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ENERGY IN THE URBAN ENVIRONMENT

PROCEEDINGS OF THE TWENTY-SECOND ANNUAL ILLINOIS ENERGY CONFERENCE

HOTEL INTER-CONTINENTAL
CHICAGO, ILLINOIS

NOVEMBER 16-17, 1994

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CONTENTS

FOREWORD

FOREWORD

The Twenty-Second Annual Illinois Energy Conference entitled, "Energy in the Urban Environment," was held in Chicago, Illinois on November 16-17, 1994. It was organized by the Energy Resources Center, University of Illinois at Chicago with support provided by the U.S. Environmental Protection Agency, the U.S. Department of Energy, the Illinois Department of Energy and Natural Resources, and the Citizens Council on Energy Resources.

In past years, it has been the practice of the planning committee to focus the annual conference on one particular energy issue such as electric power generation, natural gas, coal, nuclear, etc. This year, the committee changed this cycle by centering the conference program on the energy and environmental challenges facing large metropolitan areas. Clearly, if U.S. cities can begin to resolve their energy problems, the country will have come a long way towards improving the nation's total energy and environmental picture.

The conference was divided into four plenary sessions. Session one opened the program by looking back at the environmental status of our cities twenty years ago and compared the progress with the challenges facing today's large cities. Session two focused on the concept of sustainable economic development and how it is being implemented in Chicago. Session three addressed specific attempts to improve the energy and environmental infrastructure. Finally, session four centered on the changing urban transportation sector.

As an added feature to this year's conference program, the U.S. Department of Energy combined their "National Energy Policy" public meeting with the conference agenda. The result was a lively and informative roundtable discussion on the impact of energy policy on urban growth, jobs and the environment. The U.S. Department of Energy's Assistant Secretary for Energy, Christine Ervin, moderated the town meeting. A transcript of the discussion is available in the DOE Reading Room in the University of Illinois at Chicago library.

Appreciation is extended to the excellent speakers whose papers appear in this publication. The high quality of the program reflects the considerable time and effort expended by the speakers in the preparation of the presentations. In particular, I thank the keynote speakers Samuel F. Skinner, Christine Ervin, and Valdus Adamkus. I also thank the conference planning committee for their outstanding efforts which are reflected in the final conference program. In addition, a word of thanks is given to the University of Illinois Energy Resources Center staff especially James Wiet and David Balderas who handled the detail work of the conference.

I hope you find these conference proceedings useful in providing a new policy perspective on the impact of energy and environmental factors affecting large metropolitan areas.

JP Hartnett

James P. Hartnett
Conference Chairman

INTRODUCTORY REMARKS

INTRODUCTORY REMARKS: A FEDERAL ENERGY PERSPECTIVE

David T. Goldman
Deputy Manager
U.S. Department of Energy
Chicago Operations Office

It is a real pleasure to join John Moore in welcoming you to the 22nd Annual Illinois Energy Conference. It is highly appropriate that the State of Illinois and the Department of Energy (DOE) should team up to begin this important examination of urban energy issues. Our agencies have been collaborating for some time on a variety of energy-related topics. These range from partnerships in support of research and technology development at our national laboratories to our mutual support of energy-efficient rehabs of multi-family buildings and other urban redevelopment projects in the inner city.

This year's theme, "Energy in the Urban Environment," is a critical concern for governments at every level, and certainly for the State of Illinois and DOE.

Earlier this year the U.S. Department of Energy issued its first-ever Strategic Plan, which defined the Department's mission in terms of five main "Business Lines." These are:

- Energy Resources,
- Industrial Competitiveness,
- Science and Technology,
- Environmental Quality, and
- National Security

Our conference program relates directly to the first four of these business lines, and at least indirectly to the last. So urban energy concerns are woven throughout our Strategic Plan and are high on DOE's national energy policy agenda.

Nothing could demonstrate this point more dramatically than the opportunity we have at this year's conference to directly impact the formulation of the National Energy Policy Plan which will be submitted to Congress next year.

For years, Dr. Hartnett and the Illinois Energy Conference Planning Committee have worked hard to develop conferences that would help shape regional and national energy policy by providing a forum where top-quality speakers could address timely energy issues. This year we have integrated that process into our conference program in an unprecedented way.

Today, Assistant Secretary for Energy Efficiency and Renewables, Christine Ervin, will lead a prestigious panel representing both local and national interests in a discussion of "Energy Issues in Urban Areas." The public has been invited to join Illinois Energy Conference participants for this portion of the program to participate in a lively and productive discussion that will provide useful perspectives on these issues and input that DOE can use in its planning.

Yesterday a similar roundtable was held addressing the "Future of Coal as an Energy Resource." That panel, made up of similarly prestigious individuals interested in coal issues, was led by Susan Tierney, DOE Assistant Secretary for Policy.

Both panels are part of a nationwide program of policy discussions intended to assist DOE in the development of the National Energy Policy Plan. Input from these roundtables will be considered along with written comments received in developing our recommendations to Congress.

We are experiencing a unique opportunity to fulfill one of the most important objectives of this conference. Our discussions today will be part of the national policy process more directly that ever before in this meeting's 22 year history.

INTRODUCTORY REMARKS: A STATE ENERGY PERSPECTIVE

John S. Moore
Director
Illinois Department of Energy
and Natural Resources

For the 22nd consecutive year, the Illinois Department of Energy and Natural Resources is proud to be a sponsor and partner of this energy conference effort. On behalf of Governor Edgar and the department, I would like to express my appreciation and extend my congratulations to Dr. James Hartnett and the University of Illinois Energy Resources Center for sustaining this effort and for continuously bringing timely energy discussions to the conference. The Department of Energy and Natural Resources (ENR), through conferences such as this, continues its ongoing mission to promote the cost-effective development of Illinois' energy resources and encourage cost-effective energy use choices by Illinois energy consumers. This morning I would like to describe a sampling of ENR's efforts and programs in the area of energy efficiency and renewable resources.

First, ENR is proud to be a partner with Chicago in the U.S. Department of Energy's (USDOE) Clean Cities Program. This is a voluntary program promoted by USDOE to encourage local governments and organizations to form partnerships to establish and promote markets for clean fuel vehicles. This past year, the City of Chicago was designated to participate in the program and evaluate the use of alternative fuels in municipal refuse truck engines. The Clean Cities Program is one of USDOE's highest priorities, and ENR is proud to be a partner.

In addition to the Clean Cities effort, ENR maintains an active Alternative Transportation Fuel Program, emphasizing Illinois' own renewable fuel — ethanol. The department is part of a test program comprised of ethanol powered, flexible fuel vehicles which have been incorporated into the state fleet. Over 120 E-85 vehicles are presently operating throughout the state.

In conjunction with the U.S. Department of Energy, ENR is working on a three year test program for ethanol fuel in heavy duty, over-the-road trucks. Currently, five heavy duty trucks are operating in Illinois as part of the Archer Daniels Midland Company's over-the-road fleet. Over 800,000 miles have been accumulated on the trucks thus far.

Along with the Peoria Transit District, ENR has sponsored the first ethanol powered city bus program in the nation. The 14 ethanol powered buses have accumulated over a million total miles. This is the largest ethanol bus demonstration project in the country.

