area. The average of all estimates of conditional economically recoverable oil resources (the "mean") is 3.2 billion barrels. Based on this estimate, 1002 area production by the year 2005 could provide 4 percent of total U.S. demand; provide 8 percent of U.S. production (about 660,000 barrels/day); and reduce imports by nearly 9 percent. This production could provide net national economic benefits of $79.4 billion, including Federal revenues of $38.0 billion.

ENVIRONMENTAL EFFECTS

Potential impacts were assessed for exploration, development drilling, and production. Impacts predicted for exploration and development drilling were minor or negligible on all wildlife resources on the 1002 area. Production of oil is expected to directly affect only 12,650 acres or 0.8 percent of the 1002 area. Consequences on species such as brown bears, snow geese, wolves, moose, and the Central Arctic caribou herd are expected to be negligible, minor, or moderate.

Potential major effects on wildlife from production are limited to the Porcupine caribou herd and reintroduced muskoxen. "Major biological effects" were defined as: "widespread, long-term change in habitat availability or quality which would likely modify natural abundance or distribution of species. Modification will persist at least as long as modifying influences exist."

The Porcupine caribou herd has shown some preference for calving on the 1002 area including the upper Jago River area (84,000 acres or 5.4 percent of the 1002 area). A potential consequence would be displacement of portions of the herd seeking to calve in the upper Jago River area–the case only if the area were the site of a major producing oil field. It is unlikely, though possible, that such displacement would result in any appreciable decline in herd size.

The potential effects of oil and gas activities on the area's muskoxen are unknown, although biologists predict that major effects could be: (1) substantial displacement from currently used habitat and (2) a slowing of the herd's growth rate, as distinguished from a diminution in herd size.

Potential effects on Native subsistence fall into two categories: the village of Kaktovik and villages outside the 1002 area. In the case of Kaktovik, a major restriction of subsistence activities could occur. This would likely result from the physical changes proximate to Kaktovik which could interfere with traditional activities. Subsistence effects on villages outside the 1002 area, including those in Canada, are expected to be minimal.

ALTERNATIVES TO THE PROPOSED ACTION

Alternatives for the Congress that were discussed in the report and legislative environmental impact statement include: (1) Authorize leasing limited to a part of the 1002 area based on environmental considerations (Alternative B); (2) authorize further exploration only, including exploratory drilling (Alternative C); (3) continue current refuge status with no further oil and gas activity allowed (Alternative D); and (4) designate the area as wilderness (Alternative E). For purposes of environmental impact statement analysis, Alternative D is considered the "no action" alternative.

CONTACTS

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Division of Geology and Mineral Resources
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18th and C Streets, NW
Washington, D.C. 20240

Address to Congress

101st Congress
First Session

President George Bush

February 9, 1989 Washington, D.C.

In some cases, the gulfs and oceans off our shores hold the promise of oil and gas reserves which can make our Nation more secure and less dependent on foreign oil. When those with the most promise can be tapped safely, as with much of the Alaska National Wildlife Refuge, we should proceed. But we must use caution and we must respect the environment.

So tonight I am calling for the indefinite postponement of three lease sales which have raised troubling questions--two off the coast of California, and one which could threaten the Everglades in Florida.

Action on those three lease sales will await the conclusions of a special task force set up to measure the potential for environmental damage.

I am directing the Attorney General and the Administrator of the Environmental Protection Agency to use every tool at their disposal to speed and toughen the enforcement of our laws against toxic waste dumpers. I want faster cleanups and tougher enforcement of penalties against polluters.

In addition to caring for our future, we must care for those around us. A decent society shows compassion for the young, the elderly, the vulnerable, and the poor.

Our first obligation is to the most vulnerable—infants, poor mothers, children living in poverty—and my proposed budget recognizes this. I ask for full funding of medicaid—an increase of over $3 billion—and an expansion of the program to include coverage of pregnant women who are near the poverty line.

I believe we should help working families cope with the burden of child care.

Our help should be aimed at those who need it most—low-income families with young children. I support a new child care tax credit that will aim our efforts at exactly those families—without discriminating against mothers who choose to stay at home.

Now, I know there are competing proposals. But remember this: The overwhelming majority of all preschool child care is now provided by relatives and neighbors, churches, and community groups. Families who choose these options should remain eligible for help. Parents should have choice.

And for those children who are unwanted or abused, or whose parents are deceased, we should encourage adoption. I propose to re-enact the tax deduction for adoption expenses, and to double it to $3,000. Let us make it easier for those kids who have parents who love them.

We have a moral contract with our senior citizens. In this budget, Social Security is fully funded, including a full cost-of-living adjustment. We must honor our contract.

We must care about those in "the shadows of life," and I, like many Americans, am deeply troubled by the plight of the homeless. The causes of homelessness are many, the history is long, but the moral imperative to act is clear.

Thanks to the deep well of generosity in this great land, many organizations already contribute. But we in Government cannot stand on the sidelines. In my budget, I ask for greater support for emergency food and shelter, for health services and measures to prevent substance abuse, and for clinics for the mentally ill—and I

A Neighbour's View of ANWR

by William Oppen
Assistant Deputy Minister
Yukon Executive Council Office

The debate over the future status of the Alaska National Wildlife Refuge has been raging since the Secretary of the Interior's recommendation that the entire area be open to oil and gas exploration and development. Some have called this debate the environmental issue of the 1980's for the United States.

It is also an issue that is clearly important to Canada, and particularly to the Yukon Territory. When word of the ANWR proposals reached Yukoners there was an immediate and profound reaction. What was at stake was the future well-being of the Porcupine Caribou Herd; an international resource of great importance both in its own right and as a source of economic and cultural sustenance to our native people.

The Yukon Territorial Government quickly joined forces with the federal government, the government of the Northwest Territories and native groups in order to investigate the proposals and to lobby against them. It became clear early in the effort that the proponents of ANWR development were ignoring the significance of the area to the Porcupine Caribou Herd and that they held little sympathy for the Canadian users of this resource. Furthermore, a technical review of the Interior department's proposals uncovered inaccuracies, unsubstantial conclusions and comparisons of Impacts on other resources that could simply not be made. For example a comparison of the Central Arctic Herd to the Porcupine Caribou Herd ignored the difference in the size of the two herds, ignored differences in critical habitat needs and ignored important differences in migration patterns.

Led by the Yukon government, Canada began to actively challenge the United States proposal to open ANWR to drilling. Representatives of the Yukon Government appeared at hearings in Washington and native groups were invited to Congressional and Senate meetings on the issue. The Canadian Porcupine Caribou Management Committee also lobbied effectively in the United States against the proposal. In November of 1987 the Canadian Government formally responded to the Final Legislative Environmental Impact Statement. In conjunction with these comments a high quality magazine was produced. Titled "The Caribou Are Our Lives", the publication clearly draws the links between the Caribou and the native people of the Northern Yukon. It points out forcefully that the Caribou are not simply an economic resource to our people but in fact represent in many ways their reasons for living.

The Canadian position with respect to ANWR is based upon the lack of knowledge how the caribou of the Porcupine herd will react to extensive development in their critical calving and post calving areas. Displacement of the herd from traditional use areas could result in increased calf mortality which may irreversibly upset the growth balance of the herd. Of equal concern is that the migration patterns of the herd may be drastically altered. A shift in movement patterns of even fifty miles could mean extreme hardship for the people of Old Crow.

Canada's position also reflects an underlying concern with the cumulative effects of North Slope development and how little work has been done in assessing the implications of all the proposed on and offshore developments in the area. One cannot assess the 1002 lands simply on the basis of the onshore proposals. Activity in the Sale 97 and Sale 55 offshore areas will affect the coastal areas of ANWR. Taken together, activity in both onshore and offshore lease areas will have a much broader impact than any one proposal. Canada feels strongly that inadequate attention has been paid to the cumulative assessment of all exploration and development scenarios.

The United States administration's view of Canada's opposition to the ANWR proposal has been one of quiet outrage at times. Some in the United States consider ANWR a domestic issue and that Canada's opposition is grounded in our desire to make Canadian energy resources more attractive to the United States. They point to our own record of oil and gas development in the Arctic and cry foul.

In fact, Canada and the Yukon do not oppose responsible oil and gas development as long as it is done with due regard for critical environmental, socio economic, and cultural values.

The Beaufort Sea will be developed and has the potential to rank as one of the world's largest oil fields. Its development however will be managed under strict environmental and socio-economic conditions which will reflect the interests of the people of Northern Canada.

Already, steps have been taken to protect critical wildlife habitat and environmental features along Canada's north slope. North Yukon National Park, Canada's newest, was recently carved out of the northwest corner of the territory. Abutting the ANWR lands in Alaska, the park provides maximum protection for critical caribou habitat and ensures that no development will take place. Also, Herschel Island, an important biological and environmental feature of significance to the Inuvialuit, was designated as a territorial park.

The rest of the North Slope was included in the Inuvialuit land claims settlement. Development in this area can occur but only under strict conditions and only after an extensive review process.

Arguments that Canada has drilled numerous oil wells in important caribou habitat are fallacious. In the late 1960's and early 1970's a number of wells were drilled in the north central

Yukon. None of these wells was within important caribou range and all were abandoned.

Based on the inaccuracies, lack of data, clouding of the issues and the lack of attention paid to transboundary concerns in the United State's proposals, Canada and the Yukon continue to believe that wilderness designation is the only way to adequately protect the Porcupine Caribou Herd and other transboundary species. To this point we have received no comfort that the herd can be, or will be, protected from the effects of development.

The ANWR debate will continue into the next congress. American opponents to the development will renew their efforts to protect the region and its shared resources. Canada and the Yukon will be there as well. We will continue our efforts to ensure that the Porcupine Caribou Herd, and the people who depend upon it, will be protected. —APAJ

In the next issue we will feature the issues that surround ANWR from an American perspective. The authors will be Norman Gorsuch, Visiting Associate Professor of Law Science and Public Administration and former Attorney General of the State of Alaska, Dr. Vicky Borrego, Assistant Professor of Management and Dr. Al Borrego, Associate Professor of Public Administration.

STEVE COWPER
GOVERNOR

STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

February 24, 1989

The Honorable Sam Cotten
Speaker of the House
Alaska State Legislature
P.O. Box V
Juneau, AK 99811

Dear Mr. Speaker:

Under the authority of art. III, sec. 18, of the Alaska Constitution, I am transmitting a resolution requesting the Secretary of the United States Department of the Interior to prohibit exploratory drilling on the North Aleutian Basin Outer Continental Shelf and to defer any near-term sales, and requesting that Congress prohibit the expenditure of funds for leasing or permitting drilling or other exploration activity in Bristol Bay at this time.

The North Aleutian Basin generally, and Bristol Bay specifically, represent one of the most productive areas in the world for fisheries and other wildlife resources. The United States Department of the Interior's Outer Continental Shelf Lease Sale 92 made certain land in this area available to the oil companies for exploration, even though the area has relatively low hydrocarbon potential and the environmental impact statement for the sale indicated that there could be severe adverse effects on Bristol Bay's fisheries and other resources as a result of oil and gas development. I believe that those resources, and their contribution to the state's economy, simply cannot be put at risk by subjecting the area to oil and gas exploration and development.

Passage of this resolution as an expression of the will of the people of Alaska would provide the Administration with a significant tool in working to safeguard and protect the fisheries and wildlife resources of Bristol Bay and their significant contribution to the Alaskan economy. It is imperative that the people of Alaska, speaking with one voice through the legislature, make clear their opposition to oil and gas exploration and development of the North Aleutian Basin. At the same time, as noted in the resolution, Alaska would remain on record as fully supporting the prudent and orderly development of the state's Outer Continental Shelf oil and gas resources in an environmentally acceptable manner in other areas of the state. I urge your prompt and favorable action on this measure.

Sincerely,

Steve Cowper
Governor

STATE OF ALASKA
1989 LEGISLATIVE SESSION

BILL VERSION: HJR 32
PUBLISH DATE: HOUSE 2/24/89

FISCAL NOTE

REQUEST:

Revision Date:
Title: Oil & Gas Drilling on North Aleutian Basin OCS
Sponsor: Rules Committee
Requestor: Governor

Agency Affected: Office of the Governor
BRU: Office of Management and Budget
Components: Division of Governmental Coordination

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94
PERSONAL SERVICES						
TRAVEL						
CONTRACTUAL						
SUPPLIES						
EQUIPMENT						
LAND & STRUCTURES						
GRANTS, CLAIMS						
MISCELLANEOUS						
TOTAL OPERATING	-0-	-0-	-0-	-0-	-0-	-0-
CAPITAL						
REVENUE						

FUNDING: (Thousands of Dollars)

GENERAL FUND	-0-	-0-	-0-	-0-	-0-	-0-
FEDERAL FUNDS						
OTHER						
TOTAL	-0-	-0-	-0-	-0-	-0-	-0-

POSITIONS:

FULL-TIME	-0-	-0-	-0-	-0-	-0-	-0-
PART-TIME	-0-	-0-	-0-	-0-	-0-	-0-
TEMPORARY	-0-	-0-	-0-	-0-	-0-	-0-

ANALYSIS: (Attach a separate page if necessary)

There is no fiscal impact to the State under this resolution because it requests Congress to act, not the State government.

Prepared by: Robert L. Grogan, Director
Phone: 465-3562
Division: Governmental Coordination
Date: 2/23/89

Approved by Commissioner: [signature]
Date: 2/23/89
Agency: Office of the Governor

Distribution (by preparer):
- Legislative Finance
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- Office of Management and Budget
- Impacted Agency(ies)

NEWS RELEASE

STATE OF ALASKA

OFFICE OF THE GOVERNOR
P.O. BOX A
JUNEAU, ALASKA 99811

STEVE COWPER,
GOVERNOR

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FOR IMMEDIATE RELEASE
March 1, 1989
No. 89-40

COWPER ASKS BUSH FOR BRISTOL BAY OIL DEVELOPMENT DELAY

WASHINGTON, D.C.--Gov. Steve Cowper has asked President George Bush to delay oil exploration in Bristol Bay, at least long enough to study the environmental impacts of an oil spill in the fisheries-rich area.

The Governor this week asked Bush to include Bristol Bay with three upcoming oil lease sales off Florida and California in a federal review of the environmental effects of off-shore oil development.

". . . Since questions of both environmental and ocean resources impacts are at the heart of our concern for Bristol Bay, we respectfully request that consideration of the impacts of exploration in the area of Lease Sale 92, the Northern Aleutian Basin, be added to the scope of the review team," Cowper told Bush in a Monday letter.

"In making this request we are aware that Bristol Bay is distinguishable from the other three OCS areas in that a lease sale already has occurred," Cowper said. "Nevertheless, we believe the economic and biological reasons for postponing exploration, while we answer remaining questions, are as compelling as anywhere else in the country."

-MORE-

At issue is Bush's pledge during a Feb. 9 address to the nation to halt the California and Florida sales. The President appointed a review team to study the sales composed of the National Academy of Sciences, the Office and Management and Budget, the Environmental Protection Agency and the departments of Interior and Energy.

At Cowper's request, a U.S. House budget bill now making its way through Congress includes language to include Bristol Bay in the review. Cowper also is asking Congress not to appropriate money for Bristol Bay exploration this year.

Cowper told the President the risks of a spill in Bristol Bay outweigh the benefits of the relatively small amount of oil believed present there. The yearly value of the Bristol Bay fishery exceeds $1 billion and employs 10,000 people.

The federal Department of Interior has determined the probability of a spill there of at least 1,000 barrels over the life of development at 52-57 percent. At the same time, Bristol Bay ranks 14 of 18 outer continental shelf leasing areas in terms of net economic value.

Cowper joined with his two immediate predecessors in opposing oil development in Bristol Bay, which is the only such sale opposed by the Cowper administration.

The Governor praised Bush's support for development of the Arctic National Wildlife Refuge and said Alaska "fully supports the prudent and orderly development of the state's outer continental shelf in an environmentally acceptable manner.

-MORE-

"In Bristol Bay however, we look for your consideration of deferring exploration in order to protect its exceptional commercial, subsistence and esthetic fish and wildlife values," Cowper said.

-30-

STEVE COWPER
GOVERNOR

STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

February 27, 1989

The Honorable George Bush
The President
The White House
Washington, DC 20500

Mr. President:

Thank you for the opportunity last week, on your stopover in Anchorage, to speak with you on some issues of concern to Alaska. As you know, we are very encouraged with your stance to promote the opening of the Arctic National Wildlife Refuge (ANWR) to responsible oil and gas leasing. The coastal plain of ANWR offers a prospect of substantial oil and gas recovery under adaptable environmental conditions.

On a related issue, I was heartened by your announcement that you have directed Secretary of the Interior Manuel Lujan to set up a task force to examine the environmental impact of proposed outer continental shelf (OCS) lease sales in three areas off the coasts of California and Florida. As you know, Alaska, too, has been seeking to postpone oil and gas exploration in the OCS, off Bristol Bay, an area we believe to be of far greater value for its fish and wildlife than for its hydrocarbon potential.

It is our understanding that administration is in the process of focusing and shap he task force's scope of review, and is evaluating w er it will limit the task force's attention to the t geographic areas highlighted in your speech. Since the p has been expanded to include the Environmental ection Agency and possibly the National Oceanic and Atmos ic Administration, and since questions of both environm l and ocean resources impacts are at the heart of our con for Bristol Bay, we respectfully request that co deration of the impacts of exploration in the area of Le. Sale 92, the Northern Aleutian Basin, be added to the scope of the review team.

In making this request we are aware that Bristol Bay is distinguishable from the other three OCS areas in that a lease sale already has occurred. Nevertheless, we believe the economic and biological reasons for postponing exploration, while we answer remaining questions, are as compelling as anywhere else in the country. As further elaboration on the risks at stake in Bristol Bay, I have enclosed a copy of an issue paper which was provided to your transition team in January.

Alaska remains responsive to the nation's need to decrease its dependence on foreign oil, as evidenced by our efforts to open the coastal plain of ANWR, and fully supports the prudent and orderly development of the state's outer continental shelf in an environmentally acceptable manner. In Bristol Bay, however, we look for your consideration of deferring exploration in order to protect its exceptional commercial, subsistence, and esthetic fish and wildlife values.

Thank you for your consideration of this important matter.

Sincerely,

Steve Cowper
Governor

Enclosure

cc/enc: Richard G. Darman, Office of Management and Budget
James D. Watkins, Department of Energy
Manuel Lujan, Jr., Department of the Interior
Robert A. Mosbacher, Department of Commerce
William K. Reilly, Environmental Protection Agency
The Honorable Ted Stevens
The Honorable Frank Murkowski
The Honorable Don Young
Philip M. Smith, National Academy of Sciences

BRISTOL BAY OIL AND GAS LEASE SALE

ISSUE:

Should the Department of the Interior postpone exploration and development of Oil and Gas Leases in Bristol Bay (Sale 92)?

SUMMARY OF STATE POSITION:

The State of Alaska supports delay of oil and gas exploration in Bristol Bay because of the low hydrocarbon potential and extremely high fish and wildlife values.

BACKGROUND:

With the exception of Sale 92, the State of Alaska has strongly supported the federal OCS leasing program off Alaska. In 1985, the Governor of Alaska recommended to the Secretary of the Interior under Section 19 of the Outer Continental Shelf Lands Act (OCSLA) that Sale 92 be postponed for ten years. The Secretary rejected this recommendation and conducted the lease sale. The courts injoined the Secretary from opening the bids received from the sale. In November, 1988, the Ninth Circuit Court of Appeals lifted the injunction. The Secretary of the Interior opened and awarded the bids soon thereafter. Exploration on some tracts could begin in 1989.
The State is appealing this decision to the Supreme Court.

DISCUSSION OF STATE POSITION:

The State of Alaska supports a postponement of exploration and development in this area because of the 1) the region's unequalled fish and wildlife values, 2) its low oil and gas potential, and 3) the reasonable expectation that risks will be significantly reduced by deferring activities.

Fish and Wildlife Values

° The fisheries of the sale area are among the most prodcutive in the world according to the Sale 92 EIS. First wholesale value can exceed one billion dollars annually and employs 10,000 people.

° According to the National Marine Fisheries Service, Alaska Region the area is the single most important region of the U.S. Outer Continental Shelf for the conservation of marine mammals and endangered species and protection and management of fishery resources.

Oil and Gas Benefits

- The Department of the Interior estimates that the potential economic benefits of the North Aleutain Basin hydrocarbon resources are among the lowest of all the Nation's OCS planning areas.

- In 1985, the Department of the Interior ranked it 14 out of the Nation's 18 OCS planning areas in terms of the net economic value of recoverable hydrocarbon resources.

Risks of Exploration and Development

- 52- 57% probability that one or more spills exceeding 1,000 barrels of oil will occur over the productive life of the leases, according to Sale 92 EIS.

- EIS projects major effects to the red king crab population as well as less serious impacts to tanner crab, salmon, herring and groundfish. We estimate the discounted gross economic loss based on first wholesale values to be approximately 563.6 million dollars.

- The Department of the Interior has found that mechanical recovery of spilled oil at sea becomes ineffective between sea states three and four. In the Sale 92 area, sea states of three or greater occur from 68 to 94 percent of the time.

Deferral will Reduce Risks

- Deferral will enable important environmental information to be obtained.

- Deferral will allow imporvements in open-ocean oilspill cleanup capabilities.

- Deferral will allow the industry to obtain additional operating experience in other less sensitive areas of the Bering Sea.

Bristol Bay
Coastal Resource Service Area
P.O. Box 849, Dillingham, Alaska 99576
(907) 842-2666—842-2667

MAR 1[illegible] 1989

March 8, 1989

Representive George Jacko
Alaska State Legislature
P.O. Box V (MS 3100)
Juneau, Alaska 99811

Dear Representative Jacko:

The Bristol Bay CRSA Board would like to thank you for your efforts to defeat the Kodiak annexation. Although HJR 23 did not pass, it has helped alert other legislators of the need to enact legislative changes to the process for annexation and borough formation in rural Alaska. With all the controversy over political boundaries these last two months, we only recently have had a chance to track other pending legislation important to the region and, therefore, would like to take this opportunity to apprise you of the CRSA Board's views on several key bills.

As you are probably aware, Governor Cowper and Senator Zharoff have introduced joint resolutions to delay any post-lease sale 92 activity in Bristol Bay. The Bristol Bay CRSA Board and the region have consistently advocated a delay of oil and gas exploration and development because of the major data gaps in biological information and the technological deficiencies for containing oil spills in conditions similar to Bristol Bay. In fact, the CRSA Board, among others, were co-plaintiffs in the state's lawsuit to block lease sale 92. We realize it will take a strong message from the legislature to convince the Alaska congressional delegation of the need to support, or at least remain neutral on, Governor Cowper's efforts to lobby congress on the merits of deferring any exploration and development on the North Aleutian Basin. Since there will undoubtedly be some resistence in Juneau to this resolution, we ask that you do everything within your means to ensure it's passage. The CRSA Board also remains committed to helping out with this effort and will do what we can by contacting other state and federal legislators as well as local organizations on this important issue. Enclosed is a copy of a resolution we introduced at the Bristol Bay Tribal Government Conference held last week which I understand was passed unanimously.