In cooperation with PACE, a division of the Chicago Regional Transit Authority, the department continues to work toward the development of an ethanol fuel cell electric battery bus in the Chicago area. The Ethanol Fuel-Cell Bus Project will produce the first ethanol fuel cell bus in the nation.

Through the development of alternative energy technologies, many of our natural resources such as the sun, wind, water and products from our soil can be converted into renewable sources of energy. ENR has been an active partner in developing these resources including two major hydroelectric projects in Kankakee and LaSalle/Peru. The development and utilization of alternative energy technologies are important aspects in the development of a balanced energy policy for Illinois.

The department continues to promote residential energy efficiency through a grant program available to not-for-profit developers of low income housing. This demonstration program has won several national wards. Over 300 units have been rehabbed, producing energy savings of 50 to 80 percent.

Working with local governments, the New Construction Energy Efficient Program provides incremental funding and technical assistance for new home programs sponsored by local governments. The program develops construction plans that produce heating bills of less than $200 annually. ENR is an active partner with the City of Chicago's New Homes for Chicago Program which is an innovative city program to encourage affordable new homes in low and moderate income neighborhoods.

The Homeless Shelter Weatherization Program provides technical support and funds for the weatherization of homeless shelters. These funds are spent in conjunction with various state and city sponsored rehab programs to maximize the energy savings potential of ENR's investment.

In response to the summer flooding of 1993, the department has made available a $1,500 grant to flood victims who are rebuilding outside of flood areas. The energy incentive allows residents to incorporate energy efficiency into their new structures.

ENR has committed to working in the communities of Valmeyer, Keithsburg, Grafton and Warsaw.

As part of its continued effort to promote energy education, the ENR library provides valuable services to staff members and the public by filling research and information requests through both the library and by use of computers. The ENR Clearinghouse staff distributes energy and environmental information, free of charge, to Illinois schools and the general public.

Another energy and environmental education program for Illinois Kindergarten through Grade 12 schools is available through the department's ILEED program. ILEED, which stands for the Illinois Energy Education Development Program, provides over 2,000 Illinois schools with free hands-on workshops, newsletters, essay contests, and educational materials for all disciplines.

To further enhance environmental education, the Illinois Chamber and ENR recently developed the PIE (Partners in Education) Program and Directory. This program provides a list of resources provided by Illinois businesses to Illinois schools.

In 1990, a home energy rating system entitled, Energy Wise Homes of Illinois, was established to create a definitive method for determining the energy efficiency of residential structures.

ENR also assists schools and hospitals through the Institutional Conservation Program. Grants are provided for energy study on a facility and to cost share energy-saving retrofits. Over the first 16 grant cycles, 600 institutions have received over $57 million in funds.

With a look toward the future, ENR is spearheading a multi-agency pilot initiative exploring the energy/cost saving opportunities in select state owned facilities. The initiative utilizes private financing and guaranteed energy savings to pay for all project costs. It is expected that $17 million will be invested in this effort.

Another state building program, the State Building Energy Program, tracks energy use, complies weather data, analyzes utility rates and charges, promotes Low Cost-No Cost energy conservation improvements, and trains user agencies to further reduce the state's utility bills.

During the last four years, the department, with the cooperation of the Capital Development Board, implemented a process to review and analyze energy impacts associated with proposed capital projects in state facilities. These efforts have produced significant savings over the past years. The Low Cost-No Cost Program alone has produced energy cost savings of over $8 million.

ENR has made a firm commitment to finding additional energy savings through the Employee Commute Option Program and the Telecommuting Program. These efforts can reduce urban pollution in addition to producing substantial energy savings.

ENR is also active in the area of demand-side planning. This is an effort undertaken by consumers, utilities, energy service companies, and governmental agencies to reduce electric consumption or shift the consumption of electricity to lower cost time periods. We have worked with the City of Chicago, Illinois utilities, and others to promote cost-effective demand-side activities through several ongoing initiatives. You will hear more about ENR's Demand-Side Planning efforts during this conference.

Finally, ENR cosponsors conferences like this to encourage important debates on pressing energy and environmental issues facing Illinois.

Once again, thanks to the Energy Resources Center for this opportunity and welcome to the conference.

KEYNOTE PRESENTATIONS

MANAGING AN EVOLUTION: DEREGULATION OF THE ELECTRIC UTILITY INDUSTRY

Samuel K. Skinner
President
Commonwealth Edison Company

When I joined ComEd a little over two years ago, discussion about "restructuring our industry" had just begun. Well, things have really snowballed since then. The deregulation issue has quickly moved to the front burner. The pros and cons of deregulation are being discussed everyday in utility board rooms, state regulatory agencies, the media, and in Washington, DC.

There is no doubt about it. What you will see happen to the utility industry within the next five years will be the largest, most comprehensive change in the history of the industry. I believe it is fair to predict that shortly after the turn of the century, consumers will be able to choose a company to supply electricity just as they choose long-distance phone service today.

It is an evolution — a gradual process that becomes more complex as time changes. And the evolution in the electric utility industry is just getting started. Eventually, the regulated monopoly will be extinct.

The electric utility industry has enjoyed the special status of a regulated monopoly for more than a century. Our business was built on the premise that customers had no choice, revenues were ensured, dividends were guaranteed, and employees had a lifetime of job security.

To unravel 100 years of status quo like that and become a competitive electric industry requires a very dynamic change.

If we look back in history, we could have seen these changes coming. After all, it happened in the railroad, trucking, airline, communication and gas industries. A decade ago they, too, were the only regulated monopolies in their respective areas. Once they deregulated, the electric utility industry stood alone. If history really does repeat itself, we should have known that the "regulated monopoly" status would not last much longer, and our time would come.

If I were to identify where this evolution started, I probably would point to California. The announcement last Spring by the California Public Utilities Commission to open retail access was the shot heard around the world in the electric utility business. That law will allow consumers, for the first time ever, to buy electricity from alternative sources instead of the local utility. Large, industrial customers will be able to shop around for their electricity beginning next year. Residential customers will have that choice at about the turn of the century.

Since the California legislation, a number of other states have begun to take the entire deregulation issue, place it under a microscope, and attempt to discover a viable solution.

What we found is that the activities in California were precipitous. The changing of an industry like the electric utility industry must be done cautiously. An evolution must not become a revolution. The necessary changes must be methodic. They need to be accurate. And they need to be proven.

A failure to do so will destroy an industry that has served the people so well for more than 100 years. Let's face it. We have the most effective electric utility industry in the world. It works and it works well.

We can also learn lessons from history. And it is clear from other industry restructuring that if we are not careful, the consequences could be devastating. They can destroy that effectiveness that is so important to our world competitive position.

Those familiar with the gas industry know exactly what I am talking about. There are winners and losers, and many of the losers are losers through no fault of their own.

They lost because they played by the rules and suddenly, the rules of deregulation changed. And when they did, no one took into account the impact that kind of precipitous change had on those companies, their stockholders, employees, and most importantly, their customers.

The dilemma policymakers at the state and national level face is how to move toward the deregulation of our industry without changing the signals halfway through the game, and still protect the financial viability and operational performance of electric utilities.

We cannot forget that most of those utilities are owned by and serve people, not just institutions. If the financial stability of the electric utility business is not protected, the equity of millions of middle-class Americans will be adversely affected. If we weaken this industry, we hurt ourselves as we compete in world markets.

The policymakers, like the utilities, have a real challenge ahead of them. They must do this right. And we all need to get it right the first time. That is why it is so crucial not to move precipitously.

At the same time, business must be willing to change. Take a look at the airline industry, for example. When I was growing up, one of the premier national carriers was Eastern Airlines. The top international carrier was Pan Am. Neither of them are in existence today because the rules changed and they did not.

When deregulation hit the airline industry in 1979, it was pure chaos. Through mergers, acquisitions and liquidations, the major carriers dropped from 27 to nine. For virtually all of the airlines, operating costs rose about 96 percent during the first six years of deregulation, profits fell 74 percent and productivity was flat.

If you think those airlines were big, the nation's pool of investor-owned electric utilities — its base of employees and shareholders — is even bigger. Each one of us have a daily impact on the way that every American lives, works and enjoys the quality of life.

I do not think the utility industry or policymakers have yet discovered the best answer to this challenge. In California, they want to move by the turn of the century. Yet because of their precipitous activity, the financial well-being of utilities all over this country has been jeopardized.

In other states, such as Connecticut, regulators are advocating caution and say it is still too early to move. Here in Illinois, we recognize that change is coming. And we are taking steps to prepare ourselves to accept those changes when they are delivered to us.

Fortunately, the Illinois Commerce Commission and most reasonable parties recognize the need to proceed on a thoughtful basis and are doing so.

Without getting into the specific details of what we are doing at ComEd, let me at least paint a picture of what our response to deregulation might look like. Regardless of what happens, there are at least three known factors that will emerge from this reshaped market:

1. Customers at the retail level will have more options than they do today.

2. Transmission facilities will be operated on a regional basis, and electric companies will have access to those facilities at fair and reasonable prices.

3. The infrastructure of electric distribution systems will continue to be regulated on a franchise basis, or on a cost-plus basis. That will continue until we can discover ways to duplicate this expertise. Unlike the communications industry, we have not yet developed a way to send electricity through radio waves.

We at ComEd believe as we discover how to bring about these changes that utilities must concentrate on delivering a high level of customer service. Because if we do not take care of our customers, someone else will.

For the first time, customers will have choices. They will make those choices based on price, reliability and quality of service. If a utility cannot provide first-tier performance in all of those areas, it simply will not survive.

The "experts" have already begun to pick their winners and losers in the deregulation movement for the electric utility industry.

I suggest that the "experts" are probably basing those decisions on a complicated set of scenarios. In fact, right now, they have it entirely too complicated. The "experts" are looking at this issue on a micro basis.

If they looked at it on a macro basis, they would understand the utilities that survive deregulation will be the ones that emerge with an excellent reputation for customer service, deliver a quality product, and are competitively priced. It is that simple.

It is no longer business as usual in the electric utility industry.

We at ComEd believe that the companies who are recognized today as business leaders are the ones who have changed their culture — their way of doing business. At ComEd, we intend to emerge as a new business leader.

To many, these changes are very exciting. In the long run, it will make electricity pricing in the United States more competitive. It will eliminate the inefficiencies that have existed in this industry for years. And it will make the nation's investor-owned utilities better, stronger, more productive and more efficient.

Only one question remains unanswered: How do you initiate this change fairly, protect investors, and most importantly, ensure customers are not short-changed?

That is a tough question, and we are still searching for answers. In the meantime, as deregulation becomes more prevalent, we must emphasize caution, tact, and deliberation about implementing it.

Every one of us has a stake in this. The United States has the best electric industry in the world. By moving forward with all deliberate speed, by making well thought out decisions, and by examining all sides of an issue before the decision is made, I believe we can keep this industry as the best in the world.

ENERGY EFFICIENCY, RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT

Christine A. Ervin
Assistant Secretary
Energy Efficiency & Renewables
U.S. Department of Energy

ENERGY EFFICIENCY, RENEWABLE ENERGY

- For the past 15 years, the U.S. Department of Energy (DOE) has sponsored "Energy Awareness Month" in October.

- For parts of the country, where October brings the first signs of the winter heating season, most people begin thinking about energy. It is time to put up the storm windows, give the furnace a tune-up, patch the caulking.

- But beyond those obvious concerns, we may wonder why DOE wants us to be aware of energy. Energy is one of those things we do not want to have to think about very much, like plumbing. As long as it works, we do not want to have to worry about it.

- And today, energy seems to work. There are no obvious crises, no fuel shortages, and no skyrocketing prices.

- But, in fact, there is good reason for each of us to educate ourselves about how we use energy. Today, we stand at a crossroads.

  - It is a moment in which millions upon millions of people now living in comparative poverty around the world aspire to a far higher standard of living.

- It is a moment when resource competition threatens the world community with constant conflicts.

- It is a moment when nations — including the United States — are making crucial energy decisions that will affect the world environment for centuries to come.

- There has never been a better set of reasons for each of us to become more aware of energy and the crucial role it is playing in the future we are creating for our children.

- I would like to talk to you about energy and its importance — and about some of the things we are doing at the Office of Energy Efficiency and Renewable Energy to help guide all of us to a brighter energy future.

MISSION STATEMENT

- The Office of Energy Efficiency and Renewable Energy (EE) is part of the U.S. Department of Energy that is specifically charged with encouraging the more efficient use of energy resources, and the use of renewable energy resources — such as solar power, wind power, biomass energy and geothermal energy.

- EE's annual budget is about $1 billion. Most of that money is spent on research and development of new efficiency and renewable energy technologies.

- In the past several years, EE has increased its emphasis on technology deployment through partnerships with states, local governments and private companies. Partnerships move new discoveries more quickly into the marketplace, where they can create jobs, prevent pollution, save resources, and produce many other benefits.

- EE's mission is ambitious, but very straightforward:

  - Its job is to lead the United States to a stronger economy, a cleaner environment and a more secure future. Energy efficiency and renewable energy are the tools DOE will use to accomplish that mission.

  - Note that the mission statement uses the term "sustainable energy" — a collective term for efficiency and renewables. I will talk more in a moment about what that term means.

ENERGY AWARENESS IS LOW

- Let us start by testing your energy awareness.

- Question 1:

  We all know that we are an automobile society. What percentage of American households own three or more cars? Not two cars, but *three* or more?

  Answer:

  One in five households in the United States has a fleet of three cars or more.

- Question 2:

  How many Americans live today in counties that regularly violate one of more of the air quality standards set by the Environmental Protection Agency (EPA)?

  Answer:

  Fifty-four million Americans, or one of every five of us. And the health costs are staggering. Running for 30 minutes in an urban area that does not meet EPA standards or ozone pollution, for example, causes lung damage equal to smoking a full pack of cigarettes. About 140,000 Americans alive today can expect to get cancer due to toxic air emissions.

- Question 3:

  If current policies and energy use trends continue, how much will U.S. energy consumption rise between 1990 and 2025?