A bill that recently was brought to our attention is HB 99 relating to rents and royalties on state owned mining lands. We understand that several amendments have been proposed to HB 99 which may be acted on this week by the House Resources Committee. While mineral development has not been a major development issue in Bristol Bay to date, the region does possess several high potential areas and there has been increased exploration activity around the Iliamna Lake area. In addition, the Bristol Bay Area Plan includes approximately 13 million acres open to mineral entry and the coastal area by Togiak and selected beaches on the Alaska Peninsula identified as high potential areas for offshore mining. For these reasons, the CRSA Board strongly recommends that HB 99 be amended to apply to offshore areas and, most importantly, include reclamation language.

Offshore mining is more than just a potential use of tide and submerged lands which are owned by the state. If the purpose of 6(i) of the Alaska Statehood Act is to ensure the state receives sufficient rents and royalties from mining activities on state lands then it would seem only appropriate to include offshore mining areas within the state's jurisdiction. Additionally, the royalties from mining activities should be based on gross income, similar to that on oil and gas leases, which would provide a more equitable return to the state. In regard to reclamation, the CRSA Board feels it is extremely important that HB 99 address this issue given the significant environmental impacts of mining on water quality and other resource uses. The state's current reclamation program does not provide adequate statutory authority to the ADNR, ADFG and ADEC or the necessary coordination between these resource agencies to ensure sound reclamation practices are required and complied with. Because reclamation is such a complex and controversial issue, at a minimum, we feel HB 99 should mandate the ADNR, ADFG and ADEC to cooperatively develop comprehensive regulations on reclamation and specify a timeframe in which this is to be accomplished.

Your consideration of the CRSA Board's position on HB 99 is appreciated.

Sincerely,

Alice T Ruby

Alice Ruby
Chairperson
Bristol Bay CRSA Board

Encl

SUBMITTED BY: BRISTOL BAY COASTAL RESOURCE SERVICE AREA

Bristol Bay Tribal Government Conference

RESOLUTION NO. 89 - ____

Deferral of Oil and Gas Drilling on the North Aleutian Basin (Bristol Bay)

WHEREAS: The North Aleutian Basin is one of the most biologically productive offshore and nearshore areas in the world; and

WHEREAS: The Bristol Bay salmon run is the largest in the world and thousands of people depend on this fishery for their livelihood, and is an equally important subsistence resource for the region's residents; and

WHEREAS: The hydrocarbon potential in the North Aleutian Basin is relatively low but the risks to the fisheries and other biological resources high given the ineffectiveness of oil spill clean up technology in high sea states such as found in the North Aleutian Basin; and

WHEREAS: The Bristol Bay region has consistently expressed its support for a delay of oil and gas exploration and development to allow for additional biological studies and the time necessary to improve oil spill response technology; and

WHEREAS: Governor Cowper and Senator Zharoff have introduced to the Alaska State Legislature joint resolutions requesting the Department of Interior to defer for a reasonable amount of time any drilling, exploration activity, or other development on the North Aleutian Basin.

NOW THEREFORE BE IT RESOLVED that the Bristol Bay Tribal Government Conference delegates support a deferral of any oil and gas activity in the North Aleutian Basin and request the Alaska State Legislature to act favorably and expediently on the resolutions introduced by Governor Cowper and Senator Zharoff.

SIGNED: ______________________________

Chairperson, Resolutions Committee, Bristol
Bristol Bay Tribal Government Conference

CERTIFICATION:

I hereby certify that the foregoing is a full, true, and correct copy of the resolution adopted by the delegates to the Bristol Bay Tribal Government Conference gathered on February 27, 28, and March 1, 1989 in Dillingham, Alaska.

Resolution 89 - 30 was (unanimously) adopted by a (voice or roll call vote of: Yes ✓ No ____ Abstain ____

SIGNED: ______________________________

Secretary

UNITED FISHERMEN OF ALASKA

211 4th Street, Suite 106
Juneau, AK 99801
907-586-2820

To: Members of the House Resources Committee

You have before you House Joint Resolution Number 32 for consideration.

United Fishermen of Alaska supports both this resolution and Senate Joint Resolution Number 11.

The UFA Board of Directors has expressed unanimous opposition many times in the past to drilling in the Bristol Bay area. The fisheries resource there is one of the largest in the world, including Pacific salmon of all species, several species of crab, herring, halibut, and many other groundfish species. These are renewable resources and UFA is extremely concerned that they might be jeopardized to extract a non-renewable resource.

The extreme problems encountered in attempting to clean up an oil spill in Cook Inlet two summers ago indicated clearly to us the potential disaster that could occur should a similar spill happen in Bristol Bay. The environmental conditions in the Bay are far rougher than those in the Inlet. Adequate containment and clean-up of a spill in the Bay is simply not possible.

We sympathize with President Reagan's and President Bush's desire to reduce the dependency of the United States on foreign oil. But we believe a sense of perspective must be maintained.

Apparently President Bush agrees, because he has established a task force to examine three proposed lease sales (two in California and one in Florida) for their potential for causing environmental damage.

Governor Cowper has requested Lease Sale 92 be added to the task force's agenda, delaying the drilling until more information on its impacts can be obtained. UFA heartily supports this effort.

We urge the [illegible]ure to pass a statement supporting the delay or termination of the drilling, and we ask that you do so as quickly as possible. It is our understanding that such a statement of support would greatly increase our chances of favorable action by Congress and President Bush.

If I can provide further comments or assistance, please don't hesitate to let me know.

Kate Graham
Executive Director

UNITED FISHERMEN OF ALASKA

Cass M. Parsons
Executive Director

UNITED FISHERMEN OF ALASKA

RESOLUTION 85-3

WHEREAS the United Fishermen of Alaska is an organization representing individual fishermen as well as 17 member fisheries organizations; and

WHEREAS the UFA is vitally concerned with the use, protection and enhancement of Alaska's fisheries resources and their habitat; and

WHEREAS the Federal government has proposed leasing the Outer Continental Shelf in the area known as the North Aleutian Basin; and

WHEREAS the fisheries resources of the Bristol Bay region and North Aleutian Basin are a renewable resource of extraordinary value to the local fishermen, the State of Alaska, and the United States; and

WHEREAS the UFA has had a long standing concern with protecting the fisheries resources in this region, and has expressed particular concern over the effects which oil and gas development will have on these fisheries; and

WHEREAS the economic value of the fishery will, over the long term, greatly exceed the value of the projected oil reserves in the lease area, and therefore must receive maximum protection; and

WHEREAS both the UFA and the State of Alaska have identified several significant information needs relating to fisheries, marine mammals, birds and oilspill trajectory analyses; and

WHEREAS the UFA believes that this information needs to be addressed prior to any consideration of offshore oil and gas leasing in this region in order for all parties to fully and fairly evaluate the impacts of petroleum exploration and development on the important resources of the region.

NOW THEREFORE BE IT RESOLVED that the United Fishermen of Alaska, supports a 10 year delay in any offshore oil and gas leasing in the North Aleutian Basin; and

BE IT FURTHER RESOLVED that the United Fishermen of Alaska believe that this delay should be used to, among other things, provide time to:

1) further develop offshore petroleum drilling and transportation technologies that will ensure safe operations; and

2) ensure that oilspill containment and clean-up technologies are further developed, tested and refined so that oilspill clean-up operations will be effective under the weather and oceanographic conditions found in the region; and

3) allow time for sufficient scientific studies to address the important scientific questions which have been identified by the state and by the UFA; and

BE IT FURTHER RESOLVED that the United Fishermen of Alaska encourages the State of Alaska, and the Alaska Congressional Delegation to work with all parties and to use all of the powers available to them to ensure that the proposed OCS lease sale No. 92 in the North Aleutian Basin is deferred.

Cass M. Parsons
UFA Executive Director

2/19/85
Date

Robert M. Blake
UFA President

2/19/85
Date

Draft EPA report cites Prudhoe Bay damage

By PHILIP SHABECOFF
THE NEW YORK TIMES

WASHINGTON – Improper and careless management of chemical and oil wastes on Alaska's North Slope are seriously damaging the delicate tundra environment there, according to an unpublished draft report by the Environmental Protection Agency.

The report documents acres of tundra blackened by chemical spills, oil wastes seeping from drilling pads, stacks of leaking chemical drums, a mine flooded by a diverted river, overflowing waste disposal pits, failure to comply with federal regulations governing the handling of hazardous materials and other threats to the arctic environment by oil industry and service company operations in the Prudhoe Bay area.

Environmentalists who have seen the draft report said it strongly supported their contention that oil operations should be prohibited on the coastal plain of the Arctic National Wildlife Refuge, just to the east of the Prudhoe Bay fields.

Congress is likely to decide this year whether to allow oil development within the refuge or to add the land to the National Wilderness System, which would protect it from any development. In the Reagan administration the Interior Department recommended full development of the coastal plain.

Joseph A. Lastelic, a spokesman for the American Petroleum Institute, a major oil industry trade group, said the institute would comment in detail when it had studied the report.

But he added, "Based on 20 years of petroleum operations on the North Slope of Alaska, exploration and production waste practices meet or exceed government regulations and sound environmental guidance."

The oil industry has called the coastal plain the country's most promising area for a major new oil strike. Current estimates say that there is one chance in five of making such a strike in the refuge but that if there is a find it could produce as much as 3.2 billion barrels of oil.

The refuge's coastal plain is the breeding ground for North America's largest remaining herd of migratory caribou as well as the habitat of polar bears, musk oxen, wolves, arctic foxes and a rich variety of waterfowl and fish.

"This report makes me very nervous about what would happen if the oil industry were allowed into the Arctic Wildlife Refuge," said Ann Strickland, deputy general counsel to the National Audubon Society who is a former enforcement attorney for the Environmental Protection Agen-

Please turn to EPA, Page 12

IER

Mostly fair on Tuesday. Highs in the mid-

EPA...

Continued from Page 1

cy.

Lisa Speer, an expert on oil development effects on the environment for the Natural Resources Defense Council, a national environmental group, said, "The report and other recent information indicate that oil development would transform this spectacular and fragile wildlife refuge into a massive industrial complex."

On Friday, Congress' Office of Technology Assessment issued a report saying that if the oil operations were permitted in the arctic refuge, development there would resemble what has occurred in the Prudhoe Bay area, with extensive road and pipeline networks, gravel pads, airfields and docks "and other facilities in the middle of a land with few signs of man's presence."

The report, a copy of which was given to the The New York Times, says the state of Alaska, which has responsibility for regulating waste management on the North Slope, does not have enough authority or resources to enforce anti-pollution laws properly.

It notes that the state cannot halt drilling or impose fines when it finds violations without first going through long and costly legal procedures, which it largely avoids.

The EPA report was prepared by agency officials who toured a sampling of sites on the North Slope in the fall of 1987 and again last summer.

Sylvia Lowrance, director of the EPA office of solid waste, said the report was a staff draft that had not yet been reviewed by senior managers. She said that she could not comment on its contents.

Among the violations and evidence of environmental damage in the report were:

- At a facility operated by Dowell-Schlumberger, a major oilfield service company, the study found hundreds of gallons of spilled materials, leaking drums and "significant amounts of an unidentified thick white liquid substance were observed flowing off the pad into the tundra." The wastes gave off a "strong chemical odor." Around the site were "60 acres of dead contaminated tundra."
- A waste disposal facility operated jointly by ARCO Alaska and the Standard Alaska Production Co. appears not to be containing a variety of wastes properly. Cracks were found in a waste pit lining and oil stains were found around the site. Wastes injected into the ground at this and other sites may be turning the Prudhoe Bay field "sour" from high concentrations of hydrogen sulfide.
- ARCO is failing to handle wastes from a small refinery it operates on the North Slope even though the law requires that refinery wastes be carefully controlled as potentially hazardous.
- Oil-based wastes were improperly disposed of in an unlined pit at a Standard drill site and piles of contaminated snow were dumped onto the tundra. Oil wastes seeped from another Standard drill pad.

William A. Webb, manager of member services for the Alliance, an association of 250 companies in Alaska that supply or otherwise benefit from the oil industry on the North Slope, including Dowell-Schlumberger, said he had seen a draft of the EPA report and found it "very slanted."

Jim Yeager, manager of environmental services for ARCO Alaska, said he had not seen the report and could not comment on its contents. He said, however, that "it is certainly company policy" to comply with environmental regulations. A spokesman for Standard Alaska Production Co. said he could not comment without seeing the report.

Massive aggregates of Porcupine Caribou.

PORCUPINE CARIBOU

ALASKA YUKON N.W.T.

MANAGEMENT BOARD

R.R. #1, Site 20, Comp. 116, Whitehorse
Yukon Territory Y1A 4Z6, CANADA

Bull caribou in Ox Bow Lake, near the Crow River. Front, Porcupine Caribou calf. (D. Klein)

THE CARIBOU

The CARIBOU

Porcupine Caribou are deer that have become highly adapted to survive in harsh arctic and sub-arctic environments. The Porcupine Herd takes its name from the legendary Porcupine River which features so greatly in the lives of these caribou and the people who depend on them.

fact The Porcupine Herd consists of aproximately 100,000 adults and a varying number of calves, depending on the time of year. In the fall, about half the herd is made up of cows, one-quarter bulls and the remainder are juveniles.

fact Porcupine caribou calves are preyed upon by golden eagles, grizzlies and wolves, while adults are mainly preyed upon by wolves and to some extent by grizzlies.

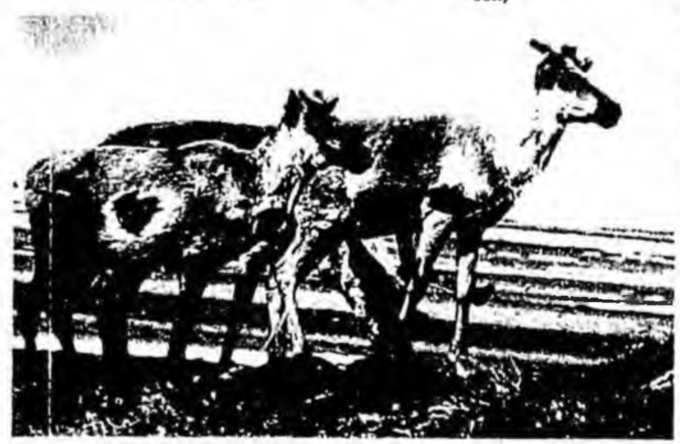
fact Porcupine caribou are hunted on the coast in summer by Inuit and inland the rest of the year by Inuit, Loucheux and non-natives.

fact Porcupine caribou were disturbed by intensive hunting on the Dempster Highway and likely would react negatively to certain oil exploration and development activities.

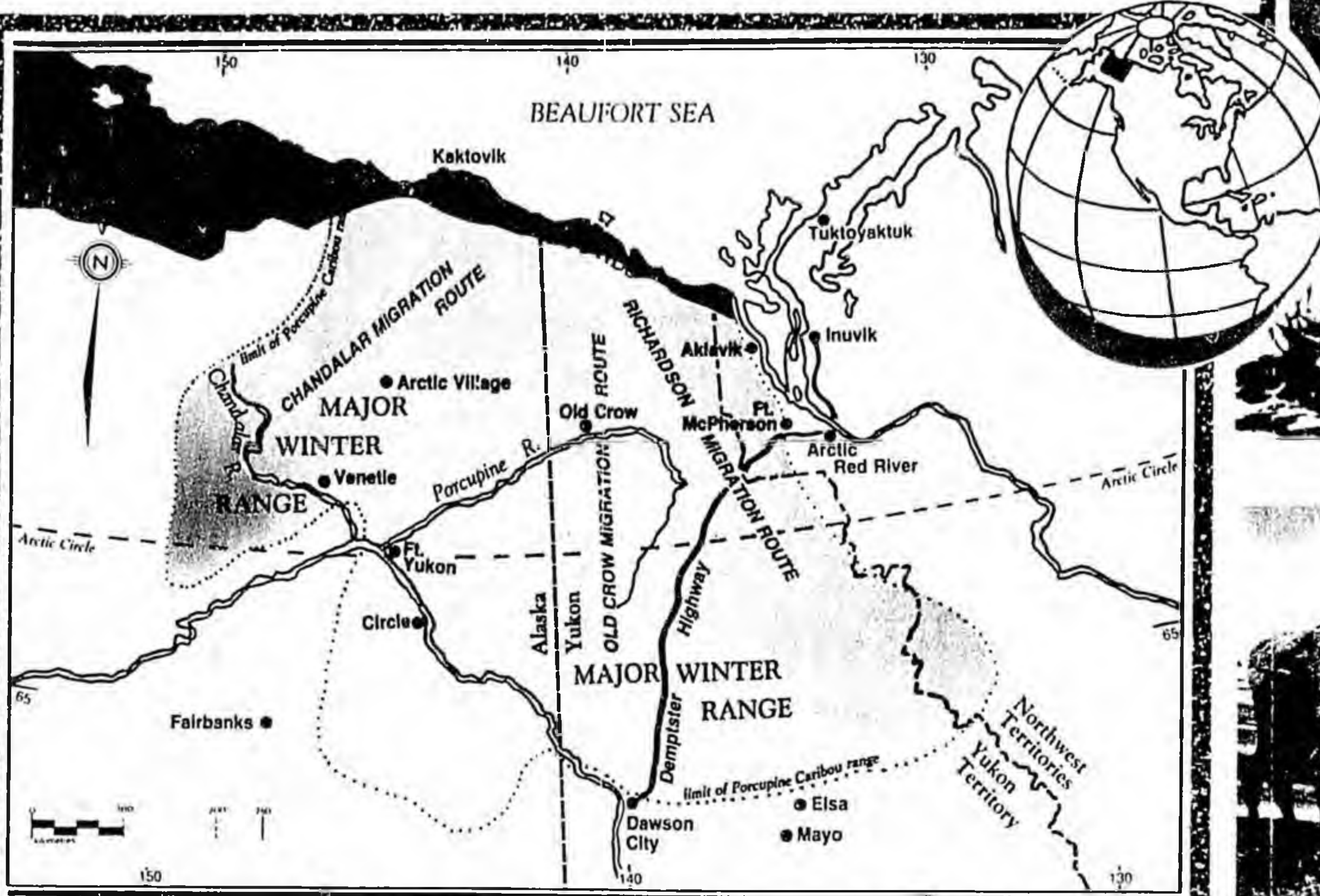
fact There is no historical evidence of any major population changes of the Porcupine Herd in this century. Over the past few years, the population appears to be growing slowly.

Above, newborn caribou calf. (D. Russell)

Left, caribou crossing the Yukon River near Dawson, 1926. (Yukon Archives)



Below, caribou on the North Slope. (D. Russell)



Alaska Environmental Lobby, Inc.

P.O. Box 22151 Juneau, Alaska 99802 907-586-2345

AEL ISSUE PAPER: SJR 28 - DEVELOPMENT OF THE ARCTIC NATIONAL WILDLIFE REFUGE

Though we appreciate the sponsor's restraint in limiting this bill to urging oil and gas exploration, rather than spending our limited state dollars on lobbying Congress, we still must oppose opening the Arctic National Wildlife Refuge to development.

The benefits to the state are uncertain:

* The U.S. Geological Survey 1002 Area report on the Arctic Coastal Plain projects only a 19% chance of finding economically recoverable oil, at a price of $33 per barrel.

* Even if oil is found there, current indications are that the state will receive only a meager royalty share of ten percent, perhaps less.

* The North Slope oil industry's recent labor record indicates that good jobs at fair wages for Alaskans are by no means assured.

* Should we we continue to chase after the next boom, and its inevitable bust, or should we turn our efforts now to developing a truly sustainable Alaskan economy and way of life?

The benefits to the nation are equally unclear:

* A recent paper published by the Southwest Energy Council (comprised of legislators from eight key energy-producing states, including Alaska) emphasizes the need for conservation and for active research into alternative energy sources. The report states that domestic oil and gas currently supplies about half our total U.S. consumption. Projections for the next twenty years forecast that even with a hypothetical 3.2 billion barrel output from the Arctic Refuge, domestic supplies will still meet only one third of our energy needs.

* The same report estimates that the fuel-efficiency of automobiles could be improved by 35%, and that a 40 mile-per-gallon Corporate Average Fuel Efficiency would save an amount of energy approximately double the potential oil and gas production of the Arctic Refuge.

* Other sources make an even stronger case for the economics, environmental soundness, and social benefits of conservation.

* Should a country which has no national energy policy at all, which has slashed research funding for energy alternatives, which has dropped the efficiency standards for new vehicles,and which has raised its fuel-conserving speed limit feel justified in raiding its last sizable piece of Arctic wilderness, just to prolong its dependence on resources we clearly realize we must wean ourselves from anyhow?

March 16, 1989
Bill Glude

A few additional notes from
Dr. Rosenfeld's 3-89 talk to
the Alaska Environmental Assembly
- by Bill Glude, AEL -

- compact fluorescent lights:
  - better ballasts, 15% more efficient
  - no flicker; fuller spectrum
  - an 18w bulb = 75w incandescent
  - lasts 13x as long
  - overall cost 1/3 as much
  - available from Phillips, GE, & others
  - fit "normal" lamps
- better windows:
  - current AK energy output ≈ window loss from the USA
  - coating (heat mirror) can produce R11 equality
  - In Colorado, incoming daytime radiation on N wall in winter has been measured as exceeding nighttime heat loss!
  - "You can learn to get along without huge quantities of oil; you just have to redesign your windows!"
- refrigerators - USA
  - 1950 efficiency took 15 "powerplants" (for 9 cubic foot refrig.)
  - 1973 efficiency took 45 "powerplants" (for 18 cubic foot)
  - 1993 will be back to 15 "powerplants" (for 20 cubic foot)
  - low-emissivity glass insulation technology, borrowed from windows, can also fit in with present-day technology, at affordable cost - can produce R30/inch, versus R7/inch for foam
  - CFC use - currently 1lb/refrigerator is in foam; 1/2 lb is in compressor; glass insulation would eliminate CFC insulation, & Du Pont already has a non-CFC fluid that is within 5% of CFC efficiency
- the above technologies save as much energy per year as Alaska produces

(OVER)

- Since 1973, US-GNP has grown steadily; energy use has remained constant
- International strategy:
  - "1 OPEC" ≈ 28 million bbl/day/year
  - US could save ½ OPEC; Europe 1 OPEC over 13 years with existing technology
  - If not, it will be ≈ 5 years to where OPEC once again controls 80% of production – & controls market
- Suggested solution:
  - keep energy use constant
  - raise GNP 2½%/yr (avg for western world over last 10–15)
  - raise energy efficiency ≈ 2½%/yr
    - practical?: auto technology currently can give us 40 years; planes likewise; refrigerators too; lighting already good for 40 years; windows already good for 20 years – all @ 2½% improvement/year
    - Volvo already has a crashworthy car ("safest on the road") which will do 85 mpg at competitive cost
    - estimated $12/car per 1% mpg increase; or cost of $200–250 to save "1 Alaska" (AK production, year)
    - Renault/Citroen now has a car which can do an actual 145 mpg @ 60–70 mph
  - energy efficiency = economic efficiency; one reason why the Japanese are doing so well

Recipe #1

Low-E Window Technology

Step 1: Invest $8 million in a low-E coating system.
Step 2: Coat 20 million square feet of windows per year for the 10 year nominal life of the coating system.
Step 3: Accumulate energy savings over the 20 year life of the window.