  Answer:

  Forty-six percent.

- Question 4:

  We have often heard that the U.S. has only five percent of the world's population, but consumes 25 percent of the world's energy. How much energy is used by the average person in a developing country, compared to the average U.S. citizen?

  Answer:

  One-twelfth. The average American consumes 33 times as much energy as the average resident of India; 13 times the average resident of China; and 2.5 times the average resident of Japan.

ENERGY CONSUMPTION PERVADES EVERYTHING WE DO

- The fact is virtually everything we do involves the production or consumption of energy. Think about it for a moment. Can you imagine any moment of the day or night when you are *not* consuming energy in one form or another?

- Because energy production and consumption are so pervasive, they have enormous impact on our economy. See Figure 1. (All figures appear at the end of this paper).

  - For example, our annual energy consumption in the U.S. amounts to $1,900 per person — the equivalent of 55 barrels of oil for every man, woman and child;

  - Energy accounts for 7.7 percent of our gross domestic product; and

  - Energy activities account for 1.4 million U.S. jobs and $11.3 billion in U.S. exports overseas.

- We spend nearly as much on energy consumption as we do each year on medical care and housing.

  - Per capita spending on medical care is $2,565; on housing, it is $2,280.

THERE IS ROOM FOR IMPROVEMENT

- Where do we get our energy?

  - As the column on the far left shows (Figure 2), more than 40 percent of our energy comes from petroleum. Nearly 25 percent comes from natural gas; about 23 percent comes from coal; 8 percent comes from nuclear power plants; and nearly 4 percent comes from hydroelectric plants.

- How do we use it?

  - About 36 percent of our energy is consumed by industry, and a nearly equal amount is consumed by buildings.

  - The transportation sector consumes just over 27 percent of our energy.

- The column in the center of Figure 2 shows a rather dramatic fact: Of all of the energy we consume, 33 percent is lost as a result of process inefficiencies and 42 percent as a result of thermal losses. Only 25 percent does useful work.

- Let me give you a specific example. How much of the gasoline energy consumed by cars do you think actually is used to move the wheels?

  - The answer is about 10 percent at 55 miles/hour. The other 90 percent of the energy in the gasoline is wasted.

- Now, some waste is unavoidable. Physical laws limit the amount of useful work we can squeeze from every unit of energy. However, we can change how we provide these services and therefore create higher efficiencies.

- There is a great deal of room for improvement in our energy efficiency. After all, what we need are the services energy provides, keeping in mind economics, the environment, and the effect on future generations.

* Finally, let us look at the contribution fossil energy makes to some of our better-known pollution problems.

  - Energy sector emissions, as a percent of all U.S. emissions, contribute:

    - Virtually all of our carbon dioxide pollution;

    - Three-fourths of our volatile organic compound emissions — the stuff that produces urban ozone;

    - Seventy percent of our carbon monoxide emissions;

    - Ninety-five percent of our sulfur dioxide emissions; and

    - Ninety-five percent of our nitrous oxide emissions.

PROBLEMS:

U.S. ENERGY IMPORTS ARE RISING TO RECORD LEVELS

- One of the problems is the amount of oil the U.S. imports from other countries.

- Figure 3 charts the roller-coaster pattern of our import levels.

- Back in the 70s, when the oil crisis made us realize how vulnerable we were to the whims of oil-producing countries, we vowed we would never let it happen again.

- But last year, we set a new import record. Our imports of crude oil were 1.8 percent higher than they were in the last record year, 1977.

- Some experts argue that we are not as vulnerable to supply disruptions as we were in the 1970s, because our imports today come from a greater variety of foreign sources. We are not as dependent as we once were on a single region of the world.

- Yet our reliance on Persian Gulf oil — and our reliance on a stable world economy fed by that oil — was still important enough to be a significant factor in our decision to go to war over the invasion of Kuwait.

- Imports have an economic impact on the U.S., as well as a security impact. Imported oil was responsible for $51 billion, or about 38 percent, of our foreign trade deficit last year.

- The trend is upward. Predictions are that our net import levels will rise to 60 percent of our oil by 2010.

- And the Energy Information Administration projects that world oil prices will increase from $18.20 in 1992 to $28.16 by 2010, driving the trade deficit even higher.

TRANSPORTATION ENERGY DEMAND IS INCREASING

- Who is using all this oil? Interestingly, oil use by many of the major sectors of our economy actually declined between 1973 and 1992. According to the Energy Information Administration:

  - Oil use by electric utilities dropped 73 percent;

  - Oil use by residential and commercial buildings declined 51 percent;

  - Oil consumption by industry dropped 5 percent; but

  - Oil use by the transportation sector is climbing.

- Energy use in the transportation sector constitutes a paradox. See Figure 4.

  - On the one hand, the mile-per-gallon efficiency of passenger cars has increased 39 percent — from 15.5 miles per gallon in 1980 to 21.6 miles per gallon in 1992.

- But on the other hand, transportation energy consumption has increased.

- Why? For one thing, driving is cheaper today in constant dollars than it was in 1980. In 1980, the fuel cost of driving was 12.5 cents per mile. By 1992, it was about a nickel a mile — down 59 percent.

- Many other factors attribute to greater energy use in transportation — not the least among them are our sprawling land use patterns and the number of cars American families own.

- The result is that even though cars are using less fuel for every mile of travel, Americans are traveling more miles than ever. Over the last 15 years, vehicle miles traveled have increased 43 percent.

- The bottom line is that transportation energy consumption has increased 14 percent since 1980.

U.S. ENERGY USE IS INCREASING

- Spurred by the oil shocks of the 1970s, energy efficiency and conservation measures reduced the *growth* of U.S. energy consumption by 30 percent between 1973 and 1986, saving consumers an estimated $225 billion a year. During this time period, our gross national product rose considerably, proving that economic growth does not inevitably mean a corresponding increase in energy consumption.

- Despite the reduced growth in consumption, our total energy consumption in the U.S. increased 13 percent between 1973 and 1993. See Figure 5.

- And as we just learned in our quiz, U.S. consumption is expected to rise 46 percent between 1990 and 2025 if current trends continue.

POPULATION GROWTH INCREASES WORLD ENERGY DEMAND

- What's true in the U.S. is also true globally. World energy demand is rising.

- Population is one of the big drivers of world energy consumption. As Figure 6 shows, world population is on a steep incline upward. Projections show that population will grow from five billion in 1987 to eight billion by 2020.

- Today, most of the world's population lives in less developed nations. Most of the world's population growth will occur in these nations.

- Every new soul is a bundle of aspirations, seeking a higher quality of life. Every new planetary citizen is an energy consumer.

- By 2010, just 16 years from now, world energy consumption is expected to increase as much as 50 percent.

OUR ENERGY USE CONTINUES TO HURT THE ENVIRONMENT

- The problem is not only where we are getting our energy, but how we consume it.

- As the *Economist* magazine succinctly put it, the production and use of energy causes more environmental damage than any other single human activity.

- We cannot bring about any significant improvement in the global environment — nor prevent serious new degradation — without major changes in where we get our energy and how we use it.