Step 4: RESULT: Savings of 36 million barrels of oil equivalent!

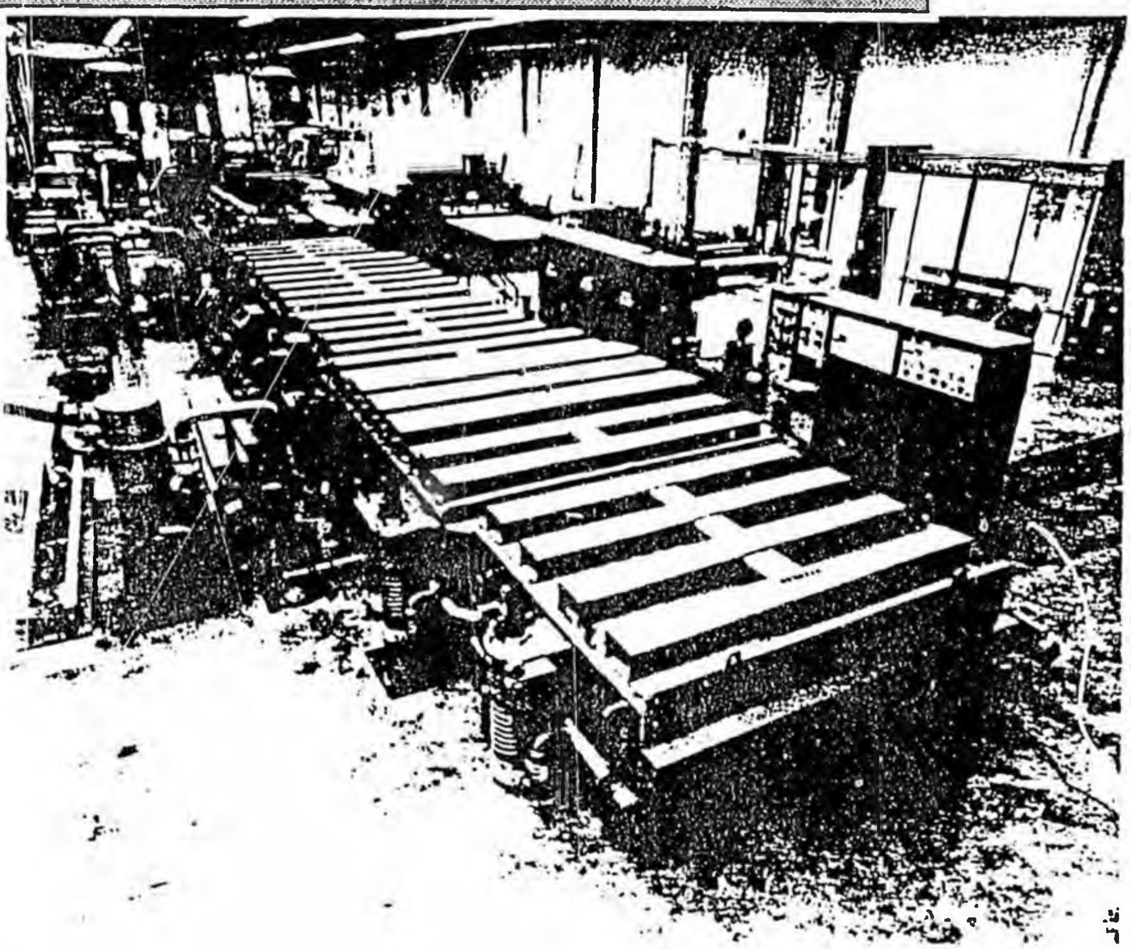


Figure 1

Glass coaters such as this high-rate sputtering system can coat large sheets of glass with sophisticated multilayer coatings for control of heat and light in buildings.
Photo courtesy of Airco Solar Products, Concord, CA.

Conservation Research Note May 1988

from the Center for Building Science / Lawrence Berkeley Laboratory

New Energy Supply Technology for the 21st Century

High Tech Window Coatings "Supply" Energy Services

Buildings account for over one third of all U.S. energy consumption. Energy policy has emphasized the development of new secure energy supply options such as off-shore oil. But advanced building technology that effectively reduces the need for current consumption can also be viewed as a supply option.

Consider the following two choices for "supplying" $1 billion of energy services:

Low-E Window Technology

Heat loss from windows is responsible for about 4% of total U.S. energy consumption, or the equivalent of 1.4 million barrels of oil per day. Transparent low emissivity (low-E) coatings provide one third reductions in window heat loss.

This industrial low-E coater (See *Recipe 1*) can coat over 20 million square feet of glass for windows each year. Savings accumulate rapidly since each window continues to save energy over its entire lifetime, at least 20 years.

Offshore Oil Wells

Oil under the continental shelf is a secure, but environmentally fragile, costly and depletable supply option. (See *Recipe 2*).

The Economics of Payback Times

Thirty-six million barrels of oil equivalent saved by low-E is worth more than $1 billion of home heating oil, natural gas, or electric resistance heat.

The simplest economic measures of energy efficiency investments are **simple payback time**, or **cost of conserved energy.**

Low-E glass adds about $2.00 per square foot cost to a new window, but pays back **this investment in 2 to 6 years** depending upon climate and energy costs. Coated glass cost may be reduced in the future, thereby further shortening the payback. The **cost of energy conserved** by a low-E window is 40 cents per therm of gas (current price, 60 cents per therm) or 54 cents per gallon of home heating oil (current price, 80 cents per gallon), or 2 cents per kilowatt for electric resistance heat (current price, 7.5 cents per kilowatt).

These energy conservation strategies are good investments for consumers, help strengthen U.S. industry and reduce our dependence on foreign oil.

For more information about **low-E windows,** contact your local building materials supplier, window manufacturer, or architect/builder.

For more information on the economics of energy conservation or other research notes in this series, contact:

American Council for an Energy-Efficient Economy
1001 Connecticut Avenue NW, Suite 535
Washington, DC 20036
(202) 429-8873

Recipe #2

Offshore Oil Wells

Step 1: Invest $300 million in a 10 well offshore oil platform, producing 10,000 barrels per day.
Step 2: Pump oil for the 10 year nominal life of the oil field (don't spill a drop).

Step 3: RESULT: Supply of 36 million barrels of oil!

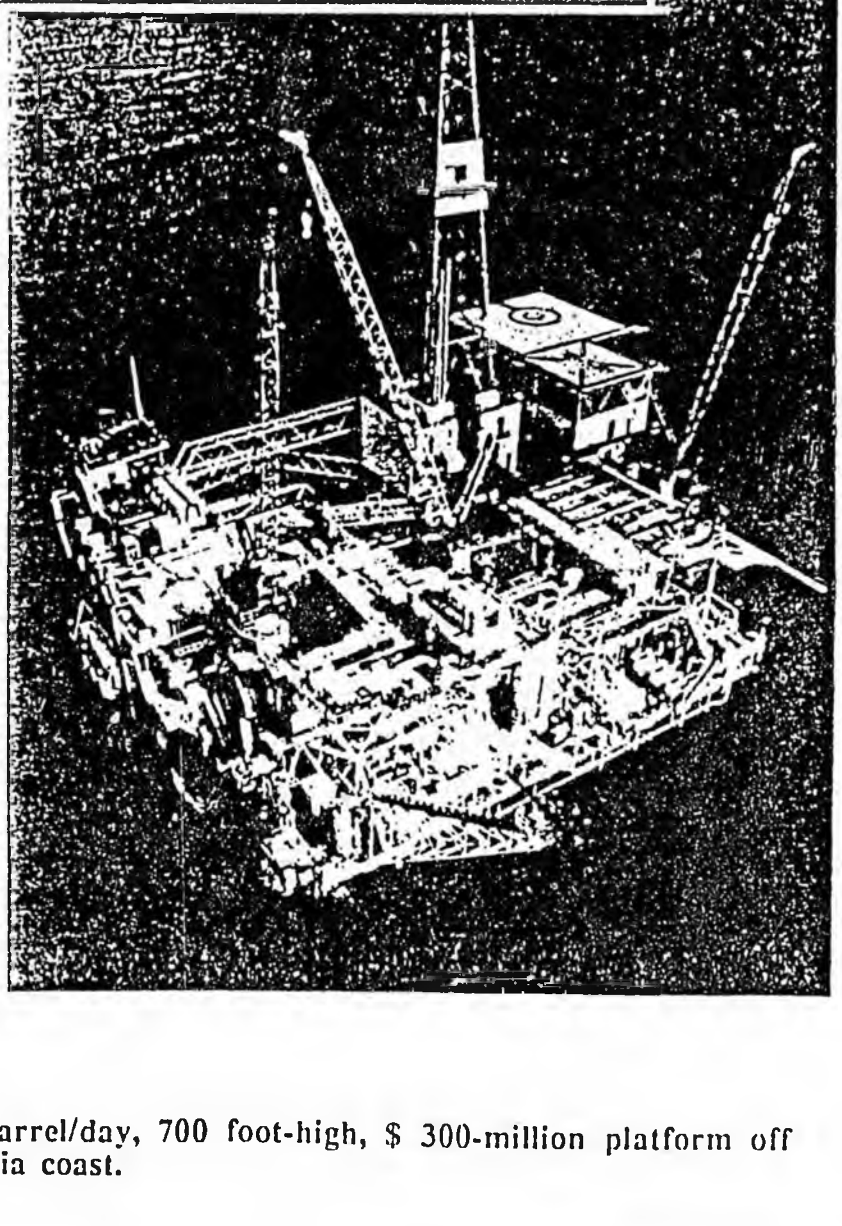


Figure 2

An oil company's 10,000 barrel/day, 700 foot-high, $ 300-million platform off the Santa Barbara, California coast.

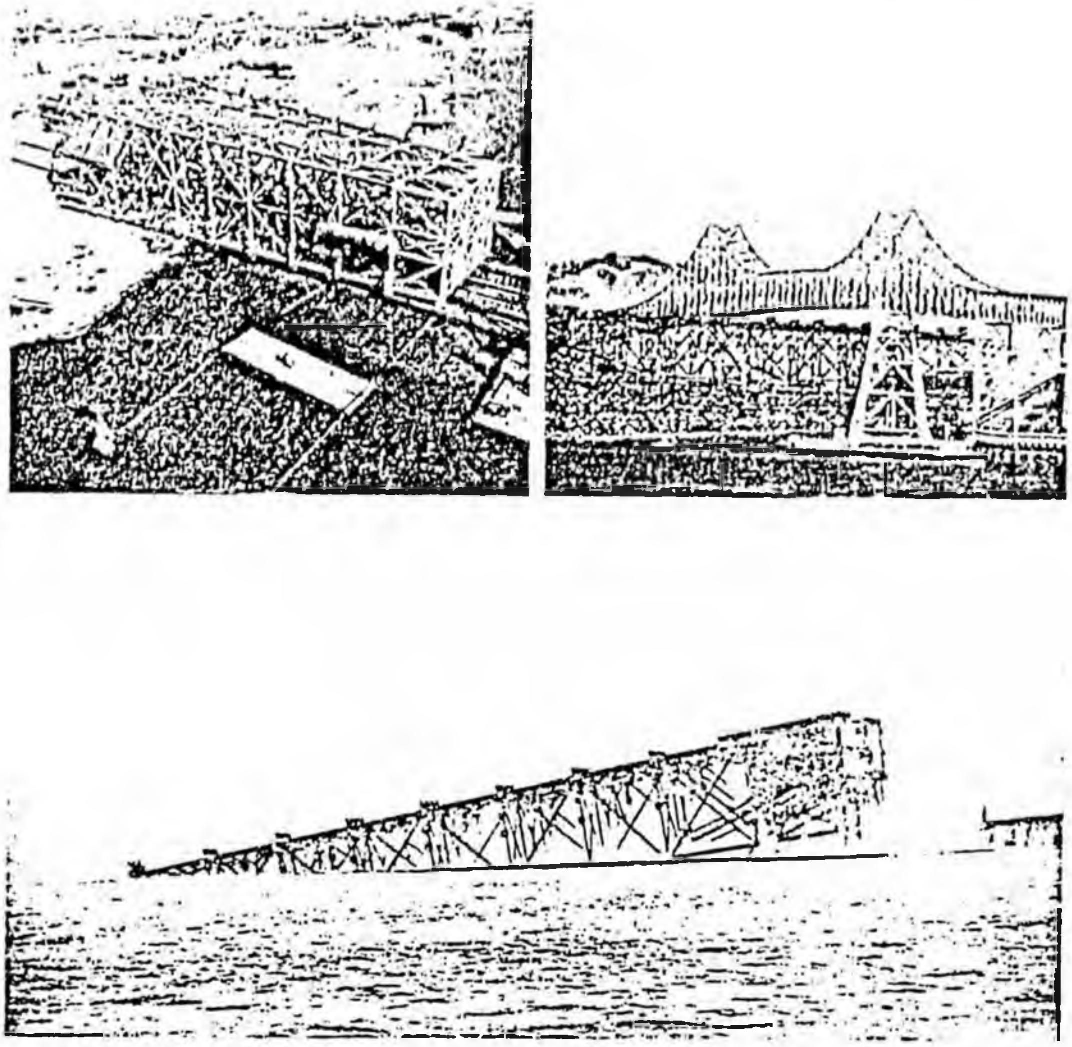


Figure 3

Recalling a Fastastic Voyage

With a length of over two football fields, Shell Oil Company's Eureka Oil Platform was placed on its side for a voyage in 1984 to a site off the Santa Barbara Coast on the California Outer Continental Shelf. In order that it pass under the Carquinez Strait Bridges, spanning the Sacramento River as it enters San Francisco Bay, the engineers had to time the platform's departure to correspond with the lowest tide, allowing it to safely clear the bridge's roadbed.

The completely outfitted 38,000 ton Eureka platform was lowered into 700 feet of water. A 24 inch diameter hole has been drilled to a depth of 200 feet below the ocean floor, directly below the platform. From this central hole, 60 off-angle wells (conductors) have been drilled to form a grid of holes that enter the oil reservoir.

Selected Energy-efficient Technologies: Current Savings and Predicted Savings at Saturation.

	Solid-state ballasts	Compact Fluorescents (PL-9)[a]	Windows Low-E[b]	Refrigerators[c] 1987 California Title 10
• Life	35,000 hr	10,000 hr	30 yr	20 yr
• Cost Premium	$12	~0	0-$1.00/$ft^2$	$100
• Lifetime Savings per unit				
$	$100	$40	$10/$ft^2$	$1600
Energy	1000 kWh	400 kWh	1.5 M Btu/ft^2	16,000 kWh
Coal	1000 lb	400 lb	52 lb Carbon/ft^2	8 tons
• Savings from 1988 U.S. Sales				
1988 U.S. Sales	2 M	8 M	200 M ft^2	6 M
$	$200 M	$300 M	$2 B	$10 B
Coal (tons = T)	1 MT	1.5 MT	5 MT Carbon	50 MT
Baseload Plants (5 Bkwh/yr)	0.4	0.6	-	20
Oil platforms (10,000 bod)	1	1.5	15	50
• Savings at Saturation				
Units in Place (1988)	600 M	~800 M	15 B ft^2	125 M
Annual $	$6 B	$6 B	$6 B	$10 B
Coal	30 MT	30 MT	20 MT Carbon	50 MT
Power Plants (1000 MW)	12	12	-	20
Oil Platforms (10,000 bod)	30	30	50	50

[a]One PL-9 replaces a series of thirteen 50W incandescents.

[b]Comparison assumes an overall weighted average improvement of 0.25 Btu/ft^2-hr-°F, 6000 heating degree days, and furnace efficiency of 70%.

[c]Comparison based on 1987 California Title-24 Standards vs. 1977 models.

Source: Geller, H, Harris, J., Levine, M., Rosenfeld, A., "The Role of Federal Research and Development in Advancing Energy Efficiency: A $50 Billion Contribution to the U.S. Economy", *Annual Review of Energy*, 12:357-395, 1987.

Some Conversions: One Baseload gas- (or oil-) fired 1000 MW power plant consumes the equivalent output of 2.7 offshore oil platforms (10,000 bod/platform). Mendocino plus Humbolt Leases call for 10-20 platforms. The Alaska National Wildlife Refuge could yield 30 equivalent oil platforms.

PROPOSED ENERGY POLICY

1. Improve efficiency 3.5% each year for the next 20-40 years

This doubles efficiency every 20 years.

2. Promote our new efficient products in both the industrial world and the 3rd world.

If industrial GNP's continue to grow 2.5%/yr, we'll reduce fossil fuel use about 1%/year (halving time 70 years). That might keep WORLD fossil fuel consumption growth down to 1%/year.

Energy Conservation Policies for the US and OECD

1. Change National Policy

Encourage Least Cost Energy Services. Level the supply-demand playing field [10-year payback for supply *vs.* 2-3 year for demand].

Stop opposing auto and appliance standards with 3-year payback.

Stop cutting R&D budgets and consumer information.

Extend the time horizon for capital gains taxes.

2. Redefine Utility Profits To Make Least Cost Energy Services More Attractive Than Just Selling Energy

3. Buildings (State and National)

Sliding Scale hookup fee/rebate. $1000/kW, revenue neutral.

4. Autos (State and National)

Slowly raise gasoline tax to $1/gal.

Immediately introduce a new car efficiency fee/rebate; $200/mpg, revenue neutral.

5. CO_2 pollution rights, with rebate (State or National)

1-2¢/lb of carbon = 1-2¢/kWh generated from coal, ½-1¢/kWh generated from natural gas. No fees or rebates cross state lines, so no threat to coal-use states; merely encourages efficiency and reduces fossil fuel use.

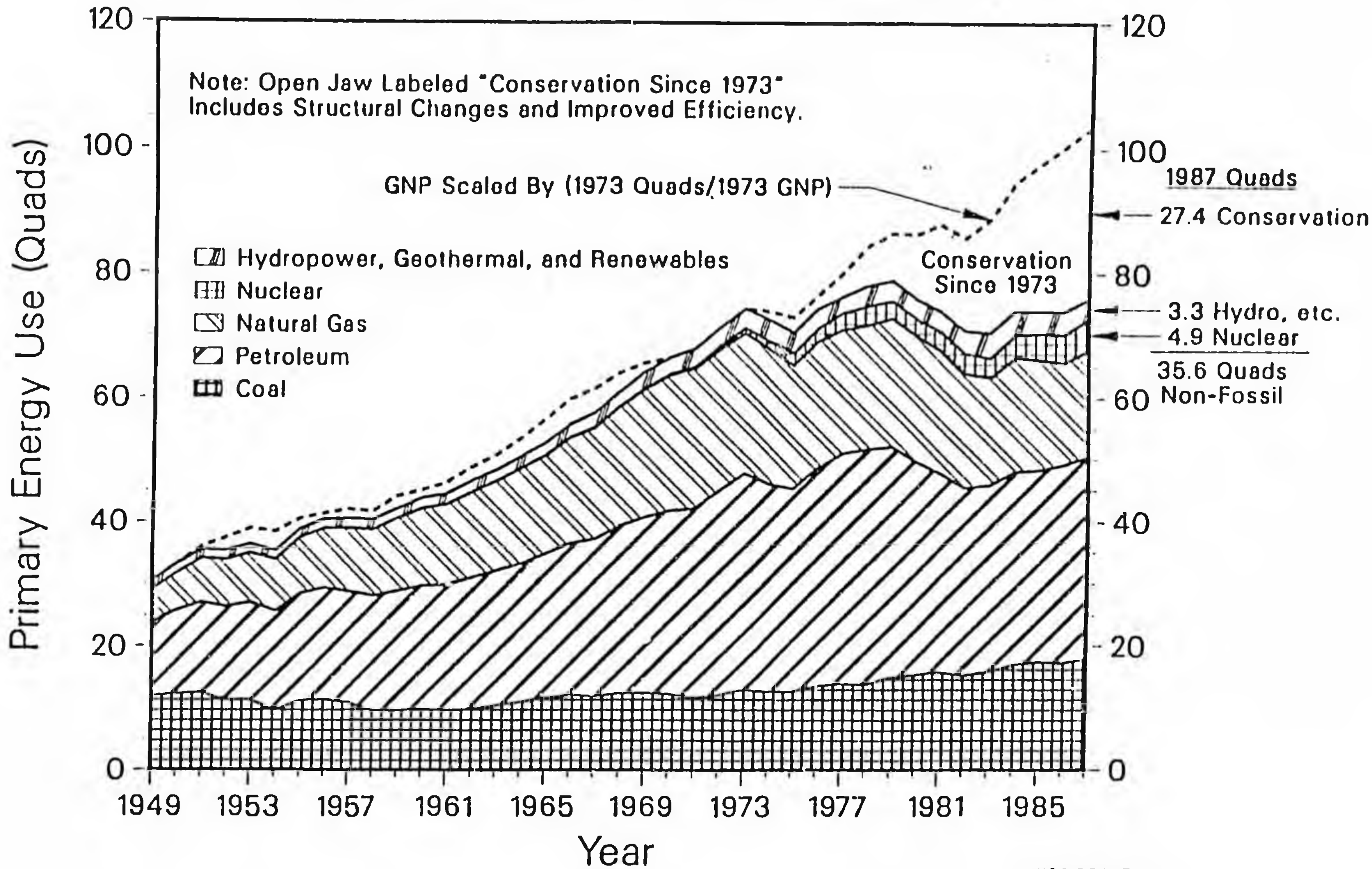
Charge fee per pound burned, rebate per customer. Fees to be determined by a pollution rights market or auction with a goal to reduce CO_2 by 1%/year.

5a. SO_x and Other Pollution Rights -

Same machinery but cut SO_x faster.

Source: A. Rosenfeld, R. Mowris, and J. Koomey, "Energy Efficiency and Least Cost Planning," Comments for the California Energy Commission, August 17, 1988.

U.S. Primary Energy Use: Actual vs. Predicted by GNP



XCG 884-RJM
4/30/88

Source: *Economic Report of the President*, Council of Economic Advisors, January 1988, and *Annual Energy Review 1987*, EIA

DRAFT

ENERGY EFFICIENCY AND LEAST-COST PLANNING POLICY PROPOSALS ABRIDGED FROM A LONGER COMMENTARY

A. Rosenfeld, R. Mowris, and J. Koomey

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Applied Science Division
Lawrence Berkeley Laboratory
University of California
Berkeley, CA 94720
(415) 486-4834

Comments prepared for the
California Energy Commission
Conservation Programs Committee
Commissioners Richard Bilas and Robert Mussetter
Public Hearing on the Draft 1988 Conservation Report
Sacramento, CA, July 12, 1988.

Revised
August 17, 1988

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THE FOLLOWING FIVE policy proposals have been extracted from a larger paper presented to the California Energy Commission in July 1988. All five proposals could be adopted nationally or by individual states, and are aimed at improving energy efficiency, increasing U.S. competitiveness, and reducing pollution.

The first four proposals are designed to remedy a wide-spread market failure: the drastic difference in time horizons between consumers who are interested in energy services and investors who are interested in energy supply. The time horizon for consumers is usually 3 years or less while the time horizon for investors is often 10 years or more. Other examples:

- Surveys of builders always show that they will invest in efficiency (insulation windows, lighting, air conditioning, etc.) only for a paback of 2-3 years.
- The 1986 appliance standards were negotiated on the basis of a 3-year payback.
- The 1988 fluorescent ballast amendment to the appliance standards was negotiated on the basis of a 1.5-year payback for efficient-magnetic ballasts, even though the solid-state ballast saves two-and-a-half times more energy and has a 3-year payback.

Proposals 1 and 2 are designed to level the investment playing field in a wholesale fashion by encouraging utilities to provide energy services at the least cost. Proposal 3 is designed to remedy the 2-3 year time horizons of builders by requiring sliding-scale hook-up fees and rebates for new residential and commercial buildings so as to include in those buildings the marginal cost to society of providing new power. Proposal 4 is designed to reduce air pollution and traffic congestion, by implementing both a gas tax and a revenue-neutral mpg fee/rebate program that would encourage new car buyers to purchase more fuel-efficient cars.

The fifth proposal, a CO_2 tax to help curb global warming, will create a politically viable economic playing field where none now exists—by attaching a price of about 2¢/lb. of fossil carbon burned (about 2 ¢ for each kWh generated from coal). This may seem politically naive, but we craft it as a revenue-neutral fee/rebate scheme, implemented by each state individually, with no interstate transfer of funds. This might be politically acceptable.

FIVE POLICY SUGGESTIONS FOR LEAST-COST ENERGY SERVICES PLUS CO_2 ABATEMENT

1. A Premium Rate of Return for Utilities Who Offer the Lowest Cost Energy Services

The fastest way to improve the efficiency of buildings is to have utilities offer financial incentives to retrofit existing ones and incorporate energy-efficient design features in new ones. But in many states utilities earn a return only on their supply-side investments; "demand-side" investments beyond the customer's meter are simply expensed. At a minimum we should permit utilities to add their demand-side investments to their "rate base" and earn the usual rate of return on them. Many states permit this "rate basing" and Washington even adds a 2% premium to the rate of return on conservation investments. Some New England states are now considering a similar premium.

We favor any incentive, such as a large premium on investments for conservation, but are now convinced by our experience with urban trees and by Maine Commissioner David Moskovitz (Moskovitz 1988), that a mere premium is inadequate, and will always fail to interest a utility in the cheapest (and hence most desirable) conservation measures. A premium on investment, rather than on the *results* of the investment is in fact the same mistake made by the U.S., and many states, in the late 1970s when the U.S. government rewarded solar energy investments rather than energy savings. That was a disaster that we don't want to repeat in the utility field.

David Moskovitz has suggested that a utility's rate of return be tied to relative improvements in average bills (for residential customers) and in electricity use per square foot of floor space (for commercial customers). He further proposes that a base period be established for average bills for a given utility, and an index comprised of the average bills of all of the utilities in the region of the country that the utility is located. On a periodic basis the entire rate of return for utilities would be adjusted up or down (with a cap of plus or minus 2%, e.g. 12% ± 2% per year) depending on the relative performance of the average customer bills compared to the index. The system focuses on relative changes in customer bills and assures that 2¢ conservation will be preferred to 3¢ supply because the cheaper option has a greater effect on lowering customer bills. The system is oriented towards "bottom-line" economics that are easy to measure, compare, and understand. There is no need to measure the cost or actual performance of conservation or other demand-side management efforts since all program savings and costs will show up in the average customer bills. Even such a novel and cheap energy-saving idea as planting urban trees (discussed below) would be cost-effective *and* profitable for a utility to pursue under Moskovitz's regulatory plan.

Example: Incentives for Planting Urban Trees

At Lawrence Berkeley Laboratory, we now believe that planting urban trees is the cheapest way to save kilowatts of air conditioning power. Put very simply the recipe is: pay $15 to $75 to plant and water 3 trees around a house, wait 10 years for the trees to grow, and then save about 1 or 2 kW of peak power and about 750 to 2000 kWh/year in air conditioning energy per house (Akbari *et al.* 1988). Table 4 compares the cost of saving a kWh of electricity and a pound of carbon (as CO_2) for urban trees and several other familiar strategies such as efficient electric appliances and efficient cars. From the table it is clear that urban trees are the most cost-effective measure—about 10 times cheaper than nuclear power.

But if urban tree planting is the cheapest way to reduce peak-power demand, why aren't conservation-minded utilities marketing this option? The answer seems to be partly psychology and partly history. Before energy conservation was a concern, utility managers were primarily interested in building big power plants. Now that they recognize the importance of energy conservation in reducing peak power demand, they are still looking for hardware solutions such as thermal storage and efficient appliances. And although these conservation measures are cost effective, they are still 2 to 10 times more expensive than planting urban trees. In order to get utility managers to consider urban trees as a viable cost-effective conservation measure that can *really* reduce peak-power demand, we must change the profit rules (as discussed above) so that utilities earn directly from saving energy through improved efficiency and conservation.

2. All-source Bidding

PURPA, the Public Utility Regulatory Policies Act of 1978, requires that utilities permit independent power producers to compete with the construction of utility power plants. An exciting new idea being tried in New England is to call also for competitive bidding from energy service companies to retrofit existing buildings and improve the efficiency of new ones. The first trial auctions have produced remarkable bids: around 1¢/kWh and $300/kW for lighting retrofits in Massachusetts (Hicks 1988).

Table 4. Cost effectiveness, energy savings, and carbon savings of urban trees/light surfaces, efficient electric appliances, and efficient cars (Akbari 1988).

Measure	CCE[1] (¢/kWh)	Payback Time (yr)	CCC[1] (¢/lb C)	Implemented Fraction[1] (%)	ΔUEC[1] by 2000	ΔE (Quad/yr)	ΔC (M Tons/yr)	Cost of Program ($B)
Urban Trees/ Light Surfaces[2]	0.2-1.0	0.3-1.8	0.25-1.25	50	24%	0.55	18	0.5-2.5
Efficient Electric Appliances[3]	2	3	2.5	100	17%	.6	21	10
Effic ent Cars[4]	50¢/gal	2.5	8.3	100%	38%	2.8	60	50
Coal Power[5]	8	10	Base Case	—	—	—	—	—
Nuclear Power[5]	11	?	4	10% of Coal	—	—	60	84

1. a) CCE is Cost of Conserved Energy, CCC is Cost of Conserved Carbon, and UEC is Unit Energy Consumption.
   b) Cost of Program is the nation-wide cost for implementing the measure.
2. **Urban Trees/Light Surfaces**
   a) We assumed 100 M trees cost $5-25 each (including water for 2 years) for a total cost of $B 0.5-2.5, a real interest rate of 7%, 3 seedlings planted per air conditioned house, and a growth period of 10 years to yield adequate shade.
   b) In calculating CCC, we assumed that electricity is produced from coal-fired power plants at 1 kWh = 11,600 Btu = ~ 0.8 lb of carbon.
   c) ΔUEC for air conditioning is direct + indirect effects of urban trees/white surfaces for both residential and commercial sectors.
3. **Appliances** (Source: Geller 1987, based on the 1987 NAECA)
4. **Cars** (Source: Ross 1987)
   a) The CCE for improving the fleet efficiency of cars from 26 to 36 mpg is estimated to be 50¢/gal.
   b) The CCC assumes 6 lb of carbon in a gallon of gasoline.
   c) Today, at 18.6 mpg, we use 6.63 Mbod of transportation gasoline. The 26 mpg standard will reduce this 6.63 to 4.75 Mbod. Further gain from 26 to 36 mpg will reduce 4.75 to 3.42, saving 1.33 Mbod, corresponding to 2.8 Quads.
   e) Program cost is based on 125 million cars and light trucks at an additional cost of $400 each.
5. **Coal Power and Nuclear Power** (Source: Delene 1988)
   a) This is *not* the CCE, but is the cost of coal or nuclear power delivered to the customer. The U.S. median cost for a new coal plant is 4.7 ± 0.7 ¢/kWh, and the U.S. median cost for a pressurized-water nuclear reactor is 7.7 ¢/kwh (this doesn't include decommissioning costs or the very uncertain physical, environmental, and economic risks). Add 3-4 ¢/kWh to both of the above costs for transmission and distribution.
   b) The CCC assumes nuclear replaces a retiring coal plant yielding a difference of 3 ¢/kWh. At 0.8 lb/kWh of carbon from coal, the nuclear option translates to a CCC of 4 ¢/lb C.
   c) Assuming nuclear replaces 10% of coal-fired plants as they are retired, translates to about 30 baseload plants (30 GW). The current U.S. median cost for nuclear plants is $2800/kW in 1986 dollars.

3. Sliding-scale Fees and Rebates for New Buildings: ~ $1000/kW

Yet another way to build efficiency into new residential and commercial buildings is through sliding-scale hook-up fees and rebates. This proposal would involve setting target energy consumption and peak demand values for new buildings. Buildings that use more than the target values would be charged a fee of about $1000/kW, and buildings that use less would receive a rebate. The revenue from the fees would be used to pay for the rebates. The target would be adjusted annually to keep the account revenue neutral. Some part of the fees collected could be allocated to cover administration costs for the utility or state agency running the program, and some portion could be shared with the utility as a reward for promoting conservation. Such a symmetrical fee/rebate scheme may also be used to encourage efficiency in appliances and automobiles, or used in emissions control (as described below).

Sliding-scale fees and rebates for new buildings are now under consideration by the Massachusetts legislature (1988: House Bills 5308 and 5309), and is the subject of testimony before the Wisconsin Public Service Commission (August 1988). For details, consult Koomey and Rosenfeld (1988).

4. Automobiles: Gasoline Tax and MPG Fee/Rebate: ~ $200/mpg

In the last few years many national leaders and policy makers have proposed some combination of a gasoline tax or an oil import tax. However, the proposals were never acted upon because the administration and many Americans are opposed to new taxes. They are scared of losing jobs and believe that an additional gasoline tax would be inflationary. Meanwhile, with lower gasoline prices and no government energy policy, automobile fuel efficiency has almost become a dead issue. The administration recently rolled back the Corporate Average Fuel Economy (CAFE) standards from 27.5 mpg to 26 mpg and oil imports are once again increasing, thus advancing the day when OPEC can again raise prices.

As discussed above, California has historically taken the lead in implementing progressive energy efficiency programs that were later adopted by the federal government. The time is right for California to once again take the lead and consider a serious and effective energy policy that includes a gasoline tax and a mile-per-gallon fee/rebate program. The fee/rebate program will reduce air pollution by motivating new car buyers to purchase more fuel-efficient cars. The gasoline tax will not only reduce air pollution but also congestion by motivating people to drive less and by providing additional tax money for improving and adding to mass transportation systems around the state.

Figure 3 compares the costs of conserved gasoline with the prices of gasoline in various countries, and highlights the fact that almost all of our trading partners have a gasoline tax of from $1 to $3 per gallon. These countries also have much higher average automobile fleet efficiencies of about 25 mpg compared to 18 mpg for the United States. The current fleet efficiency of *new* U.S. automobiles is 26 mpg compared to 30 mpg for new cars produced in Europe and Japan. The U.S. could improve average fleet efficiency from 26 to 35 mpg at a cost of about 50¢/gallon conserved by reducing vehicle weight, improving engine efficiency, reducing aerodynamic drag and tire rolling resistance, and improving the efficiency of accessories. We could further improve fuel economy to 45 mpg at a cost of 80¢/gallon by enhancing the previously mentioned items and adding continuously variable transmissions (Ross 1987).

Since short-term gasoline price elasticities are small, and manufacturers need at least 5 years to switch over to more fuel-efficient cars, we suggest a $1.00 per gallon tax phased in at 10¢

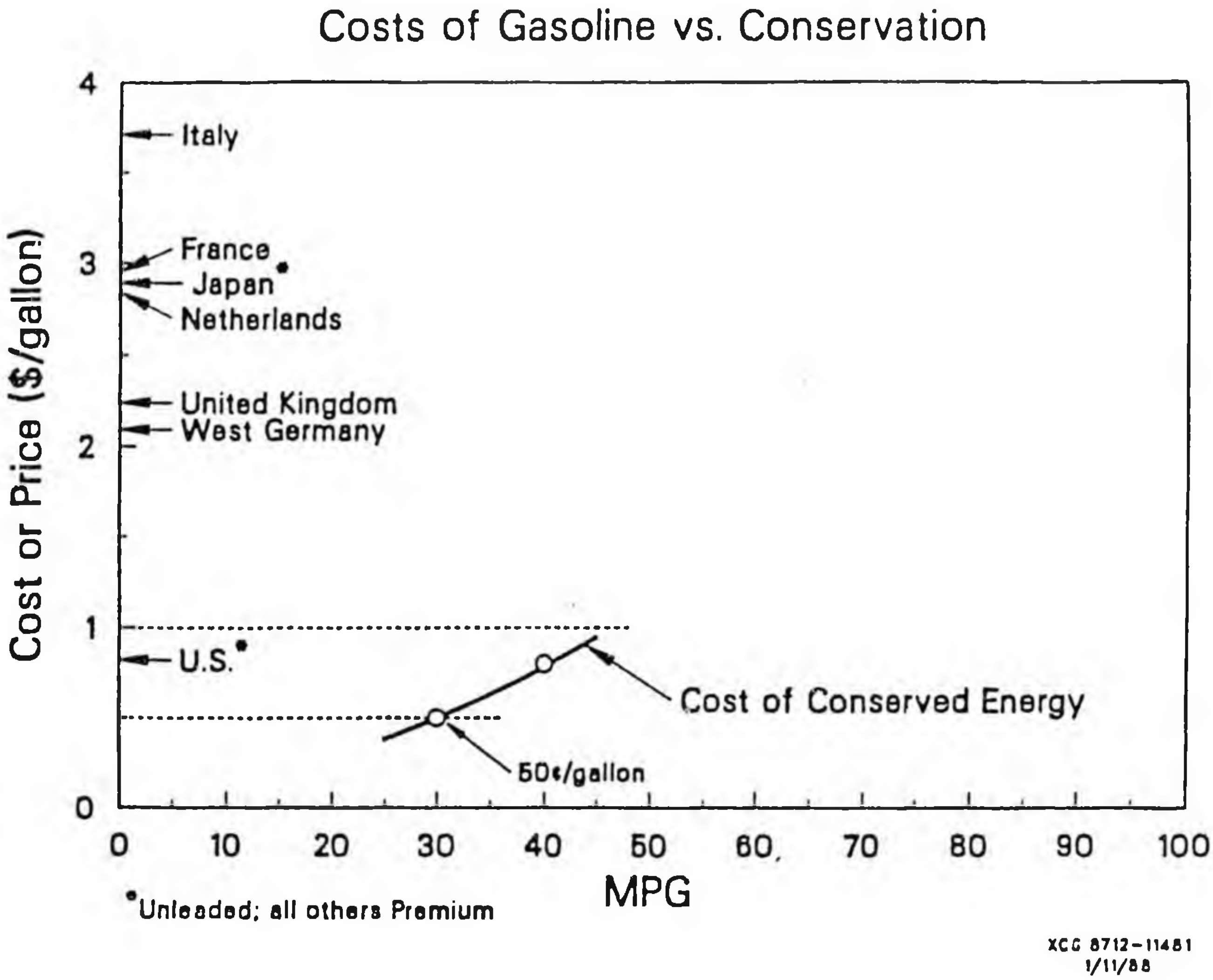

FIGURE 3. Costs of Purchased and Conserved Gasoline. The figure compares the purchase price per gallon of gasoline in various countries with the discounted cost of conserving one gallon of gasoline by improving the fuel efficiency of new automobiles. The two points on the cost-of-conserved-energy curve represent an average cost of 50¢/gallon saved between 26 to 35 mpg and 80¢/gallon saved by improving to 45 mpg. At 40 mpg we could surpass Japanese imports at a cost of only 80¢ per gallon saved and at the same time eliminate the need for all oil flowing to the U.S. through the Alaskan pipeline and the Persian Gulf plus the estimated extractable oil from the Outer Continental Shelf of California and the Arctic National Wildlife Refuge. Source: Ross 1987, Rosenfeld 1987, and U.S. EIA 1987.

per year. Compared to our trading partners, this is a tiny amount. The gasoline tax would raise about \$1 billion in the first year and increase each year thereafter by about the same amount.

We also suggest a revenue-neutral fee/rebate program that would require purchasers of new cars to pay a fee of \$200/mpg for every mpg below a target value, and rebate consumers \$200/mpg for every mpg above a target value[1]. The target value could be set at the current CAFE standard of 26 mpg, and afterwards the target would be annually adjusted to keep the program revenue neutral. Some portion of the fees collected could be allocated to research and development for improving automobile fuel efficiency. Each state could set up an R&D program with involvment from universities, manufacturers and smaller entrepeneurs that would allow for new ideas to be developed, tested, and transferred to production. Over time the mpg fee/rebate program will effectively improve the average fuel economy of new automobiles. We advocate this mpg program for the entire U.S., but it would also work just in California. Such a program would not be inflationary because more efficient automobiles would be reduced in price as less efficient automobiles are increased in price. These two programs would provide incentives for new car buyers to purchase more fuel-efficient cars and provide the necessary state tax revenues to purchase right-of-ways and build more extensive mass transportation systems in order to relieve traffic congestion and reduce automobile pollution.

5. A Revenue-neutral CO_2 Pollution Fee/Rebate Program: ~ 2¢/lb. of Fossil Carbon

Having proposed two fee/rebate programs to level the playing field for more efficient new buildings and automobiles, we end by proposing a third revenue-neutral incentive to reduce the production of CO_2 and prevent global warming.

The political problem with a CO_2 tax is that states with utilities that burn coal see such a tax as a huge plot to financially penalize them and place them at a disadvantage compared to states with utilities that burn gas or oil. Thus understandable vested interests have held up acid rain legislation for years and are expected to do the same for CO_2. Another problem with a CO_2 tax is that it would simply motivate utilities to petition their Public Utility Commission for rate adjustments, and thus defeat the purpose of the tax.

Our solution is to call for national leadership requiring that all 50 states adopt a *revenue-neutral* CO_2 fee/rebate program, with *no* interstate income transfers. We believe that without interstate income transfers our CO_2 fee/rebate program will be more palatable to the vested interests. The idea is to mitigate CO_2 generated by utilities just as our mpg fee/rebate program will mitigate CO_2 from cars. The fee/rebate program would motivate utilities within a given state to shift from fossil fuels to improved energy efficiency, hydropower, and renewables.

The fee would be based on the number of pounds of fossil carbon burned. The rebate in the first year would be equal to the fee, so that no utility would be penalized in the first year. Rebates paid to individual utilities in succeeding years would be based on the fraction of the total fee paid by the utility in the *first* year. If the population in a utility service area increases more rapidly then neighboring utilities, the PUC in that state would have to adjust the fractional basis for rebate payments.

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[1] \$200/mpg is the discounted present value of a \$2/gallon tax (as charged in France or Japan) using the current average new automobile efficiency of 26 mpg, a 7% real discount rate, average driving distance of 10,000 mile/year, and a 10-year automobile lifetime.

How big should the fee be? In order to influence the utility industry, it should be an appreciable fraction of the cost of electricity and gas. We suggest that 25% of the current retail price of electricity would be sufficient, or about 2¢/lb of fossil carbon burned. This corresponds to 2¢/kWh for a coal-fired plant, about 1¢/kWh for a plant burning oil or gas, and nothing for hydropower, improved energy efficiency, or nuclear power.

The program effectively internalizes one environmental cost of burning fossil fuels, and introduces an incentive to minimize the use of such fuels by seeking cost-effective alternatives such as conservation. In order to get the program accepted by states heavily reliant upon coal, the federal government could provide funds to retrain coal miners, and provide other financial incentives for energy conservation or renewable energy demonstration programs.

There are of course details to discuss.

- How to handle interstate or international electricity transmission? We would apply the fee/rebate to the end-using utility. This would encourage utilities to look for the *most* electricity for the *least* fossil carbon burned.
- Who participates—ratepayer or investor? We would suggest the investors are more sensitive to profit opportunities than ratepayers to savings, so we would load most of all of it on the investors. Since nothing changes the first year, we're just giving them an opportunity for profits.
- State or federal program? It could start with individual states but FERC support would be a big accelerator.

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Energy-efficient Buildings

Energy conservation and economic development can go hand in hand. Efficiently designed homes and offices will slash energy bills, liberate investment capital and avoid the expense of building new power plants

by Arthur H. Rosenfeld and David Hafemeister

Jimmy Carter and Ronald Reagan are not known for holding similar opinions on questions of national policy, but on the subject of the energy crisis both presidents shared the view that conservation was a remedy that necessarily demands a decline in living standard. President Carter, in his politically disastrous "malaise" speech, called on Americans to make sacrifices in order to end the nation's "intolerable dependence on OPEC oil." Eighteen months later, president-elect Reagan derided conservation as an approach that meant being too cold in winter and too hot in summer. Both men, to put it plainly, were wrong. Since the oil shocks of the early 1970's Americans have enjoyed a 35 percent rise in the gross national product without increasing their energy consumption. The main reason is that the services energy can provide—comfort, mobility, a cold beer on a hot day—are generated much more efficiently today than they were back in 1973.

Much of the decline in energy consumption is due to the more efficient use of energy in homes and offices. In buildings, new technologies and better management of lighting, heating and ventilation systems have cut $45 billion from the nation's energy bills. More tangibly, in spite of the addition of 20 million households and 15 billion square feet of commercial and residential floor space, heating-fuel demand has dropped by 1.2 million barrels of oil per day, an amount equivalent to two-thirds of the output of the Alaska pipeline. (The output of the pipeline, 1.9 million barrels per day, is henceforth referred to as an "Alaska.") The 125 million household refrigerators and freezers in operation today require the electricity from 30 standard 1,000-megawatt power plants. If they were as inefficient as the average 1975 model, they would require 50 power plants.

The size of these savings is not surprising. After all, the buildings sector, rather than transportation, is the single largest consumer of energy—40 percent—in the U.S. economy. For electricity alone, the sector accounts for an even larger share: 75 percent of the nation's $150-billion electric bill is consumed in buildings.

All told, the savings from improved "end-use efficiency" in all sectors are enormous. If Americans today were to use as much energy per unit of G.N.P. as they did in 1973, they would need 35 percent more fuel than is actually being consumed. If one looks at the savings in oil and gas (which are interchangeable), this difference is equivalent to 13 million barrels of oil per day, or half of the entire production capacity of OPEC. In monetary terms, conservation is saving this country $150 billion per year in energy costs, a sum that approaches the size of the Federal budget deficit or the U.S. trade deficit.

With the recent plunge in oil prices, however, energy conservation has ceased to be a national concern. This is shortsighted in the extreme. First, the cost of oil amounts to only 3 percent of the cost of generating electricity, the most expensive form of energy. Second, the oil glut will not last forever. U.S. oil production has already crested in 1970 and world oil extraction is expected to begin declining early in the next century, led by the stabler and friendlier oil exporters: Canada will begin a steep decline in about 15 years and the U.K. in about 20 years. By then OPEC will be a smaller, more cohesive group with greater leverage than it has today.

Whether the shift comes in the next 10 years or 30 years, no one doubts that the era of cheap oil will end. When that time comes, this country's economy and national security could be endangered. Fortunately there are many cost-effective steps the U.S. can take now to prevent such a catastrophe. In this article we shall describe technologies and policies for energy-efficient buildings that could cut energy consumption further by at least $50 billion per year. These changes are urgent: 50 to 100 years from now—as long as buildings from the 1980's still stand—this country will have to pay the price of construction decisions made today.