TOTAL COSTS OF ENERGY CONSUMPTION AREN'T ALWAYS COUNTED

- It would be wonderful if the energy marketplace reflected these problems, but it often does not. The true costs of our current energy consumption patterns are not always counted. They remain hidden. See Figure 7.

- Let us use the transportation sector as an example once more, and look at the real cost of driving.

- According to the World Resources Institute (WRI), the hidden costs of driving include:

  - $10 billion annually in health care costs due to air pollution;

  - More than $25 billion each year in spending to protect our energy security;

  - More than $100 billion in lost wages and fuel consumption due to traffic congestion; and

  - Nearly $360 billion annually in accident costs.

  - According to WTI, if this $495 billion in hidden costs were really reflected in the cost of energy, the cost of a gallon of gasoline would increase by at least $3.84.

- To sum up, if we continue business as usual, we face more resource competition, environmental damage and enormous costs. These are the reasons that one can argue we have a quiet energy crisis underway today.
  - We do not have gas lines, and we do not have immediate fuel shortages.
  - But we do have the signs of a broad and gradual crisis.
  - We stand at a critical crossroads. How will we supply the energy needed here in the U.S. — and the staggering amounts of energy needed worldwide — in the decades ahead?

OPPORTUNITIES:

WORLD ENERGY MARKETS OFFER INCREDIBLE POTENTIAL

- In a business-as-usual scenario, the steep growth in world energy demand is trouble. But in a different scenario — a "green" scenario — it is filled with opportunity. See Figure 8.
- The United Nations estimates that more than two million village worldwide are without electric power for their water supply, refrigeration, lighting and other basic needs.
  - Worldwide, the anticipated investment in electric technologies will be staggering over the next several years — totaling $1 trillion dollars, according to the World Bank.
- A huge market also is opening for green technologies — a market of $84 billion a year, by some estimates.
- These new markets present enormous opportunities for our emerging renewable energy and energy efficiency industries. For example, the cost of extending utility grids, which were as much as $46,000 per kilometer in 1988, is prohibitive in many areas of the world, making renewable electric systems very desirable.

COST OF RENEWABLES IS DECREASING

- Are renewable energy technologies ready to seize this opportunity? Yes.

- Renewables now supply about eight percent of our total energy demand in the U.S., and about 18 percent of the energy used worldwide. They are poised to grow.

- DOE's research and development programs have been working hard to make renewable energy systems competitive, and they have come a long way in the last 15 years.

- Figures 9 through 12 show the price trends for power produced by photovoltaics, wind turbines, biomass energy and geothermal energy. The prices per unit of energy are decreasing, and our research will keep these costs moving down.

CLEAN ENERGY IS ESSENTIAL TO SUSTAINABLE DEVELOPMENT

- I would like to mention one final area of opportunity. Around the world, new attention is being given today to a strategy know as "sustainable development."

- Energy efficiency and renewable energy are absolutely essential to our ability to implement that strategy.

SUSTAINABLE DEVELOPMENT:

WHAT IS SUSTAINABLE DEVELOPMENT?

- The term was coined in 1987 by the Brundtland Commission, a United Nations panel that studied world development trends.

  - Sustainable development is defined as "meeting the needs of the present without compromising the ability of future generations to meet their needs."

  - In economic terms, it means living off the earth's interest, and not its capital.

- Since the Clinton Administration took office, sustainable development has become a key principle in public policy.

  - The White House created a President's Council on Sustainable Development that is scheduled to make policy recommendations next spring.

  - At DOE, Secretary Hazel O'Leary has created a new policy office focused on the role that energy production and consumption plays in sustainable development.

- ◻ DOE has sponsored eight round tables around the country to lay the groundwork for a new National Energy Policy Plan due to Congress next year. Sustainable energy has been the theme of these town meetings.

- Although we may think of it as a relatively recent policy goal, Thomas Jefferson believed that each generation has an obligation to leave the next a planet whose resources are unencumbered by debt.

- The fundamental concept of sustainable development has been around a long time. It is based on enduring human values — such as good stewardship and responsibility to our children.

SUSTAINABLE ENERGY POLICY

- Because energy production is responsible for so much environmental damage, we cannot achieve sustainable development without a profound change in where we get energy and how we use it. Energy use is critical to sustainable development. Here are a few of the attributes of sustainable energy use:

  - Sustainable energy policy improves the efficiency of energy consumption;

  - It reduces the environmental impacts of economic activity;

  - It minimizes wastes, and often prevents pollution before it occurs;

  - It minimizes the use of finite resources; and

  - It makes our economies and industries stronger by diversifying our energy mix, protecting against supply disruptions, price spikes, and the other hazards of a nondiversified mix.

PROGRAMS TO IMPLEMENT SOLUTIONS:

EE SEEKS MEASURABLE RESULTS

- To begin fulfilling the promise of sustainable energy, we have set a number of strategic objectives. Her are just a few:

  - By the turn of the century — and remember, that is less than six years away:

    - ◻ We will reduce America's energy costs by $30 billion a year;

- ☐ We will increase the market penetration of renewable electric generation technologies to produce 20,000 megawatts of new electric generation capacity; and

- ☐ One of every ten cars on the road will be using alternative fuels.

■ In the next ten years:

- ☐ We will *cut federal energy consumption* by nearly a third;

- ☐ We will increase industrial facility energy efficiency by 20 percent;

- ☐ The nation will be producing three billion gallons of biomass motor fuels, helped in part by DOE technology; and

- ☐ U.S. leadership in efficiency and renewable energy will be established worldwide.

■ And in the next 15 years:

- ☐ We will improve national energy use by 30 percent; and

- ☐ We will create more than one million U.S. jobs based on energy efficiency and renewable energy.

SUSTAINABLE ENERGY INITIATIVES: UTILITIES

- What are some of the specific programs we have launched to reach these objectives?

- In the utilities sector, we are implementing a program called "Climate Challenge." It is part of the President's Climate Change Action Plan aimed at reducing the emissions of greenhouse gases. Climate Challenge is a voluntary program with utilities to reduce emissions.

  ■ By 1995, more than 680 utilities of various types had signed up for the program.

- Another climate change program involves Renewable Energy Collaboratives. We are creating joint ventures between DOE and private companies to demonstrate a variety of renewable electric technologies, using solar, wind, geothermal and biomass resources.

- An example is a collaboration underway right now to use renewable electric technologies at the 1996 Olympic Games in Atlanta, where a worldwide audience can see them work.

UTILITIES CASE STUDY: TURBINE VERIFICATION PROGRAM

- DOE is especially proud of the difference we have made in wind power technology.

- In the 1970s, there was a great surge of interest in wind machines. But the models on the market to produce electricity in those days used blades modeled on airplane propellers. Before long, there were large numbers of blade failures, which damaged the reputation of wind machines.

- Throughout the 1980s, our scientists and engineers worked steadily to improve wind turbine technology. It has been a classic success story. Today's wind machines are dramatically more efficient and reliable than the old models.

- Today, wind power is competitive with conventional electricity in many parts of the U.S., and its contribution is growing.

  - In California, wind machines are producing 1,700 megawatts of electricity today — the equivalent of two large coal plants. Wind provides 1.2 percent of California's electricity, keeping millions of tons of greenhouse gases out of the atmosphere.

  - But other parts of the nation hold potential to produce even more. In North Dakota alone, there are enough good wind sites to supply 36 percent of all the electricity consumed in 1990 by the lower 48 states.

- As much as 5,000 megawatts of wind electricity is planned or under construction around the U.S. Wind is booming in other nations, too. Sizeable wind plants are underway in Europe, Argentina, Chile, China, India, Mexico and the Ukraine.

  - We are continuing to work on better technology and lower prices to make sure that U.S. companies capture these new markets.

  - To verify new technical breakthroughs as they occur, we have established a $40 million program with the Electric Power Research Institute, and we have just dedicated a new, world-class wind technology center at the National Renewable Energy Laboratory (NREL) — a facility that will allow NREL and the wind industry to test and verify technical advances.

SUSTAINABLE ENERGY INITIATIVES: BUILDINGS

- Let us turn to the buildings sector. Buildings are an enormous energy consumer in the U.S.

  - They use 36 percent of our energy supply, worth $193 billion each year;

  - They account for 15 percent of the carbon dioxide emitted into the atmosphere; and

  - Their energy consumption is growing 3.3 percent a year.

- Energy waste by buildings — and therefore the potentials for improvement — also are enormous.

  - Poorly insulated windows alone account for one-quarter of the heating and cooling requirements in the U.S. — totaling $22 billion.

  - The energy lost through poor windows is equal to the amount of energy flowing through the Alaska oil pipeline every year.

  - Lighting accounts for 25 percent of all the electricity consumed in the U.S. — costing over $4 billion a year.

- Who is the nation's largest consumer of energy in buildings? The federal government. We have an obligation to set an example of efficiency for other sectors of our economy.

  - The President has issued an executive order requiring a 30 percent reduction in federal energy consumption in the next decade.

  - We operate a Federal Energy Management Program that is working hard to meet that goal.

- To inspire more efficiency in non-federal buildings, we are encouraging lenders to offer "energy efficient mortgages" to provide private capital investments in energy efficient installation.

  - In an energy efficient mortgage, a lender recognizes that a little more front-end investment in a home or commercial building means that the user of that building will save energy dollars every month and make the building more valuable.

BUILDINGS CASE STUDY: HIGH FREQUENCY BALLASTS

- One of our success stories has been our partnerships with industry on high frequency ballasts for lighting.

- Our work with industry has resulted in lighting that is 33 percent more efficient than it was using old-style ballasts.

- The offshoot has been the birth of a new U.S. industry that has sold 54 million of the efficient ballasts since 1985, saving the amount of energy it would take to drive across the U.S. 47 million times. That's a lot of vacations.

BUILDINGS CASE STUDY: SUSTAINABLE REDEVELOPMENT

- In addition, we are testing some innovative approaches to help people use sustainable energy.

  - After the devastating floods along the Mississippi and Missouri Rivers during the summer of 1993, we launched a pilot project in the Midwest.

  - We assembled a team of national experts in sustainable energy to work with the communities of Valmeyer, Illinois and Pattensberg, Missouri. The team explored how renewable energy, energy efficiency and other environmental technologies could be used in creating the new communities.

  - Today, Valmeyer is planning a community that will make widespread use of energy efficient building technologies, passive solar design, and other features the community would not have adopted without this technical assistance.

  - As an outgrowth of this pilot project, we will be working with a number of organizations during the coming year to create a sustainable development toolkit to assist other communities.

SUSTAINABLE ENERGY INITIATIVES: INDUSTRY

- The industrial sector consumes nearly 37 percent of the nation's total energy — energy worth about $115 billion.

- Industries in the U.S. produce more than 14 billion tons of waste each year. In 1990, industry paid $45 billion to treat and dispose of those wastes — more than Chrysler's annual sales revenues last year.

- Energy efficiency and renewable energy technologies often can prevent that pollution before it occurs, or they can help industry find economical ways to recycle and reuse its waste products.

- EE has several very successful programs to help industry reduce its energy and waste costs, while saving money and making industry more competitive and productive.

  - For example, our Energy Analysis and Diagnostic Center program sends engineering students into small and medium size manufacturing plants to conduct free audits that identify energy efficiency and pollution prevention opportunities.

- We have recently launched a new Motor Challenge Program under the President's Climate Change Action Plan.

  - New, efficient electric motor system technologies can save industry enormous amounts of energy and money.

  - Replacing inefficient motor systems with efficient models could save U.S. industry 240 billion kilowatt hours of electricity by 2010. The cost savings is worth $136 billion a year.

  - Just as important, the change would reduce greenhouse gas emissions by 48.5 million tons.

INDUSTRY CASE STUDY: NICE^3

- Another of our popular pollution-prevention programs is known as NICE-Cubed — an acronym that stands for National Industrial Competitiveness through Energy, Economy and Environment.

- In this program, we put up half the money for industries to develop new technologies and processes that have triple benefits: They must save energy, prevent pollution and create jobs.

- In just a few years, NICE^3 has grown from a pilot project to a popular national grant program, and it is producing wonderful results.

- Two of the many projects funded thus far by NICE^3 are:

  - A new process that is saving enormous amounts of money and preventing methanol wastes for FMC Corporation of Texas; and

- A process that has reduced wastewater by 95 percent while saving hundreds of thousands of dollars annually for PPG Industries in Ohio.

SUSTAINABLE ENERGY INITIATIVES: TRANSPORTATION

- I have talked a great deal about the impact of transportation on our economy, our energy mix and the environment. We have several programs underway to improve transportation performance.

- We have launched the Clean Cities program, for example, challenging cities around the U.S. to undertake ambitious, organized programs to use alternative fuels and vehicles. The program works like this:

  - Cities across the nation form local coalitions of fuel suppliers, auto manufacturers and government officials to pledge to dramatically increase the number of alternative fuel vehicles in their fleets.

  - We offer to help by providing technical assistance. And we pledge that as federal vehicles are purchased in those cities, the federal government will purchase cars using the types of fuels each city has selected to meet their objectives.

  - The goal is to get enough of those vehicles on the road to support a refueling infrastructure.

  - We expect to have 25 cities signed up as Clean Cities by the end of calendar year 1994, and double that number by the year after that.

- In addition, we are aggressively deploying alternative fuel vehicles in the federal fleet — in line with the Energy Policy Act of 1992 and an executive order issued by President Clinton, which requires that by 1999, 75 percent of the vehicles purchased by the federal government will be alternative fuel vehicles.

  - In Fiscal Year 1995, we plan to deploy 15,000 new alternative fuel vehicles in the federal fleet.

TRANSPORTATION CASE STUDY: PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

- But our most ambitious initiative is this one, popularly called the Clean Car program.

- In partnership with the Big Three automakers and other manufacturers, we are working to produce a car in the next ten years that is three times as efficient as those on the road today.

  - This new car will get a least 80 miles to a gallon of gasoline; and

  - It will emit 80 percent less greenhouse gases.

  - By 2010, we believe, this new vehicle can increase the gross national product by between $20 billion and $50 billion a year, create a half-million new jobs and reduce oil imports by $7 billion a year.