Profiting from Conservation

Energy conservation has already made more energy available to the U.S. economy than any other single source. Yet there is room for even larger gains. In 1985 this country spent $440 billion on energy, which amounts to $5,000 per household or 11 percent of the G.N.P. If all cost-effective conservation measures were taken and the U.S. became as energy-efficient as, say, Japan, this country would consume half as much energy as it does today and save $220 billion per year. The annual cost of achieving this goal would be only about $50 billion per year.

Moreover, by slowing the growth in demand for new energy capacity, conservation could liberate 10 percent of U.S. industrial investment capital for other uses. Already the rate of capital investment in new power plants has fallen sharply owing to energy conservation. In 1982 utilities spent $50 billion, 14 percent of the total U.S. investment in industrial plant and equipment. In 1985 the amount dropped to $30 billion. By 1991 it is forecast to fall to $17 billion. The electric industry predicts that investment will eventually rebound to $45 billion, but if the measures discussed in this article are adopted by 1990, the need for new capac-

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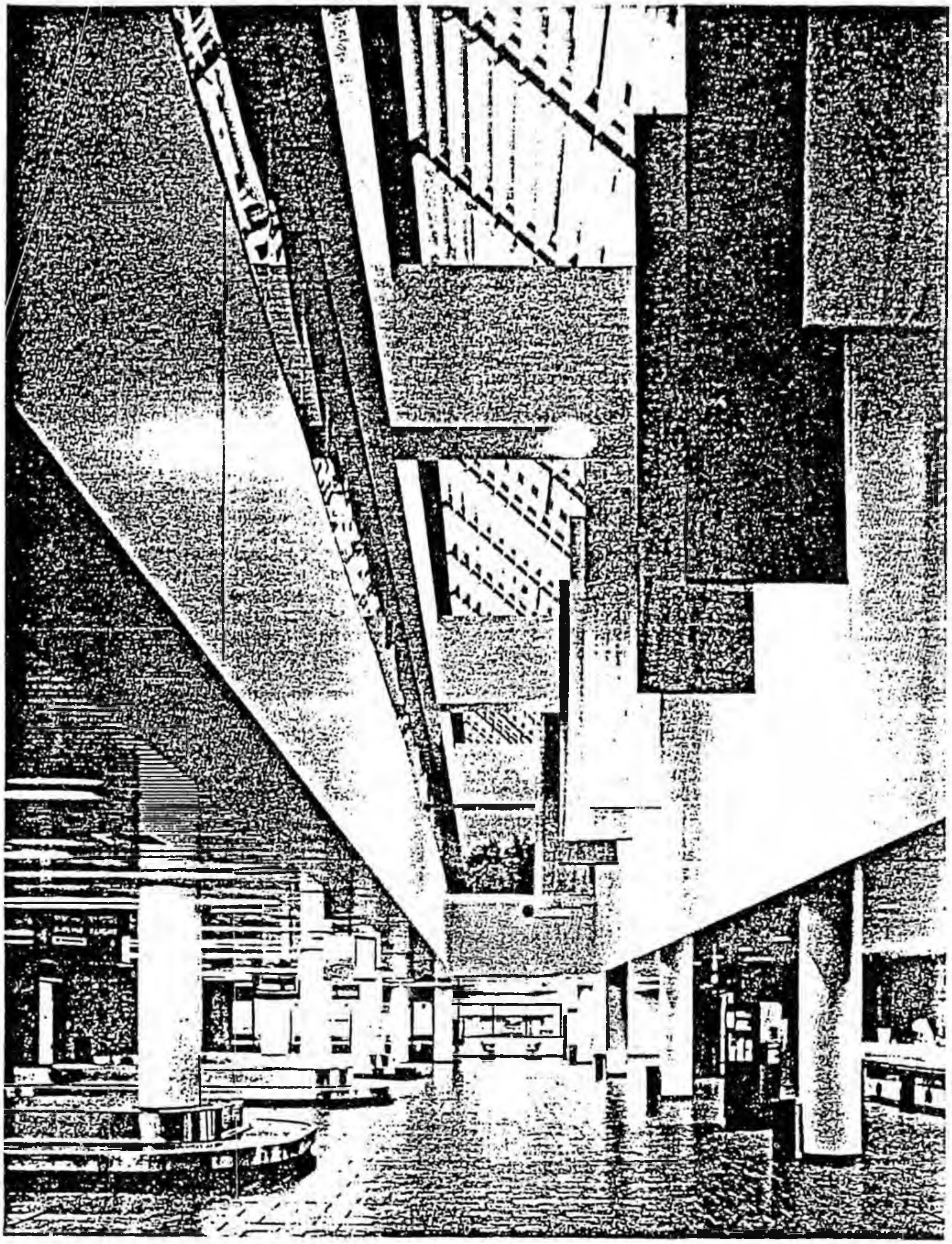
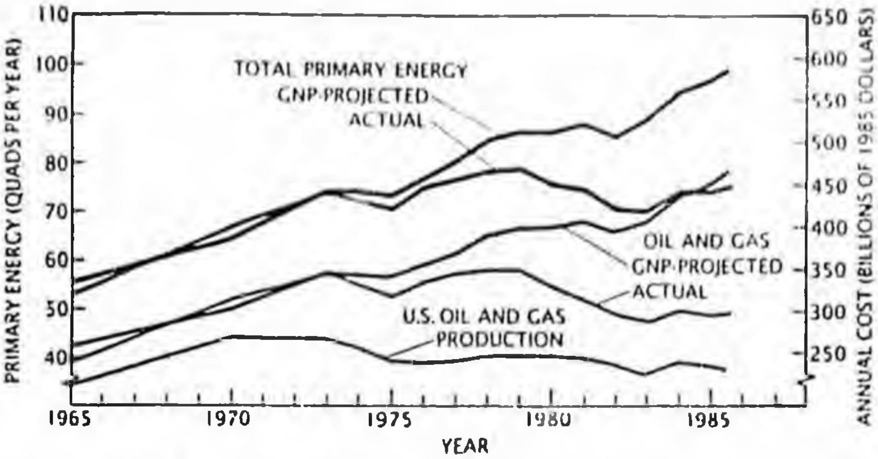


SKYLIT SOLAR COURT provides 40 percent of the lighting and 20 percent of the heating in the new passenger terminal at the Albany County Airport in Colonie, N.Y. A microcomputer, programmed with the solar altitude and azimuth angles until the year 2000, continuously gauges the indoor and outdoor environment and selects the most energy-efficient position for the louvers. The dark masonry wall supporting the skylight stores solar heat. The stone floor provides additional thermal mass. When daylight is available, photoelectric controls dim the artificial lighting supplied by efficient fluorescent and mercury-vapor lights. Einhorn Yaffee Prescott designed the terminal, and the energy consultant was W. S. Fleming & Associates, Inc.



ENERGY CONSUMPTION was assumed to be tied to the gross national product (G.N.P.), as was in fact the case before the oil embargo. Since then, however, energy consumption has leveled off at 73 quads (quadrillion B.t.u.) per year even though the G.N.P. has risen by 35 percent. The difference between G.N.P.-projected consumption and actual consumption is 25 quads. The savings for oil and gas lead to a direct reduction in oil imports of 13 million barrels per day—half of the entire production capacity of OPEC.

ity can be delayed and attenuated.

Many players in the energy market, from oil companies to regulators, now recognize the importance of investing in end-use efficiency. This has not always been the case. In 1975, for example, California's utilities predicted an annual growth rate for electrical demand of about 5 percent, even though one of us (Rosenfeld) warned that rising energy costs would cause consumers to improve their end-use efficiency so that the growth rate would be much lower, about 2 percent. By now the difference between these two projections is about 15,000 megawatts, the output of 15 large power plants.

As it turned out, demand grew at only 2 percent, and the 15 plants were never built—testimony to the market forces that led people to use energy more efficiently when the price rose, and to the foresight of regulators who imposed standards on appliances and buildings and also prevented the construction of the new plants. Chastened by cost overruns, lengthy delays, plummeting bond ratings and competition from "cogeneration" by major customers, California utilities have indefinitely scrapped plans to build any new central power stations.

Today many utilities recognize it is much cheaper to improve customers' energy efficiency, because the saved energy can then be sold to new customers. The Pacific Gas and Electric Co., for example, reports that "conservation will allow us to avoid $5 to $7 billion in outlays for new capacity that would otherwise be needed in the next decade. It costs up to seven times as much to produce a kilowatt-hour from a new energy source as it does to save a kilowatt-hour through PG&E conservation programs."

Given that it pays to save energy, how should consumers and society choose among conservation options? The individual consumer normally considers "simple payback time," or the time that must elapse for the annual saving from conserved energy to repay the initial investment. A good investment might have a payback time of a year or less, and a poor investment might not pay back for 10 years. Society, however, needs a different measure that allows an investment in efficiency (such as a better refrigerator) to be viewed as a new source of energy, which can then be compared with an investment in new supply. This measure is the "cost of conserved energy" and is usually expressed in cents per conserved kilowatt-hour of electricity (or dollars per conserved gallon of fuel).

Suppose, for example, an efficient refrigerator conserves 1,000 kilowatt-hours per year but costs $100 more than a less efficient model. To distribute the $100 over the 20-year life of the refrigerator, one should figure a cost of $10 per year (assuming an inflation-corrected cost of money of 7 percent per year). The cost of conserved energy for the refrigerator is then $10 divided by 1,000 kilowatt-hours, or one cent per kilowatt-hour. The average U.S. price of one kilo-

COMPUTER-CONTROLLED LOUVERS at the Albany County Airport regulate sunlight entering through the skylight (*see illustration on preceding page*). On a bright winter day sunlight heats the back wall. Warmed air is drawn into a space behind the wall and recirculated through the building. At night the louvers, which are filled with foam insulation, are shut to trap heat. In summer the louvers reflect direct sunlight but admit diffuse light. Warm air collects under the skylight and is vented by exhaust fans.

watt-hour is 7.5 cents, so that the net saving is 6.5 cents per kilowatt-hour. If the 125 million refrigerators in the U.S. are replaced with new models each of which saves 1,000 kilowatt-hours per year, there will be an annual energy saving of 125 billion kilowatt-hours. At 6.5 cents per kilowatt-hour the net saving for the nation is about $8 billion. This kind of analysis enables us to study the real benefits and costs of the specific conservation measures we shall now discuss.

Office Buildings

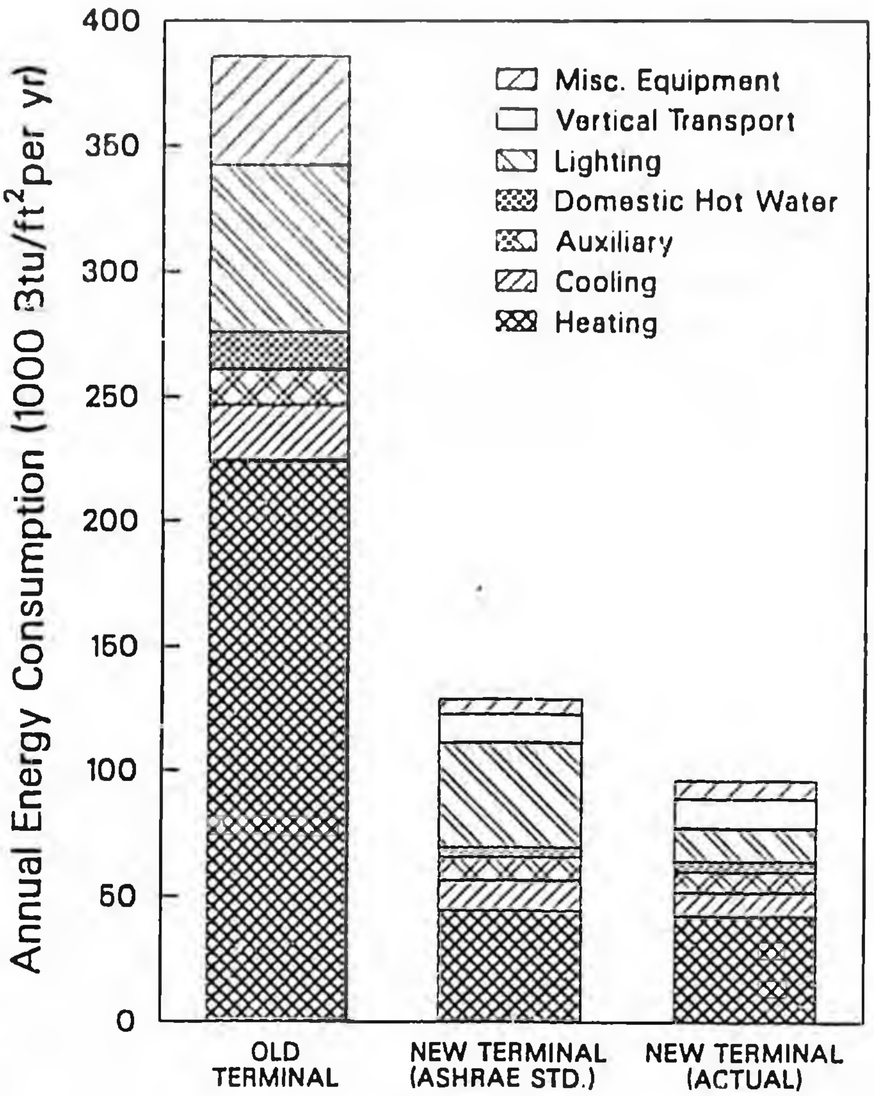
Before the 1973 oil embargo the supply of cheap energy encouraged flagrant inefficiency in office buildings. Acres of floor-to-ceiling single-glazed windows leaked warmth in the winter and admitted unwanted solar heat in the summer. To this was added more heat from excessive lighting by inefficient lamps and equipment. Inefficient building design meant that from 5 to 10 percent of total floor space had to be devoted to air-conditioning equipment.

In 1979 the average commercial building was 20 years old and annually consumed 270,000 B.t.u. of primary energy per square foot (the total amount of fuel needed for heat and electricity generation). At today's prices the energy bill for such a building would be an extravagant $1.60 per square foot. Some buildings were even worse, racking up annual energy bills of $3 per square foot. Such profligacy meant that over a building's 50-year life span the energy bill would be double or triple the construction cost. The embargo forced builders to recognize the absurdity of the situation and to start thinking in terms of a building's life-cycle cost. Since the embargo, energy use in commercial buildings has fallen by almost .5 Alaska, and it continues to fall, albeit less rapidly. With further improvements in lighting, automated controls and thermal storage, 100,000 B.t.u. per square foot should become standard.

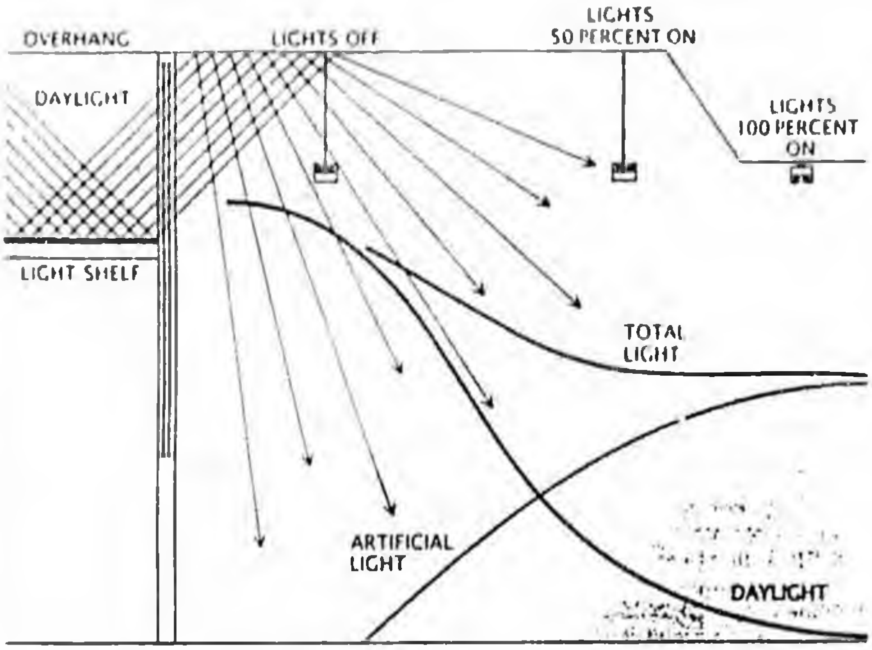
Efficient building design has had a particularly dramatic impact on heating needs. Because heat in large buildings comes mainly from internal sources—heat from people, appliances, lighting fixtures and so forth—it is possible to manage heating requirements by exploiting the thermal mass of the building, for example by storing excess daytime heat and using it to warm the building during the night. The worst of the early-1970's buildings required 170,000 B.t.u. per square foot for heating alone. The average 1979 buildings consumed 72,000 B.t.u. With yet more energy-efficient designs, heating needs will fall to less than 10,000 B.t.u., or six cents per square foot.

The decline for electricity is not as striking because new, improved equipment takes time to develop and install. For air conditioning, however, electric bills can be reduced through simple systems of thermal storage, which make it possible to move from 40 to 50 percent of electrical demand into off-peak hours. In 1979 annual electricity consumption was 27 kilowatt-hours per square foot in the worst office buildings and 18 kilowatt-hours in typical ones. New energy-efficient offices get by on between 10 and 15 kilowatt-hours.

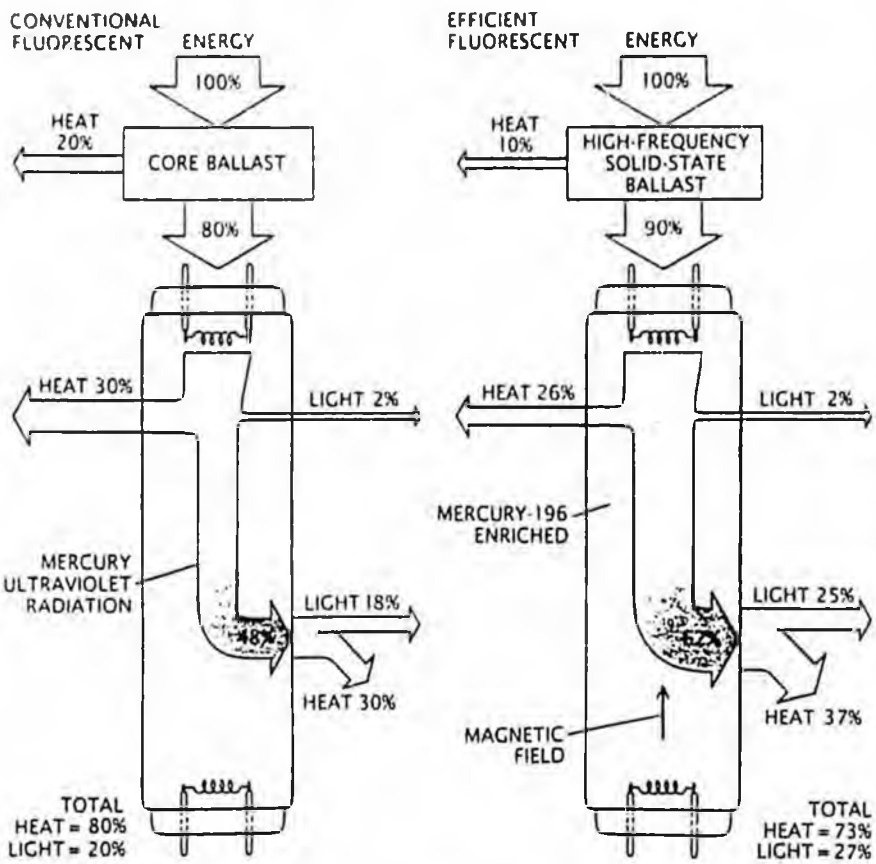
Remarkably, it costs no more to construct an energy-efficient office building than it does to construct an inefficient one. The reason is that by reducing the size of air-conditioning



DOE-2 COMPUTER PROGRAM is a powerful tool in the design of energy-efficient buildings. The program's analysis of annual energy requirements in the old and new terminals at the Albany County Airport is shown here. The simulation was based on the local climate and the building's thermal mass, internal heat gains, solar gains and air-conditioning and ventilation systems. The old terminal was a gas-guzzler. In 1975 the American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) set standards for materials, lighting, ventilation and so on, which called for the new terminal to be markedly more efficient. Actually the final design performed even better than the standard. DOE-2 was developed for the Department of Energy by the Lawrence Berkeley Laboratory. It is now the national reference tool for building-energy analysis.



DAYLIGHTING can reduce lighting bills by up to 15 percent in commercial buildings. Overhangs and light shelves shade the windows from direct summer sunlight and reflect daylight into the work space. Systems actuated by photocells and controlled by microprocessors dim artificial lights in proportion to available daylight. The controls combine natural and artificial light to provide even lighting throughout the building.



FLUORESCENT lamp systems can be made at least 35 percent more efficient through various new technologies. In a conventional lamp a core ballast generates enough voltage to initiate the ionization of mercury vapor and then limits the current through the discharge. Ionized mercury atoms emit some visible light and a larger amount of ultraviolet photons, which diffuse through the vapor and strike phosphor molecules coating the inner wall of the tube, causing them to emit visible light. Energy losses can be reduced at each stage. Solid-state ballasts reduce heat loss in both the ballast and the filament. Enriching the vapor with the mercury-196 isotope or applying an axial magnetic field will further boost the intensity of ultraviolet radiation reaching the phosphor.

systems and getting rid of single-glazed windows and excess lighting, one can pay for insulation, smaller double-glazed windows and automated thermostat and lighting controls. Fifty years from now, when these improvements have been fully adopted for commercial buildings (assuming the same total floor-space area as today), this country will have liberated 85 power plants, costing two to three billion dollars each, and eliminated fuel needs equivalent to two Alaskas—not bad for an efficiency investment of zero.

Superinsulated Houses

Since the oil embargo fuel consumption in housing for the developed countries has fallen by about 30 percent. New "superinsulated" houses have done much better than this average, reducing fuel needs by more than 75 percent. These houses are built with heavily insulated walls and ceilings, tight-fitting components and, often, ventilation systems that recover heat from the exhaust air. The walls and ceilings have extremely high insulation values, or R values. (The R value is a measure of resistance to heat flow; a standard four-inch-thick insulated wall is R-11 and a standard attic ceiling is R-19.) A superinsulated house would have walls and ceilings rated up to R-30 and R-60 respectively. By investing from $2,000 to $7,000 to superinsulate a house it is possible to reduce annual heating costs to between $20 and $300, even in climates as cold as Minnesota and Saskatchewan.

The remarkably low heating bills result because superinsulated houses store the "free" heat from people, lighting, appliances and passive solar heating through windows. Even ordinary houses tend to "float" about five degrees Fahrenheit above the outdoor temperature because of the internal free heat. Therefore when the thermostat in a conventional house is set at 70 degrees, the furnace will not go on until the outdoor temperature falls below 65 degrees, the "balance point" of the house. The five-degree difference is called the free temperature rise of the building.

In a superinsulated house the free temperature rise can be as much as 30 degrees, so that if the thermostat is set for 70 degrees, the furnace will not go on until the outside temperature drops below 40 degrees; moreover, below 40 degrees it takes less fuel to heat the house. In a typical U.S. climate such as that of New York

City, if the thermal resistance of a house is doubled, annual energy consumption is cut by about two-thirds.