- The array of technologies needed to accomplish this is so formidable that some people have called the initiative a terrestrial Apollo program. In other words, in the universe of automobile technology, achieving this goal will be like going to the Moon and back.

- We are committed to doing it.

ENERGY EFFICIENCY AND RENEWABLE ENERGY BUDGET

- All of these programs — all of these attempts to resolve the invisible energy crisis and to capture the many opportunities facing us worldwide — have made the Office of Energy Efficiency and Renewable Energy one of the few growth areas in the federal government today.

- While scores of other programs have been cut or held steady by the Clinton Administration in its efforts to lower the federal budget deficit, the President has proposed steady increases in our budget.

- The reason for this growth is simple: As we have seen, energy efficiency and renewable energy are investments in new industries and new jobs in the U.S. And they are investments in a sustainable future in which the enormous economic development on the horizon worldwide occurs in a way that leaves our children a planet they can live with.

- Yet, despite our recent budget history, it is very important to understand that the significant increases in funding that began in 1991 are not so much budget *growth* as they are budget *restoration*.

- They are merely moving us toward our historic funding levels.

- All indications are that the public wants aggressive funding of efficiency and renewables. Poll after poll shows broad support for green technologies — and even a willingness by the public to pay more for them.

STRATEGIC OUTLOOK

- Under the leadership of Energy Secretary Hazel O'Leary, our vision is crystal clear.

    - Within the next few years, we at the Department of Energy will use our leadership in science and technology to produce a stronger nation — stronger in terms of our economy, our energy use, our environmental health and our national security.

    - And we will ensure that our nation leads the world in developing and using energy technologies that are sustainable, clean and economically competitive.

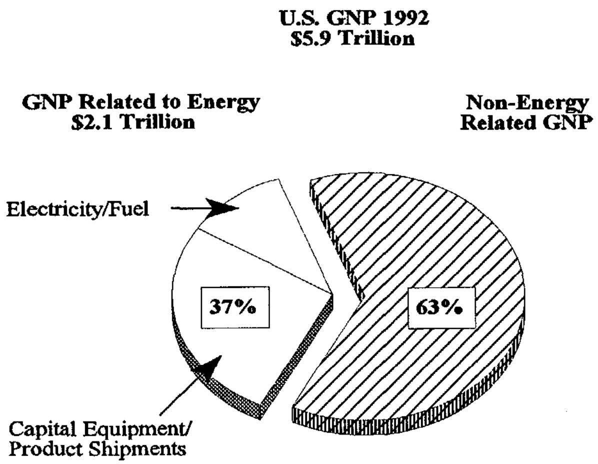
- When we sharpen our energy awareness — which is the objective of Energy Awareness Month — we can see why these goals are so critically important.

- With the support and help of the public, we will carry out these goals.

- Thank you for the opportunity to speak to you.

FIGURE 1

FACT: ENERGY CONSUMPTION PERVADES EVERYTHING WE DO



ENERGY ACCOUNTS FOR:

- 37% of GNP,
- $1,900 in annual spending per person in the U.S.
- 55 barrels of oil equivalent, per person each year,
- 1.4 million U.S. jobs, and
- $11.3 billion in annual U.S. exports

Source: Statistical Abstract of the United States 1993

FIGURE 2

FACT: THERE IS ROOM FOR IMPROVEMENT

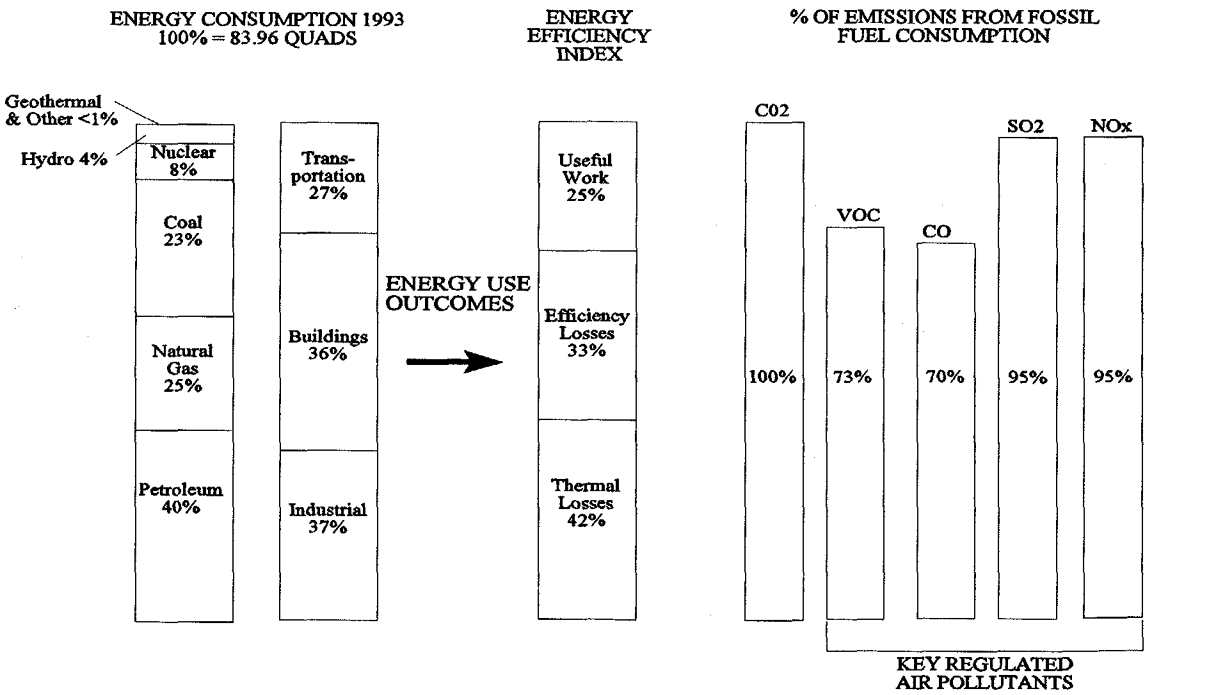
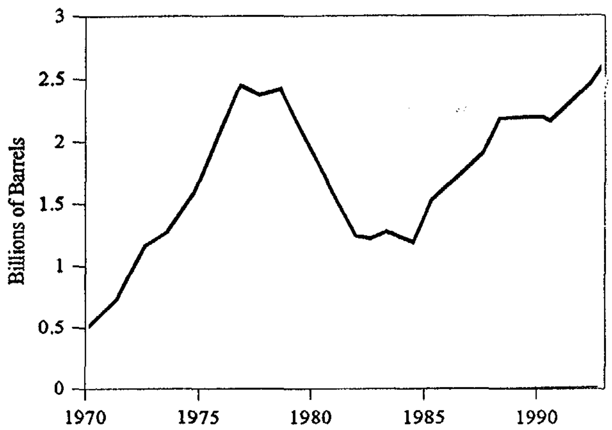