Lighting and Windows

Last year it took 500 billion kilowatt-hours—the output of 100 standard plants, or 20 percent of all electricity generated in this country—to provide lighting in the U.S. Incandescent lighting now accounts for 40 of the plants, fluorescent lighting for another 40 and high-intensity discharge lamps for the remainder. Technical advances in fluorescent lamps and their fixtures would eliminate 20 power plants, and compact fluorescents would replace enough incandescent bulbs to eliminate a further 20 plants, for a total saving of 40 plants. Moreover, because the new lights would give off less heat, there would be additional savings in air-conditioning bills.

Solid-state ballasts, which operate lamps at high frequency, can be major energy savers. The ballast in a fluorescent lamp provides a voltage high enough to initiate ionization of mercury vapor in the tube and then limits the current for stable operation. The new ballasts dissipate less power and also allow the brightness of the lamp to be adjusted over a wide range, making it economical to install lighting-control systems that reduce intensity when natural light is available or when work spaces are vacant. These advantages combine to reduce energy needs by from 25 to 70 percent, at a cost of about two cents per kilowatt-hour.

By 1995 solid-state-ballast lamps should gain 50 percent of the market. It is worth noting that the new ballasts were developed as a joint effort by the Lawrence Berkeley Laboratory's Lighting Research Program, under the direction of Sam M. Berman, and small entrepreneurial firms. It was only after the initial success of these developments that major companies such as Norelco and the General Electric Co. introduced similar products.

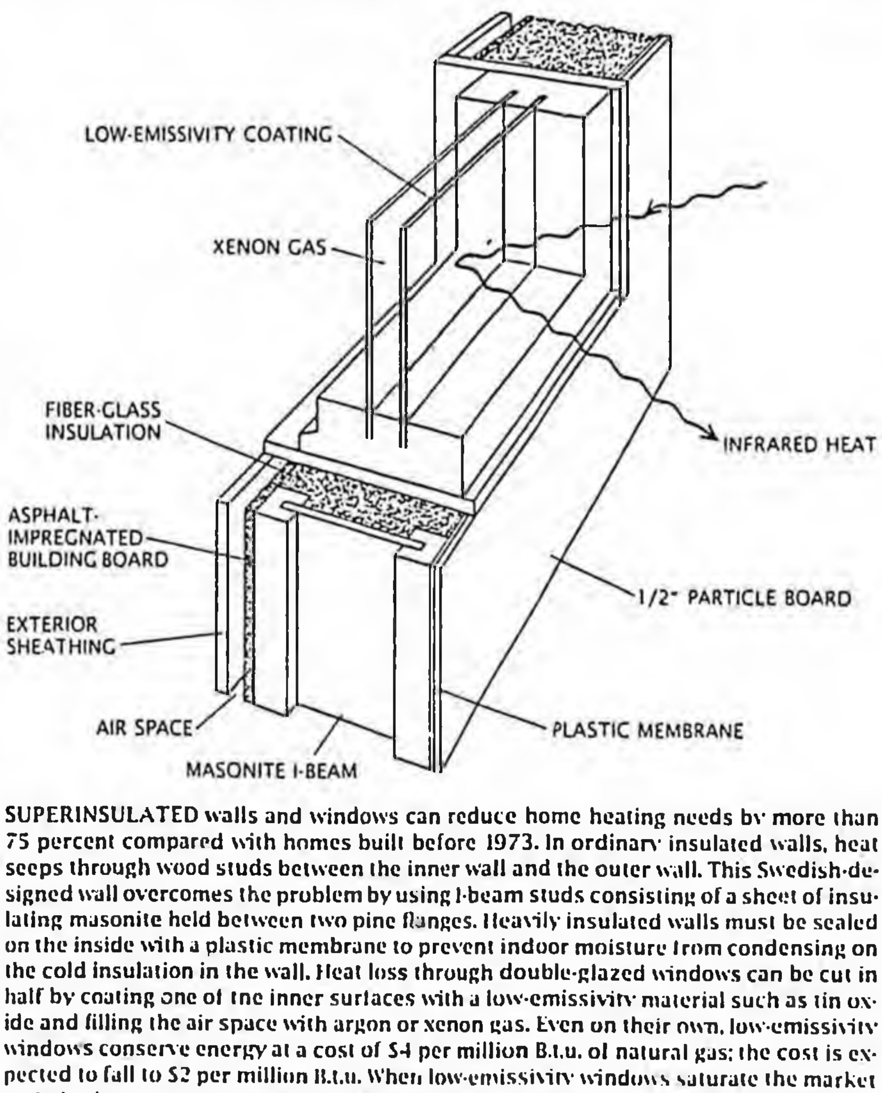
New, compact fluorescent bulbs are also beginning to replace many incandescent lamps. These fluorescents require only from a third to a fourth as much power as incandescents of equivalent brightness and last 10 times longer. The 18-watt Phillips SL-18, for example, costs $20 and consumes $10 worth of electricity during its 7,500-hour lifetime. In contrast, a 75-watt bulb with the same luminosity costs 50 cents but lasts for only 750 hours, during which time it consumes $4 worth of electricity. The life-cycle cost of the SL-18, then, is $30 compared with $45 for 10 incandescent bulbs. Moreover, the SL-18 eliminates nine bulb changes and the burning of 400 pounds of coal at the power plant.

Windows offer further ways to save energy. At present they leak about a third of the heat out of U.S. homes, corresponding to an astounding .5 Alaska. To reduce this waste it is necessary to increase the R value of windows. A normal single-glazed window is rated at about R-1, whereas a standard insulated wall is R-11 or better. The R value of windows can be raised from R-1 to R-11 by a series of steps. Half of the heat lost through single-glazed windows can be saved by double glazing, thanks largely to an insulating air space between the two panes. Such windows are rated at R-2. Double-glazed windows can be improved to an R-3 rating by coating one of the inner surfaces with a thin film of a transparent low-emissivity material, such as tin oxide, which reflects infrared heat radiation back into the house.

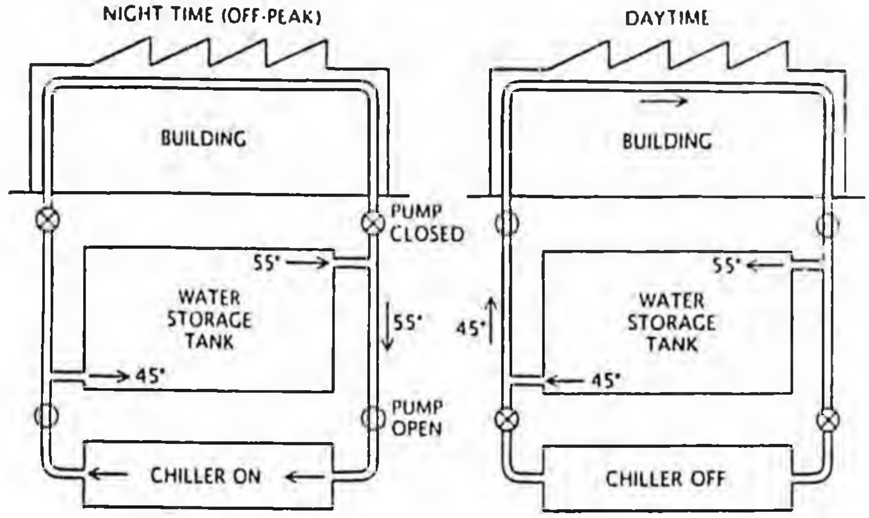
Windows can be upgraded to R-6 by replacing the air between the two panes of glass with xenon or argon gas, both of which are better insulators. One can obtain the same R value by inserting half an inch of a high-tech insulator called aerogel between the panes. (The substance is used by particle physicists as a radiation detector.) Aerogel consists of a very sparse skeleton of tiny glass particles that are transparent to visible light but scatter infrared radiation. If the air in the aerogel is then replaced with xenon gas or with a weak vacuum, one can achieve a window as resistive as a wall.

Home Appliances

Close to one-third of the energy consumed in buildings goes to power major home electrical appliances: refrigerators, freezers, water heaters and air conditioners. They account



SUPERINSULATED walls and windows can reduce home heating needs by more than 75 percent compared with homes built before 1973. In ordinary insulated walls, heat seeps through wood studs between the inner wall and the outer wall. This Swedish-designed wall overcomes the problem by using I-beam studs consisting of a sheet of insulating masonite held between two pine flanges. Heavily insulated walls must be sealed on the inside with a plastic membrane to prevent indoor moisture from condensing on the cold insulation in the wall. Heat loss through double-glazed windows can be cut in half by coating one of the inner surfaces with a low-emissivity material such as tin oxide and filling the air space with argon or xenon gas. Even on their own, low-emissivity windows conserve energy at a cost of $4 per million B.t.u. of natural gas; the cost is expected to fall to $2 per million B.t.u. When low-emissivity windows saturate the market early in the next century, they will save energy equivalent to one-sixth of an "Alaska."



STORAGE TANK for cold water, installed in a building's air-conditioning system, can reduce peak power demand. At night the chiller cools the water in the tank. During the day the chiller is turned off and the precooled water circulates through the building.

for 12 percent of the nation's energy budget, or 2.3 Alaskas, at a cost of more than $50 billion per year. Refrigerators, which are in virtually every home and operate 24 hours a day on electricity, presented an obvious target for an efficiency study. In 1977 Arthur D. Little, Inc., analyzed improvements such as better insulation, compressors and gaskets and concluded that at an extra retail cost of $100 it would be possible to have more efficient refrigerators consuming only one-third as much electricity as the average 1977 model.

A decade later these predictions are being realized in mandatory national standards, first set in California. In 1977 an automatic-defrost model with a capacity of from 16 to 18 cubic feet consumed 1,900 kilowatt-hours per year. Under the California standard the figure dropped to 1,500 in 1979 and to 1,000 in 1987; by 1993 it should reach 700 kilowatt-hours per year. These improvements add less than $150 to retail cost, and the payback time for the 1993-standard model (compared with 1977 models) is only one year. For the 125 million refrigerators and freezers in the U.S. the energy saving will be equivalent to the output of 30 power plants. In other words, an investment of $12.5 billion in improved efficiency will avoid the need to spend $60 billion on 30 new plants, eliminate their operating costs and spare the environment of their pollutants.

Efficiency improvements in other home appliances can also produce large economic benefits. In 1975 Congress directed the Energy Research and Development Administration to devise mandatory standards to minimize the life-cycle cost of 13 major appliances, but the Reagan Administration opposed the concept and delayed its implementation.

Impatient with the delay, several states set their own standards. The lack of uniformity troubled manufacturers, who in 1986 met with public-interest groups and developed new standards, which Congress then adopted as mandatory. President Reagan pocket-vetoed the bill, but it was reintroduced and signed into law last year. Its sponsors estimate that, under the standards, appliances sold by the year 2000 will decrease the nation's peak load by as much as 22 gigawatts and save $27 billion.

Exploiting Off-Peak Power

End-use efficiency is one way to conserve energy and forestall the construction of new plants. Another approach is for utilities to develop pricing strategies calculated to reduce the huge surges in demand that occur at certain times. Peak demand on summer afternoons is often from two to three times as high as the demand at night. Air conditioning accounts for one-third of the 500-gigawatt peak demand in the U.S.

Common sense and basic economics dictate that utilities should charge the highest rates for electricity at peak hours during the day and discount it at night, following the practice of other industries such as telecommunications and airlines. Yet until recently time-of-use electric meters have been relatively expensive, and so utilities have offered time-dependent rates mainly to large customers—buildings and factories that consume 500 kilowatts or more—even though residences and small commercial buildings account for two-thirds of the peak-power load. In the next 10 or 20 years inexpensive microprocessor-based meters will enable utilities to apply time-of-use rates to these customers as well.

Time-of-use pricing gives consumers an incentive to store energy in off-peak periods. In 1977, for example, Stanford University recognized that its daytime cooling needs were rising and that it needed to plan for three megawatts of new peak demand. Adding that much new air-conditioning capacity would have cost about $1.5 million. Instead, for only $1 million, the university built a four-million-gallon cold-water storage tank connected to the existing air-conditioning system. By cooling the water during off-peak hours and then drawing on the stored refrigeration, Stanford trimmed 3.5 megawatts from its peak demand for an additional saving of $200,000 per year.

Market Failures

Clearly there are many opportunities for boosting the energy efficiency of buildings. Yet improvements are not proceeding as fast as one would expect. The reasons can be traced to a number of market failures. The most important one stems from the different time horizons the various principals consider when making decisions. Investments in energy supply are made by utilities and other large companies that raise billions of dollars for huge projects and expect to pay off their investors over a decade or two. In contrast, most homeowners will not invest in efficiency if the payback time is 2.5 years, even though this represents a hefty 40 percent (nontaxable) annual return on investment. Large institutions such as governments, universities and corporations seldom consider paybacks longer than three years, thereby rejecting a 30 percent return on their own or taxpayers' money.

Utility pricing introduces another distortion. Electric companies are regulated and may only charge their average cost (plus a 10-to-15-percent return on investment) for the power they sell—about seven cents per kilowatt-hour. Yet the replacement cost for that kilowatt-hour is considerably higher—say 10 cents—depending on the utility's new sources of supply. Consumers may therefore reject an efficiency improvement because they do not perceive it to be cost-effective at today's prices even though it would actually be cost-effective if they considered the higher prices the utility will charge when it is forced to build a new plant.

Remedies

Fortunately specific policies can be adopted to counteract these market failures. One of the most promising policies is for utilities themselves to sponsor conservation. Utilities can offer incentives, such as low-interest loans, rebates and outright grants, as a way of encouraging customers to make their homes and businesses more energy-efficient. In California the utilities pay commercial customers $300 per kilowatt saved as an incentive to reduce peak demand. In the Northwest utilities pay home builders between $3,200 and $3,800 for meeting the new construction standards of the region before 1990, when they will become mandatory. In Dallas last year a utility-sponsored rebate program induced 40 percent of the new large office buildings to install thermal-storage systems.

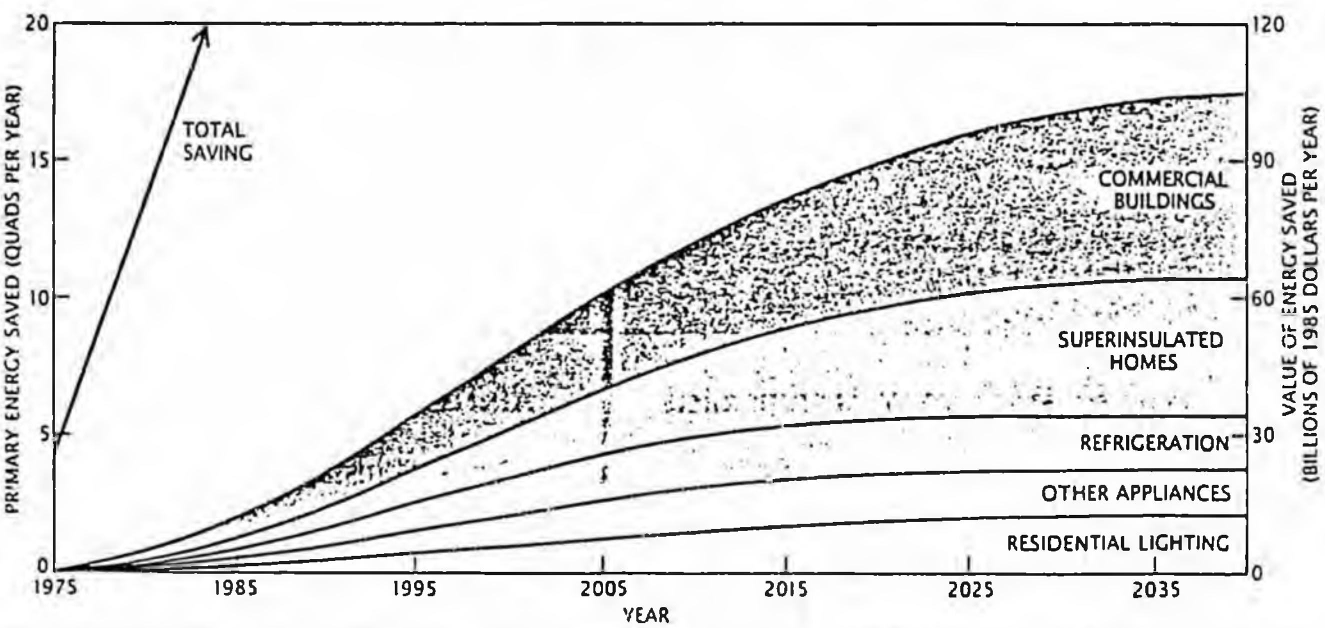
Some utilities have also changed to a progressive rate structure. Before the era of OPEC, the more one consumed, the less one was charged per kilowatt-hour. Utilities in California and elsewhere now do the opposite. Their rates are low for the first few hundred kilowatt-hours per month and go up as consumption increases. In the highest tier, customers must pay the cost of power from a new plant the utility would have to build if consumption increased any further. With such a rate structure, conservation can compete with energy purchases fairly. The next step could be to charge new buildings "compulsory utility bonds," which would reflect the cost of the new capacity that would be needed for the building and would more accurately convey the costs of electric demand to the builder and the buyer.

The Federal Government also introduces distortions in the economics of energy, by supporting research and development for energy supply (particularly nuclear power) much more generously than R&D for energy efficiency. The Government should either drop the supply incentives or level the playing field by providing equivalent incentives for conservation.

Already R&D in end-use efficiency has contributed mightily to reducing the nation's energy needs. For example, we estimate that Federal R&D funds hastened the commercialization of high-frequency fluorescent ballasts by five years. Those five years will save the country more than $25 billion. Yet the Federal program cost less than $3 million, of which half came from industry. That represents a benefit-to-cost ratio of 8,000 to one. Moreover, the research helped U.S. industry to retain its market share vis-à-vis Europe and Japan, both of which had independently developed high-frequency ballasts. Yet every year the Administration requests a 50 percent cut in research in energy efficiency. Given the decades necessary for new technologies to saturate the marketplace, it makes more sense to maintain the levels of research funding.

Finally, we argue for reasonable standards for appliances and buildings, an approach that has worked well in California. These could be aimed at keeping the worst appliances off the market and could be based on, say, a five-year payback period.

The U.S. has the means to reduce its energy costs by $220 billion per year, above and beyond the $150 billion it is already saving as a result of conservation. For the buildings sector the potential annual savings are from $50 to $100 billion. In order to achieve these goals it will be necessary to remove the market barriers we have described. This will require the concerted efforts of utilities and government. The penalty for not doing so is severe: money will continue to be wasted, remaining reserves of cheap energy will be squandered, the U.S. will wane in competitiveness with Europe and Japan, the country will remain dependent on foreign sources and the environment will continue to be degraded. The nation should take advantage of the opportunities at hand without delay.



ENERGY SAVINGS from five of the six examples described in the article save only a few billion dollars per year today, but 50 to 100 years from now, when the new technologies saturate the marketplace, they will save more than $100 billion per year. The savings shown are for commercial buildings (including most of the savings from improved lighting), superinsulated homes (including windows), refrigeration, other appliances and residential lighting. Thermal storage is not included because it saves peak power, not energy. The total-savings line shows all U.S. energy savings (*see top illustration on page 80*). The calculations are based on figures fixed at 1985 levels for the total number of households and area of commercial floor space in the U.S.

The basis for this article is Rosenfeld's
11/4/87 testimony before the

Hearing on Energy Security:
The Role of Conservation in the National Energy Picture
Subcommittee on Energy & Power
Philip R. Sharp, Chairman
Committee on Energy & Commerce
U.S. House of Representatives

(with some concluding remarks made at the 15th Annual Illinois Energy Conference, University of Illinois at Chicago, 11/10-11/87).

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Energy Conservation, Competition and National Security

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People who have worked in the field of energy conservation have a lot to be proud of. In the last 14 years we have made dramatic improvements in the efficiency with which we use energy and have made an impressive head start on weaning ourselves away from our fossil fuel habit.

Conservation Has Temporarily Overwhelmed OPEC

We have saved a truly staggering amount of energy through conservation—by which I mean efficiency improvements, not freezing in the dark—since the first oil embargo. Figures 1a and 1b illustrate these savings, which have accelerated since the second and more serious oil price shock in 1979.

Before 1973, energy prices were low and there was little interest in improving our efficiency. It was conventional wisdom that energy use would grow at least as fast as GNP. In Figure 1a (for the U.S.), the heavy solid line represents the actual consumption of total primary energy. The lighter solid line is simply GNP, scaled to go through

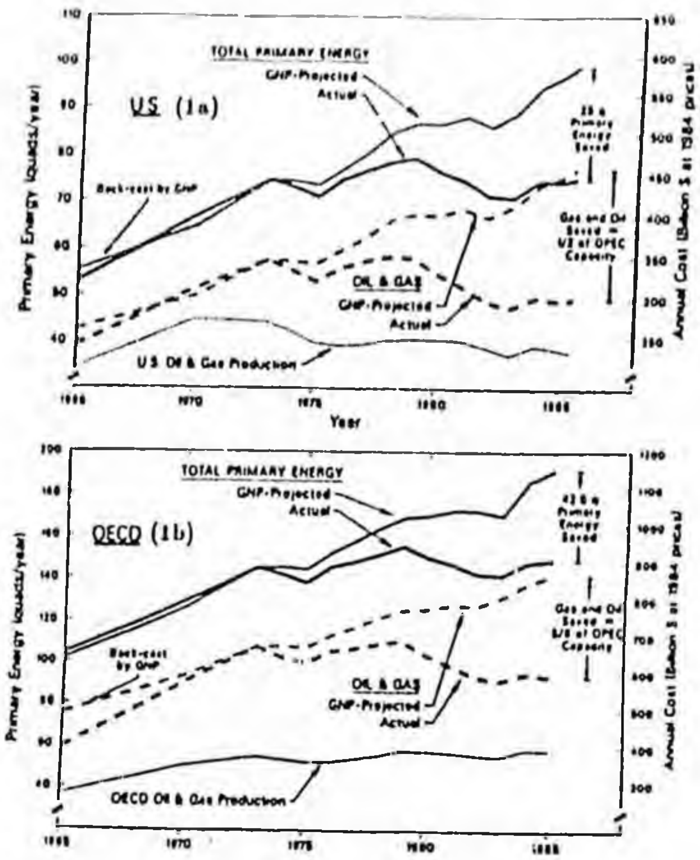

Figure 1a and 1b. U.S. and OECD Energy Use: Actual and Projected by GNP

The upper figure is for the U.S. and the lower figure shows comparable data for the entire Organization for Economic Cooperation and Development (OECD). Projected energy is calculated on a GNP basis in constant dollars, with both forecast and "Lack-cast" values from 1973. Note that the GNP back-cast generally follows the actual consumption curve before OPEC. The "primary energy" on the left hand scales includes fuel burned at the power plant, in units of "quads" [quadrillion (10^{15} Btu)]. The oil and gas savings were converted from quads to fractions of OPEC capacity using an estimated 1986 total OPEC production capacity of 29 Million barrels per day (58 quads). For the right-hand scales, quads were converted to 1985 dollars using the 1984 U.S. cost of energy (about $440 billion for 73 quads). Savings for the U.S. in 1985 were one-half of OPEC total capacity. The OECD includes all of North America, Western Europe, Japan and Australasia, and consumes about twice as much total resource energy as the U.S. alone. Oil and gas savings for the OECD in 1985 were five sixths of total OPEC capacity.

the 1973 energy use of 73 quadrillion Btus (73 "quads"). Backcast to 1965, we see that GNP and energy use tracked nicely, corresponding to frozen efficiency, but forecast to '85 we see GNP rising 33%, while actual use has leveled off at 73 quads. Thus we have achieved an astounding 33% increase in efficiency and a remarkable annual saving of $150 Billion, but are still left with a $440 Billion annual energy bill.

In the figure the broken lines represent oil plus natural gas, which are partially interchangeable in our economy since many boilers switch from one fuel to the other, depending on the price. Despite the 33% growth in our GNP, our oil and gas use has declined even faster than our (also declining) domestic production of fossil fuels (indicated by the dotted line). Compared to 1973, we are now annually saving ½ of OPEC's current capacity of 29 million barrels of oil/day.

If the U.S. and OECD had not reduced the need for this oil and gas, it could have come only from imports, since our domestic production is steadily declining. Thus our imports, instead of today's 6Mbod at $20/barrel, costing annually $44B, would have been about 20Mbod, and at a price probably exceeding $30/bbl, for a staggering cost of more than $200B/year, applied to our trade deficit. [Realistically, of course, this could not have happened—we don't have that much foreign credit. Instead we would have avoided the bill with a drastic decrease in our standard of living.]

Figure 1b tells the same story for the OECD, which includes all of North America, Western Europe and Japan. The OECD annual energy bill is $900 B, but (compared to 1973 efficiency) we are saving $250 B/year. Our oil and gas savings are 5/6 of current OPEC capacity. Because of the North Sea, OECD production of oil and gas is still rising, but nowhere near enough to supply the amount that we have saved. So, again, OECD imports would be nearly 5/6 of OPEC capacity higher.

What would we be paying today for oil and gas if OPEC were at 100% capacity, and in addition there were still a major shortage of oil? Figure 2, taken from DOE/EIA's International Energy Outlook, hints at the answer—OPEC was able to raise prices in all those years that 80% or more of its capacity was in use. This suggests substantial price increases every year above the $30/barrel which we paid in 1980, disastrous increases of $100, $200 or even $300 Billion in our trade and budget deficits, and a global security problem, compared to which the present problems in the Persian Gulf pale into insignificance.

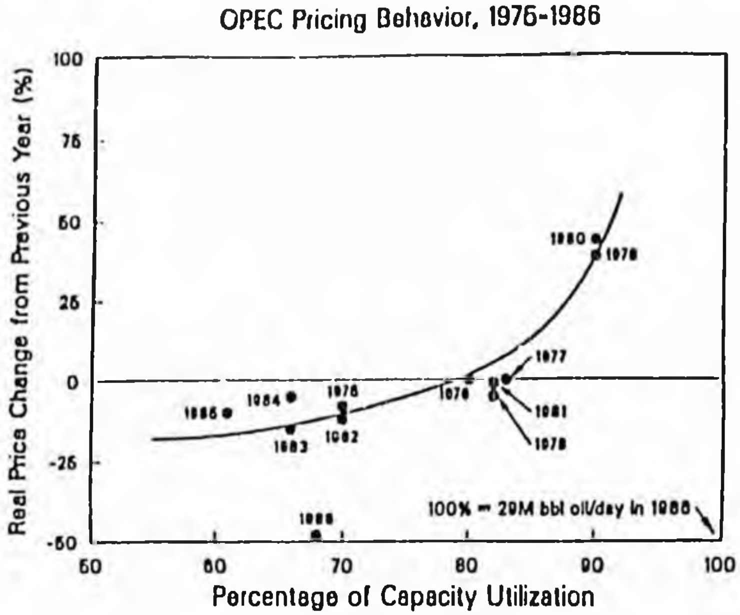

Figure 2. OPEC Pricing Behavior, 1975-1986

The 1986 observation, which was not used to derive the curve, reflects Saudi Arabia's decision to switch from providing price support to increasing market share. Figure adapted from. *International Energy Outlook, 1986*. Energy Information Administration, U.S. Department of Energy, page 10.

Conservation has bought us valuable time and we had best continue to support this winning strategy. But how long can we maintain the "glut," i.e., keep OPEC down to 60% of its capacity?

A vigorous government/utility conservation program can continue the flat demand of Figure 1 almost indefinitely, despite a reasonable growth in GNP. But oil production is going to drop, faster and faster for the U.S., and will peak in about 10 years for the North Sea and for the Soviets. Even OPEC, running at full capacity, is good for only about another 40 years.

Figure 1 covers only 20 years, so the decline in production does not appear very steep. Lest the reader be deceived, Figure 3 shows U.S. oil production, which goes out past 2020, when our children will still be paying energy bills but living without much domestic oil. The figure comes from *Beyond Oil*, by the Complex Systems Research

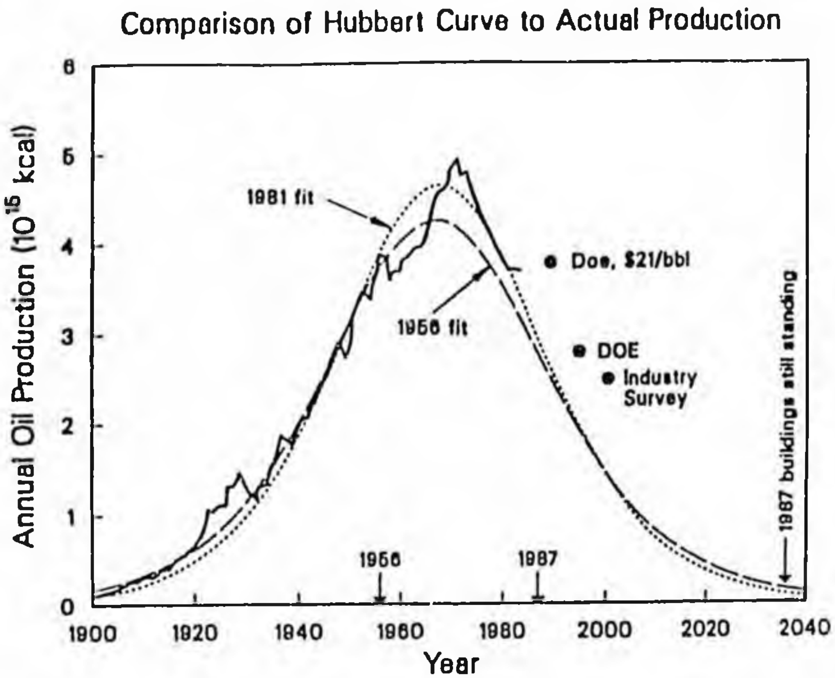

Figure 3. Comparison of Hubbert Oil-Depletion Curve to Actual Production, Excluding Alaska

Solid line is actual U.S. oil production; dotted line is Hubbert's 1958 curve; dash-dotted line is Hubbert's curve updated by authors of *Beyond Oil* based on 1981 data. Source. *Beyond Oil*, by the Complex Systems Research Center, University of New Hampshire, Ballinger Publishing, 1986. DOE estimates for 1990 (6.9 Mbod) and for 1995 (5.2 Mbod) and Oil Industry Survey for 2000 (median = 4.5 Mbod) are from Energy Security (DOE S 57, 1987) and "U.S. Oil Production," U.S. Office of Technology Assessment (Report E-349, 1987)

Center of the University of New Hampshire. It shows our inexorable decline in oil production. To emphasize this, its authors point out that in the 1950s we discovered 50 barrels of oil for every barrel invested in drilling and pumping. But by 2000 or 2010 this ratio will have dropped to 1:1, at which time domestic exploration will become uneconomic.

What is more, the two smooth curves reflect reserves at a time when oil was very inexpensive. We spent $¼ *Trillion* exploring for oil in the 1980s. The bullets to the right of the curves show that this has bought us a mere eight-year delay in the day of reckoning.

Note that buildings generally last for 50 years, so a sub-optimal building constructed today will still be guzzling expensive energy long after American oil and gas have run dry. And today's buildings are very sub-optimal, as can be seen by noting American ideas about acceptable payback times. Builders (including the U.S. government) will not tie up their money in efficiency investments if the payback time is more than 2-3 years; yet, on the supply side, the typical investor will accept a payback time of 10-15 years from a power plant or an oil-and-gas venture. So the playing field is badly tilted in favor of supply. Thus a conservation measure such as thermal storage, which avoids running air conditioners at peak power times, has a payback time of only 2-3 years, yet is largely ignored (and completely ignored in new federal buildings). If we persist in ignoring thermal storage until the turn of the century, we'll have to build the equivalent of 100 otherwise unnecessary standard 1000-MW power plants at a cost that will probably exceed $1.5 Billion each.

Figure 4 (taken from *Electrical World)* shows the effect on electric utility construction expenditures of the conservation success of Figure 1. During the power plant overbuilding spree around 1980, we invested $50 B/year (12% of our annual capital investment in plants and equipment).

Now we have 50 baseload plants (about 1000 MW each) in excess of current need, and utility construction is predicted by *Electrical World* first to fall to $17 B/year (leaving another 10% more of our capital formation for other productive investment) and then to rise to $40 B/year as electrical demand continues to grow at 2%/year. Conservation R&D today, leading to more efficient use of electricity in 1995, can greatly delay and mitigate the need for this looming $40 B *annual* investment.

Figure 1 showed that conservation is now saving the U.S. $150 B/year, and we have cut our energy bill to "only" 11% of our GNP. But the Japanese spend only 5% of their GNP on energy.

"Least-cost" calculations show that optimal investment would halve our energy use by the turn of the century (see Figure 5). This suggests the following analogy: if we were stuck at 1973 efficiency, we would be pouring $590 B worth of energy into a pipeline each year and getting out only $220 B in energy services. The rest—$370 B—would have leaked out.

But we've already plugged more than a third of the leaks, and we now waste only $220 B/year, so we pour in "only" $440 B worth.

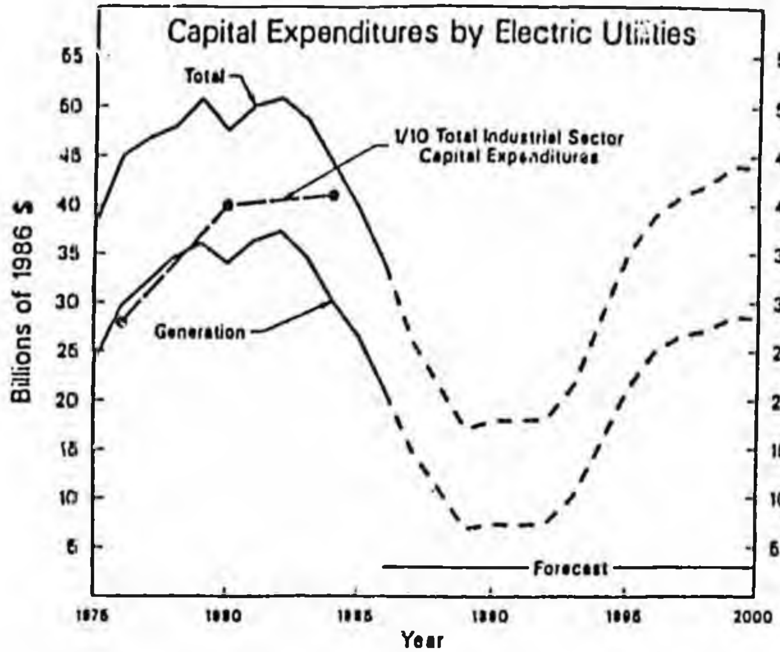

Figure 4. Electrical Industry Annual Investment in Plant and Equipment, in 1986$

The equivalent investment by all of industry is about $1B per day, so that the electric fraction has dropped from about 15% ($50B) to a minimum that will be about 5% ($17B). The utility investments do not include cogeneration, which is running at about $2B/year. Source: *Electrical World*, McGraw-Hill, Inc., September 1986. Figures for total industry investment are from ***1986 Statistical Abstract of the United States***, 106th Edition, Table 901, p. 529, using GNP implicit price deflators to convert to 1986 dollars.

Of course, we didn't achieve these savings at zero cost; we did it by investing.

To be fair, we are investing around $15-$30 B/year in retrofits—a modest amount yielding something like a one-year payback. We can save the remaining $220 B that is wasted—and cut in half what we currently spend on energy—three-to-five times more cheaply than continuing to pay for wasted energy. So our first priority should be to finish plugging the leaks before we invest more in new supply.

The longer we let the leaks continue, the quicker we will exhaust cheap, secure sources of oil and gas. Seeking new supplies—"draining America first"—while we continue to waste energy and backslide on

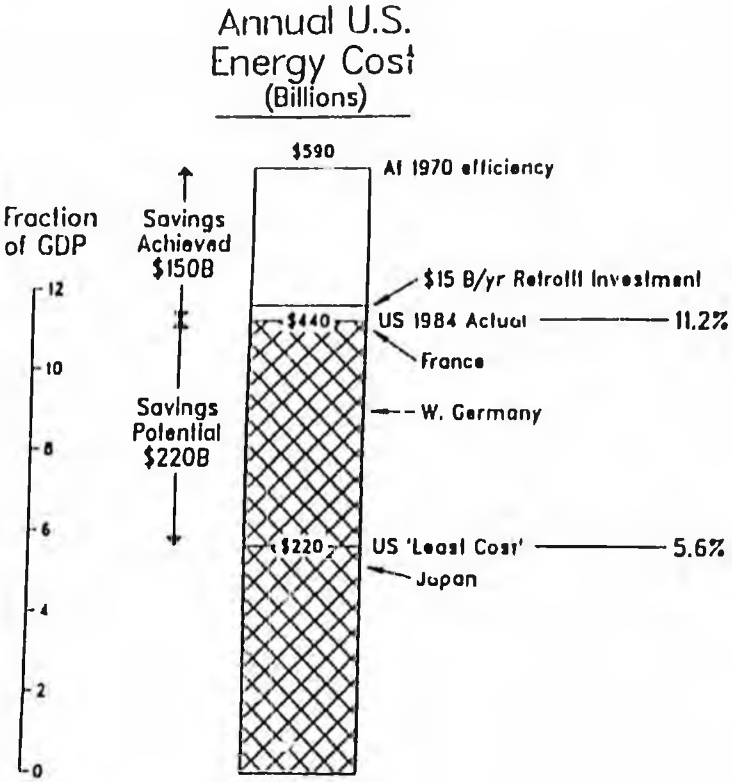

Figure 5. Annual U.S. Energy Cost

By 1984, the energy use per dollar of GNP (in constant dollars) has dropped to 74% of the 1970 level. If efficiencies had stayed frozen at 1970 values our $440-billion annual cost today would instead be $440 B/0.74 = $590B. On right scale, "Fraction of National GNP," are lines representing 1984 fractions for European countries and Japan. These lines show what the 1984 U.S. economy would pay for energy at various foreign efficiencies.

auto efficiency just hastens the depletion of our reserves; heightened efficiency saves the energy until it is really needed.

And how much has it cost to plug the leaks? So far, because we have been skimming the cream, conservation has typically been five times cheaper than purchasing energy. So to save $150 B/year, we have probably invested $30 B/year, leaving a net savings of $120 B/-year.

In terms of incentive programs sponsored by governments or utilities, we can do even better than 5:1. PG&E, the giant Northern California utility, boasts that in 1985 it spent $0.25 B on conservation programs but avoided committing $1.75 B to new supply, a benefit/cost ratio of 7:1. To save the next $200 B/year, some of the cream will be gone, but least-cost analysts estimate that conservation will still be three times cheaper than supply.

We are Losing the Efficiency Race with Japan

In 1985, the U.S. used 11.2% of its GNP for energy; Japan used 5%. Figure 6 clarifies this point and puts the efficiency, as measured by energy use per GDP,[1] of other countries in perspective. The details of the figure are explained in the caption, but the summary is that we spend about 6% more of our GNP on energy than do the economical Japanese.

Japan is beating us in absolute energy efficiency (they use half as much energy per capita as Americans) *and* in the rate of improvement. In the period plotted in Figure 6, Japan has improved its energy use per dollar of GDP by 31%, while we have improved by only 23%.

At the same time, Japan's per-capita income has come up from behind and is now passing that in the U.S. Nevertheless, we can be proud that we have the second best record of nine countries pictured, thanks to appliance and automobile labels, automobile standards (*and* imported cars), building standards, federal and utility conservation programs, a vigorous R&D program, and of course the market.

How has Japan become as productive as the U.S. on less than half the energy? The answer lies in Japan's unflagging commitment to energy efficiency. For example, between 1973 and 1985 energy use per pound of steel produced had declined by 15%, electricity used to operate new refrigerators had dropped by 73%, and electricity used to run room air conditioners had dropped 42%.

Japanese new cars are already at 29 mpg and under the influence of their gasoline prices of nearly $3/gallon will probably continue to climb, whereas the U.S. CAFE standards are now stuck at 26 mpg. The security-enhancing aspects of increased auto efficiency will be discussed in more detail later in this article.

[1] In the U.S., GDP is only a percent or two less than GNP.

Energy Consumption and GDP: 1970-1985

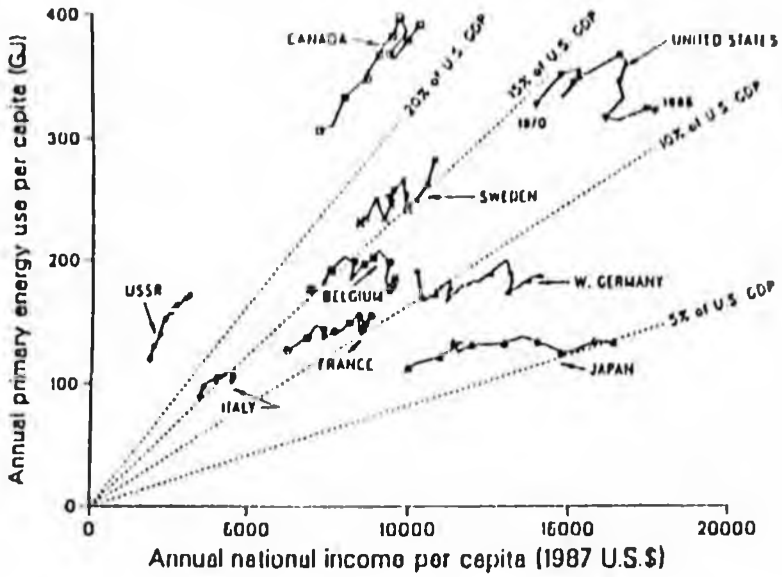

Figure 6. Resource Energy Use vs. GDP
(both per capita)
for 9 Industrial Countries

Each country is represented by a sequence of points connected by straight lines, beginning in 1970 and ending in 1985. The conversion from local GDP to dollars depends only on the July 1, 1987 exchange rate, earlier points are plotted using individual national deflators. For the lines labeled 5%, 10%, 15% and 20% of U.S. GDP, we use an average 1987 price of resource energy of $6.14/GJ. Hydroelectric and nuclear electricity are converted to resource (primary) energy using IEA's standard generation efficiency of 38.5% (except in Japan, 35.1%). Data for the USSR is unfortunately site energy

Sources. *Price*—DOE/EIA 0376 1984 (updated to 1985 by phone to EIA).

Income and Population—IMF International Financial Statistics 1986.

Energy Consumption—the OECD/IEA volume *Energy Balances 1970-1985* (it should be noted that we use the "Total Energy Requirement" data as opposed to "Total Final Consumption", the former is resource (or "primary") energy and the latter is site energy, where the losses in electricity generation are ignored.

Soviet Data—"UN Demographic Yearbook," 1985. Exchange rates are for July 1, 1987.

1 TOE = 42.6 GJ.

Of course to achieve this efficiency the Japanese had to make investments, whose repayment eats into about 20% of the savings. So instead of having 6% more of their GNP available than we do, they really have gained only about 5%. This differential of 5% of GNP means that, even if all else were equal, our products cost on average about 5% more than comparable Japanese products, thus impairing our balance of payments, the dollar/yen ratio, and our life-style.

Some readers may find this assertion obvious and can skip this paragraph, but those who are surprised at a 5% cost penalty should consider this argument. The total energy cost of any product is the sum of the direct energy cost (significant for iron and steel, insignificant for most high-tech products) *plus* the indirect cost embedded in wages. (For the same life-style, a U.S. worker who commutes in a gas guzzler and lives in a poorly insulated dwelling needs higher wages than his Japanese competitor.)

Effectively, U.S. manufacturers pay a total 5% energy tax. But unlike other taxes, which arguably provide government services, this 5% just goes up in smoke and pollution.

The defense version of this tax is already much discussed. Thus, if the Japanese had a GNP equivalent to ours, they would avoid a tax of $300 B (7.5%) for defense, giving them a 7.5% competitive edge. Now we have added a $200 B (5%) energy efficiency differential tax, for a total handicap of 12.5%—and as energy prices rise, this gap will widen.

Let us examine in more detail what will happen in 10 or 20 years if OPEC regains control and energy prices double. Without a continuing, vigorous conservation program, our energy bill could zoom from 10% to 20% of GNP. We predict that the Japanese will continue to invest in efficiency even during the glut, get down to 2% of GNP at today's cheap prices, and later climb back to only 4%. And they will be experienced at manufacturing and exporting energy-efficient products, which seem likely to be in demand. The competitive outlook begins to look bleak.

Public R&D for Energy

Conservation R&D Compared with Other Economic Sectors

Table 1 disaggregates our $440 B annual energy bill according to the buildings, industry and transport sectors, and Table 2 compares our total expenditure in several economic sectors with our publicly-supported research and development effort in them. Despite the prominence of our national energy bill (the largest single sector), we invest barely one-half of one percent of that amount in research aimed at meeting our energy needs.

If we consider R&D effort on construction and conservation (which can meet our needs at one-third to one-fifth the cost of new supply), we invest less than one-tenth of one percent. By comparison, for Defense, Health and Agriculture R&D we spend anywhere from 1% to 12% of total expenses, or 10 to 100 times more than for conservation. But if we look at what really works, it is conservation that has (literally) fueled our post-OPEC economic growth.

Figure 7 shows the U.S. Department of Energy (DOE) budget during the post-OPEC decade. It grows from its foundation in 1976 to a peak of $15 Billion a year, then comes down sharply under the Reagan administration. Only five to six percent of this has gone to improving energy efficiency.

This misplacement of priorities isn't a sickness for which DOE is solely susceptible; it's a general trend in our society. If one looks at the Electric Power Research Institute's (EPRI) budget, for example, one sees that it has 6% demand-side and 94% supply-side research.

We're very much a society that pays attention to big water projects rather than to water conservation, to large power plants than to many small and efficient lamps, to a rail line than to a flexible fleet of buses in urban areas, to a freeway than to well-timed street lights, to a hospital than to preventive health care.

In 1980, DOE was spending $100 million on Buildings and Community Systems research, or $1.20 per home in the United States. The potential savings are around $2000 a home, aside from commercial buildings where a large savings potential also sits untapped. The Reagan administration thought that DOE was spending too much and requested zero budgets by 1983. Congress helped a bit, and so things haven't been zeroed out yet. We're now at 50 cents per home

Table 1. U.S. Energy Expenses, 1985*

Sector	Fuel ($10B)	Electricity ($10B)	Total ($10B)
Buildings	60	110	170
Residential	40	60	100
Commercial	20	50	70
Industry	70	40	110
Buildings	3	7	10
Transport	160	0	160
TOTAL	290	150	440
Percent of GNP			11.2%

*Excluding Federal subsidies and rounded to the nearest $10 billion. Source *State Energy Price and Expenditure Report 1985*, October 1987.

Table 2. Comparison of Energy Expenses and R&D With Other Economic Sectors

	Total Expenses (Billions 1984$)	Publicly-Supported R&D + Tech Transfer (Billions of 1985$)	Percentage of 1984$
Energy	$440B		
Total Supply R&D		2.50	0.5%
Conservation R&D		0.16	<0.1%
Health	400		
N.I.H.		6.20	1.6%
Construction	340	0.01	<0.01%
Defense	300	37	12%
Education	200	<0.1	<0.1%
Federal Deficit	200	---	---
Trade Deficit	200	---	---
Agriculture	140	---	---
Experiment & Extension		1.70	1.2%

per year, with Reagan asking for half of that for next year in the face of a 100-to-1 return potential.

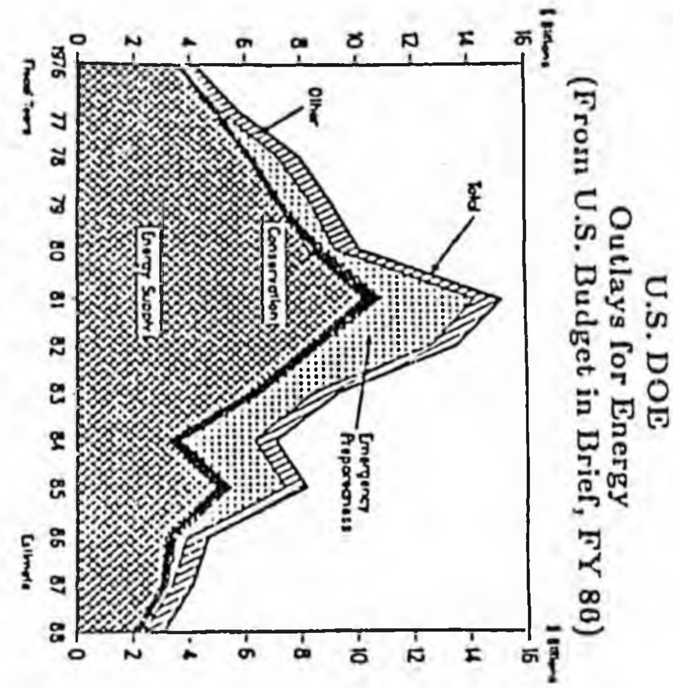

Figure 7. Trends in Outlays for Energy by the U.S. Department of Energy

Source H. Richard Heede, Rocky Mountain Institute, Testimony to Subcommittee on Energy and Agricultural Taxation, U.S. Committee on Finance, 21.VI.85. The total 1984 outlay was equivalent to 11% of the U.S. energy bill in that year. For detailed 1984 data, see *Energy Conservation Digest*, June 24, 1985.

Technological Triumphs of DOE-Supported R&D

In the DOE-sponsored 1986 Conservation White Paper (see Table 3), case histories were presented for three important technical developments: high-frequency, solid-state ballasts for fluorescent lamps, "heat-mirror" (low-E) window films, and improved refrigeration. The paybacks on federal R&D funding were typically 5000:1, but the delay times are long, partly because the buildings industry is so fragmented (see Figure 8).

Table 3. Lead-Times and Net Savings for Successful DOE-Sponsored Buildings Energy R&D Projects

	Solid State Ballasts	Low-E Window Films	Residential Absorption Heat Pump	Advanced Electric Heat Pump	High Efficiency Refrigerator Compressor	High Efficiency Refrigerator -Freezer	Heat Pump Water Heater
1. DOE Project Duration	1976-1980	1976-1990D	1978-1988	1977-1986	1977-1981	1978-1983	1977-1982
2. Est. 50% Penetration of Sales	1995	2000	2001	1998	1990	1996	2000
3. Years by which DOE advanced commercialization	5 yrs.	5 yrs.	5 yrs.	2 yrs.	2 yrs.	2 yrs.	2 yrs.
4. Cost of Conserved Energy, (CCE)	2¢/kWh	$2/MBtu	$2.50/MBtu	$2.75/MBtu	1¢/kWh	3¢/kWh	6¢/kWh
5. Cost of DOE Project	$3M	$2M	$0.8M	$2M	$1M	$0.8M	$0.7M
6. Net Annual Savings in 1985	$11M	$14M	$0M	$0M	$0.4M	$0.2M	$0.3M
7. Net Annual Savings at Saturation (i.e. 10-15 after 50% penetration)	$5,000M	$3,000M	$2,400M	$2,600M	$1,100M	$850M	$1,800M
8. Cumulative Net Savings (Line 7 x line 3)	$25,000M	$13,000M	$12,000M	$5,000M	$2,200M	$1,700M	$3,600M
9. DOE Project ROI (Return on Investment, =Line 8 ÷ line 5)	8,000: 1	7,000 : 1	1,500 : 1	2,500 : 1	2,000 : 1	2,000 : 1	5,300 : 1

Source "Federal R&D on Energy Efficiency A $50B Contribution to the U.S. Economy, a White Paper on the Consequences of Proposed FY'87 Budget Cuts," by the American Council for an Energy-Efficient Economy and the Energy Conservation Coalition, March 4, 1986.

Size & Diversity of the Buildings Sector

- New construction totaled $340 billion in 1985 (9% of GNP)
- The cost of energy consumed in the buildings sector totaled $165 billion in 1985
- The construction industry is:
  —Over 28,000 homebuilders
  —Over 150,000 special trade contracting establishments
- The construction material and component manufacturing industries are also fragmented:
  —Over 600 manufacturers of non-electric heating equipment
  —Over 100 manufacturers of mineral wool insulation
- Each new building requires inputs from more than 50 industrial sectors

Figure 8. Size and Diversity of the Buildings Sector

The high degree of fragmentation delays the diffusion of conservation practices. Source. DOE Assistant Secretary's Review of Office Buildings and Community Systems, Lawrence Berkeley Laboratory. October, 1986.

Thus, at LBL we started to develop the heat mirror film in 1976, but as shown in Figure 9 it will not reach 50% market penetration until around 2000 (12 years from now), and the majority of existing windows will not be replaced until 2020 (32 years from now). So to save scarce-energy for our children, we need to support R&D today.

The savings from these three completed projects are astounding: nearly $17 B/year when they finally saturate the market (even at today's prices). This equals the yearly output of about 25 baseload power plants, and an oil and gas saving equivalent to half the yearly output of the Alaska pipeline.

In addition to saving energy, conservation has also saved some U.S. industries and created others. The $0.7 B/year U.S. ballast market would have been invaded by the Japanese and the Europeans had it not been for U.S. development of the solid-state ballasts. In California, we have two new industries based on the "heat mirror" films:

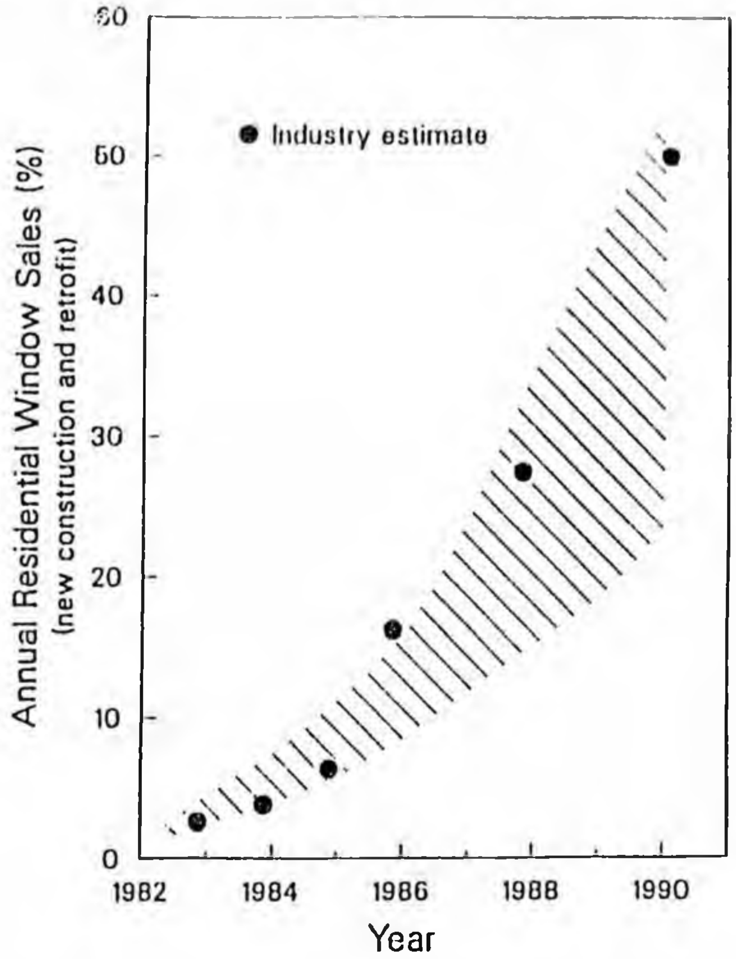

Figure 9. Industry Estimate of Low-E Windows Market Share Based on Annual Sales

With a projected 20% market share in 1987, sales will be over 100 million square feet. Savings from cumulative installed window area will be approximately $60 million in 1987. At saturation of existing residential stock, savings will be $4-5 billion per year at current fuel prices. These savings will be equivalent to one-quarter of the output of the Alaska Pipeline.

Southwall Technologies sells low-E coated plastic to window manufacturers, and Airco Solar Products sells multi-million dollar plants for sputtering the thin films on glass.

I conclude from the data in Table 3 that DOE-developed technologies have paid off very well and that they will become commercial in America several years sooner than if we had waited for either domestic or (more likely) overseas industry to develop them. In the case of the examples above, several years' acceleration of the savings of $17 B/year (the sum of Row 8 of Table 3) represents a savings to U.S. ratepayers of $62 B.

With good R&D, we can advance by five to ten years the times when new demand-side options become available and in the process help prevent penetration of foreign products. With low oil prices, development of energy-efficient cars and products has slowed, but if we don't keep R&D alive we won't have solutions when we need them. Let us look more closely at one technology—lighting—and why innovation and diffusion has taken so long.

Lighting: Why It Takes 30 Years to Saturate the Market

Early on in our energy-efficient buildings research efforts, it was clear that we should target lighting. We knew that by exciting fluorescent lamps at a very high frequency, 30,000 Hertz or so, we could gain about 15% efficiency. Regular fluorescent lamps cycle at only 60 Hertz. Also, before the oil crisis, ballasts were made out of copper wire laminates which ran very warm and thereby dissipated 13 watts of waste heat. So for every 100-watt fixture, a total of 28 watts could potentially be saved with these two improvements.

Along came solid-state electronics which made possible the solid-state ballast, or more accurately the solid-state oscillator. Because they dissipated only a few watts of waste heat, the net efficiency gain was 20%. To this we added a photocell that looked down on the workspace and adjusted the intensity to make up the difference between the available daylight and the preferred lighting level.

Since lighting in the U.S. required 30 power plants, the savings potential was phenomenal. We went to GE and were disappointed with their reluctance to adopt such innovations. They much preferred to wait for small companies to take the risks; when the technology and marketing were proven, the big boys would move in and buy the small guys out. Sylvania, Westinghouse and Advance Transformer (Phillips) told us the same story.

So, we went to ERDA, DOE's predecessor, and convinced them

to support small R&D efforts with small companies. With 60 interested firms, we selected two and within six months had our first prototype. This was 1976. Then we went to our local utility, PG&E, and convinced them to let us showcase the ballasts and daylighting controls throughout three stories of their skyscraper in San Francisco.

By the time the installation was debugged, we were saving 40% on lighting costs. Then we waited for two years and nothing happened. To our dismay, the underwriting labs—whose committees were chaired by representatives of the four big lighting companies—still hadn't granted any approvals for the new technologies.

Then, Beatrice Foods decided to become the fifth big actor and bought the solid-state ballast patent rights from one of the small companies (Iota Engineering). That finally got the industry's attention; Universal Manufacturing, a major ballast manufacturer, bought Luminoptics (the other small company), and a third small company, Triad-Ultrad started production.

Today, sales are over a 1.5 million units/year, and we expect by 1995 that these new ballasts will have 50% of the annual $1.2 B market of 90,000,000 ballasts/year.[2]

The other lighting success story is the compact fluorescent, screw-in lamps like the Phillips SL-18. The SL-18 replaces a standard 75-watt incandescent and provides the same lighting service for only 18 watts. What's more, it lasts 7500 hours, outliving the incandescent by 10 to 1.

What are the economics? Say we save 33%, or 33 watts for each 100-watt fixture. The cost of conserved energy is 2.5 cents per kilowatt-hour, and the payback is less than a year. During its ten-year life, it will save five barrels of oil and costs a lot less. The combination of the new ballasts and compact fluorescents will save about $10 Billion a year when saturated into buildings in the United States.

What have we learned? For one thing, this business takes a long time. A ballast lasts about 10 years, so before they actually saturate all the buildings—the last of the old electricity guzzlers won't burn

[2] We estimate today's electronic ballast market at 1.5 million units, selling for $25-$30 retail, versus a "core" ballast market of 60-70 M units, selling for $10 retail. By 1995, electronic ballasts are expected to grow to 30 M units and the price to drop to $20 (in today's dollars), while core ballasts will have grown to 60 M units, and continue to retail at about $10/unit. Thus, at these prices and saturations, the electronic ballasts will have grown by 1990 from 7% of a $0.6 B market to 50% of a $1.2 B market.

out until about 2005–it will be 30 years. Federal acceleration of R&D can reduce the time it takes for new energy-efficient technologies to appear on the market.

Competitiveness Needs Major Attention

Despite the successes of DOE R&D programs, the outlook for the U.S. energy-efficiency industries is clouded by our general inattention to new product development. DOE's conservation R&D program is far too small, and we have nothing in the U.S. comparable to Japan's MITI (Ministry of International Trade and Industry) or to the EEC's BRITE (Basic Research Industrial Technology for Europe.)

For many reasons, including its perception of the market, U.S. industry is lagging in producing energy-efficient products, cars, manufactured homes, air-conditioners, etc. (Aircraft are a notable exception.) As mentioned earlier, at LBL we had disappointing experiences in trying to interest large U.S. manufacturers in high-frequency ballasts or heat mirror films for windows.

The pattern is quite different in Japan, where R&D budgets are comparable to ours, but MITI can step in to manage and support commercialization of new, beautifully-engineered, efficient, exportable products. Sometimes the original R&D was Japanese, but often it was American, acquired by licenses or technology agreements. It is well known that despite U.S. R&D on electronics, Japan has taken the front seat in the world market on VCRs and compact discs.

A similar pattern exists in another high-technology product line: efficient electric motors and controls. U.S. industrial, commercial and residential consumers pay about $80 B/year for power used to run electric motors. Recent advances in magnetic materials and power electronics are greatly improving the efficiency of these motors and motor-driven systems, reducing costs to consumers.

For example, permanent-magnet motors can have 20% lower losses than the best induction motors, run cooler, are smaller and lighter, and can be more precisely controlled. Current applications include machine tools, robotics, computer peripherals, and home appliances.

A 1986 study[1] points out that:

> U.S. competitiveness in this rapidly growing market for new motor technologies is of concern. As pointed out by the National Materials Advisory Board, 'The fundamental work leading to the REPMs [Rare-Earth Permanent Magnets] was done largely in the United States . . . but after government support ceased, materials R&D in the U.S. magnets industry deteriorated. Practically all recent PM materials have been developed to commercial maturity in Japan.'
>
> Thus the NMAB concludes that 'despite the critical importance of magnetic materials, the U.S. is rapidly losing its competitive position.' And this in a market that is expected to reach $2 Billion annually next year.

The fast-growing market in power electronics (electronic devices which control power-consuming equipment) is also facing intense foreign competition. For example, electronic adjustable-speed drives (ASDs), which control the speed of electric motors subjected to varying loads and reduce electricity use by 20% to 30%, use basic components that were first developed by American companies.

Nonetheless, foreign penetration of the U.S. market for ASDs has grown from 15% in 1980 to over 40% in 1985. Foreign companies have not only taken over the lead in production of ASDs, they have taken over the lead in innovation and product development.

Ralph Ferraro of EPRI estimates that the U.S. manufacturers' share of the domestic power electronics market will erode from its present level of 50% to about 25% within five years. According to the Federation of Materials Societies, "if the current trend continues, it can be anticipated that the U.S. will be a minor force in the world market for electronic materials and systems by the 1990s."

A final example of competitive problems is in the area of housing technology, an industry that is traditionally seen in the U.S. as fragmented and slow to accept technical innovation. Contrast our situation with that of Sweden, where the government supports an ambitious R&D program in all aspects of basic and applied building technology.[2]

Total funding is similar to that in the U.S., even though the Swedish market is only about one-twentieth the size of ours. Swedish researchers have produced a host of technical innovations that are already used in "superinsulated" homes around the world. Applications of R&D results to an industrialized building sector have made high-quality, energy-efficient homes the norm in Sweden rather than the exception. Several firms are now exporting their factory-built housing to the U.S. and are beginning to compete successfully in up-scale markets.

Action Items for the Department of Energy

The U.S. can save about $200 B of annual energy bills, delay the resurgence of OPEC, help our environment and, over 10 years, erase Japan's 5% efficiency advantage by investing $50-$100 B annually in improving our energy efficiency.[3]

This can be achieved by redirecting U.S. energy policy (R&D, taxes, and the regulations and profit rules for utilities) towards providing all energy *services* desired by the customer at low cost rather than providing all desired *raw energy* but at high cost.

1. We must redirect DOE's mission from energy supply to energy services. This mission, of course, still includes supply, but DOE must recognize that currently it is far cheaper to improve efficiency. Today DOE pursues mainly long-range, high-risk R&D hoping that industry will take responsibility for improving its short-term efficiency. This has worked fairly well; we have improved our efficiency faster than Western Europe but not nearly as fast as Japan. So DOE must expand its R&D target to improve efficiency and reduce energy costs in buildings, industry, transoortation, and utilities, and to produce competitive, exportable products. All this must, of course, be done in tight collaboration with industry, as has been so successfully carried out by Japan's MITI.

2. In terms of energy efficiency, public buildings and facilities lag the private sector. For example, I know of no large, new Federal buildings with thermal storage, even though "coolth" storage is the current conservation success. We should design our new buildings and retrofit our stock into cost-effective efficiency showplaces. Innovative manufacturers and energy service companies could benefit from the purchasing power of the government; the private sector could learn from these projects, and meanwhile the savings would accrue to the public.

3. U.S. utilities are moving towards "integrated resource planning" which means that they are beginning to treat end-use efficiency as a resource and as an investment that competes with new supply. Accordingly, DOE has started a modest ($1-2 M/year) program in support of least-cost utility planning to provide the necessary infrastructure of uniform information, data and evaluation. The present funding level is inadequate to service the utilities' information needs. This very efficient program should be expanded.

4. Just as DOE is supporting least-cost studies by utilities, it should itself carry out a national least-cost study for all sectors of our economy: buildings, industry and transport. This was last done during 1980 and is published as *A New Prosperity—The SERI Solar/Conservation Study.*[3] This thick book has hundreds of tables and supply curves of conserved energy and power so that one can look up the cost and cost-effectiveness of investments in buildings, appliances, cars, motors, and some industrial processes. The SERI study showed that we could cut energy growth roughly to zero (which has since happened) and that we were building roughly 50 power plants too many (also correct), but the study remained largely unheeded until the plants were completed. Since 1980, the technology and cost picture has improved markedly, and thus these SERI data are obsolescent. We should use least-cost data bases, which are being modernized under least-cost funding and repeat the SERI study.

[3]In order to be saving $200B/year within 10 years, with a 4-year payback, we must invest roughly $800B/10 years = $80B/year.

Policy Suggestions
(Delivered at Chicago Energy Conference)

I conclude with some policy suggestions which are outside the purview of Mr. Sharp's Subcommittee on Energy and Power. As the Director of LBL's Center for Building Science, I first make some suggestions—mainly to utilities and their regulators—about how to get more efficient buildings. Moreover, since the buildings sector pays for 70¢ out of every dollar of electricity sold, the suggestions are mainly aimed at electric utilities.

Efficient Use of Electricity

• *Regulated rate of return for utility demand-side investment.* The fastest way to improve the efficiency of buildings is to have utilities offer financial incentives to retrofit existing ones and incorporate energy-efficient design features in new ones. But in many states utilities earn a return only on their supply side investments; "demand-side" investments beyond the customer's meter are simply expensed. We should change the rules so that utilities make at least as much profit from demand-side investments as from their traditional investments. Even better, we should follow the lead of Washington State, which now gives a 2% *premium* on the rate of return on conservation investment. Massachusetts and Connecticut now have such legislation pending.

• *Acid rain.* It is not yet widely realized that the cheapest way to avoid acid rain is to buy efficient home appliances and equipment which reduce the need for electricity and its associated SOX emissions. But unlike scrubbers, which cost money and reduce power plant efficiency, efficient appliances save money. Of course, efficient appliances will typically only save 25% of our electric use, and our goal is to cut SOX emissions by about 50%, so we'll have to buy some scrubbers too, but we can finance them out of the conservation savings. This topic is nicely discussed by Howard Geller.[4]

• *Competitive bidding between conventional new energy supply, cogeneration and conservation.* PURPA, the Public Utility Regulatory Policies Act of 1978, requires that utilities permit independent power producers to compete with the construction of utility power plants, but an exciting new idea being tried in New England is to call also for competitive bidding from energy service companies to retrofit existing buildings and improve the efficiency of new ones. The first trial auctions have produced remarkable bids. around 1¢/kWh and $300/kW for lighting retrofits in Massachusetts.

• *Compulsory Utility Bonds.* Yet another way to build efficiency into new buildings is via compulsory utility bonds that must be purchased by builders at a price in proportion of the burden that the new building places on the electricity system. Eventual repayment of the bonds substitutes for a new tariff.

Let's take as a specific example: Pepco's next plant, which will cost $400/kW and go on line in 1994. Assume that a speculative builder plans an office building which will demand 6W/square foot (square meters). At $400/kW, this will require the builder to invest $2.40/square foot in the utility capital fund (bond). Faced with this

roughly 3% increase in his first cost, he may redesign and reduce the peak demand to 3W/square foot, resulting in a $1.20/sq ft bond price. The redesign will cost considerably less than this.

A few years after the building is completed, the new plant comes on line, is rate-based, and starts to pay off its indebtedness, typically over 20 years. The builder (or the next owner to whom the builder has sold the note at its face value) now receives equal monthly payments for 30 years or perhaps monthly deductions from their electricity bill.

When the entire life-cycle is complete in 2013, the builder (or new owner) has been fairly returned his capital. But society has had the benefit of a more-efficient building, whose life cycle costs have been reduced by about 30%.

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Citations

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