FIGURE 3

PROBLEM: U.S. ENERGY IMPORTS ARE RISING TO RECORD LEVELS

CRUDE OIL IMPORTS

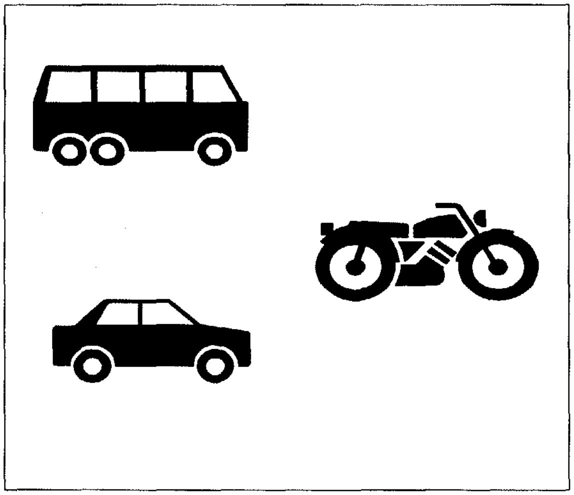


- The U.S. imported 2.5 billion barrels of crude oil in 1993. This surpassed the 1977 record level by 1.8%. (EIA Annual Energy Review 1993).
- Crude oil and petroleum imports were responsible for $51 billion (38%) of the nation's trade deficit in 1993 (U.S. Dept. of Commerce, Survey of Current Business).

Chart Source: EIA, Annual Energy Review 1993

FIGURE 4

PROBLEM: TRANSPORTATION ENERGY DEMAND IS INCREASING



FACT:

- Since 1980, MPG efficiency for all passenger cars increased 39%; and
- Real fuel cost per mile has declined 59%.

RESULT:

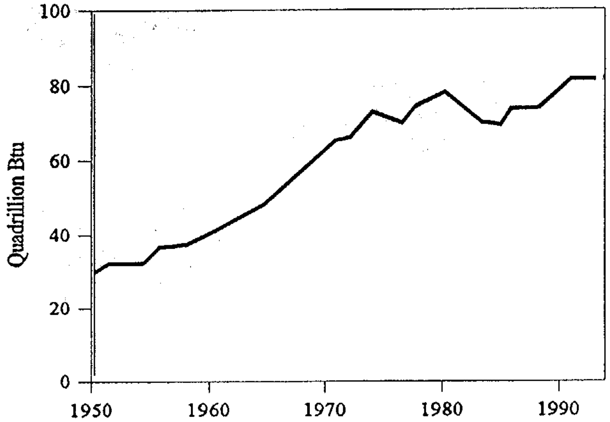
- The real operational cost of driving has dropped 50%;
- Vehicle miles traveled increased 43%; and
- Transportation energy consumption increased 14%.

Source: Transportation Energy Data Book, May 1994. Constant 1990 Dollars

FIGURE 5

PROBLEM: U.S. ENERGY USE IS INCREASING

TOTAL ENERGY CONSUMPTION

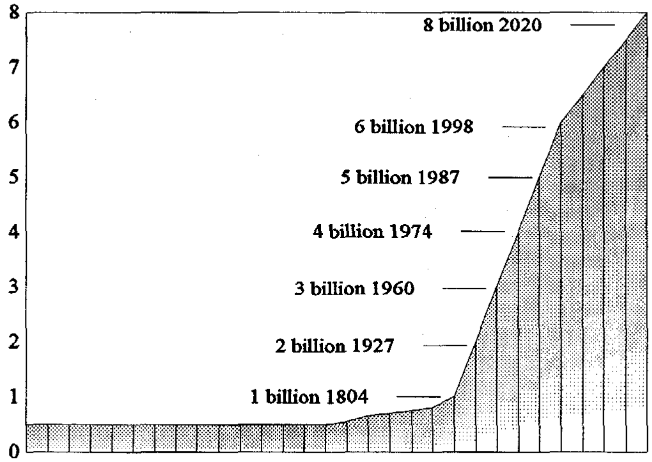


- Efficiency measures reduced the growth of U.S. energy consumption by 30% between 1973 and 1986.
- But total energy consumption increased 13 percent between 1973 and 1993. (EIA, Annual Energy Outlook)
- U.S. consumption will rise 46 percent between 1990 and 2025 if current rends continue. (National Energy Strategy)

Chart Source: EIA, Annual Energy Review 1993

FIGURE 6

PROBLEM: POPULATION GROWTH INCREASES WORLD ENERGY DEMAND



- Since 1950, the world has consumed as many goods and services as all previous generations combined.
- About 93 million people, roughly the population of Mexico, are added to the world each year.
- The industrialized world accounts for 22% of earth's inhabitants but accounts for 66% of consumption.
- Developing countries will need to create 30 million jobs each year to maintain current employment levels.
- Global energy consumption is expected to increase as much as 50% by 2010.

Sources: Census Bureau, United Nations, Population Reference Bureau, Gallup Poll of 1,007 Adults-April 1992

FIGURE 7

PROBLEM: TOTAL COSTS OF ENERGY CONSUMPTION AREN'T ALWAYS COUNTED

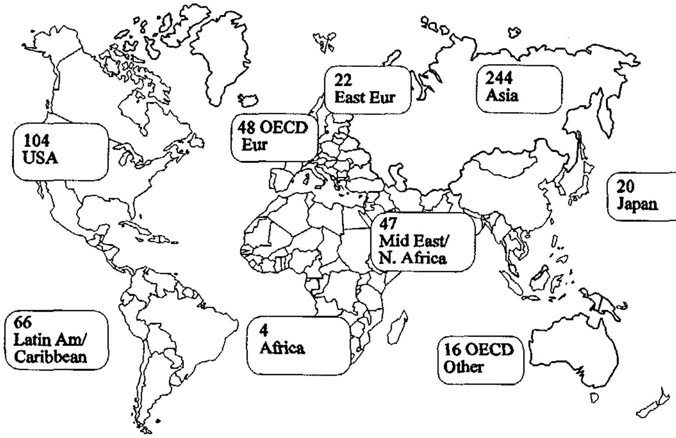
HIDDEN COSTS OF DRIVING	BILLIONS PER YEAR
■ Health Costs from Air Pollution	$ 10.0
■ National Energy Security Costs	
■ Strategic Petroleum Reserve	$ 0.3
■ Military Expense	$ 25.0
■ Traffic Conjestion and Delays	$100.0
■ Accident Costs	$357.0
Total:	$494.3

Source: World Resources Institute, "The Going Rate: What It Really Costs to Drive,", June 1992.

FIGURE 8

OPPORTUNITY: WORLD ENERGY MARKETS OFFER INCREDIBLE POTENTIAL

New Electric Generating Capacity Requirements in the 1990s ≈ 600 GW*



***1 GW is enough power for 500,000 US homes for 1 year**

- Nations will spend $1 trillion this decade to meet new electric generating needs. (World Bank)
- The global market for energy efficiency technology and services is $84 billion per year. (International Institute for Energy Conversation)
- The global market of environmental technologies (including the US), could grow to $425 billion annually by the year 1997. (White House, "Technology for a Sustainable Future")

FIGURE 9

OPPORTUNITY: COST OF RENEWABLES IS DECREASING

PHOTOVOLTAICS

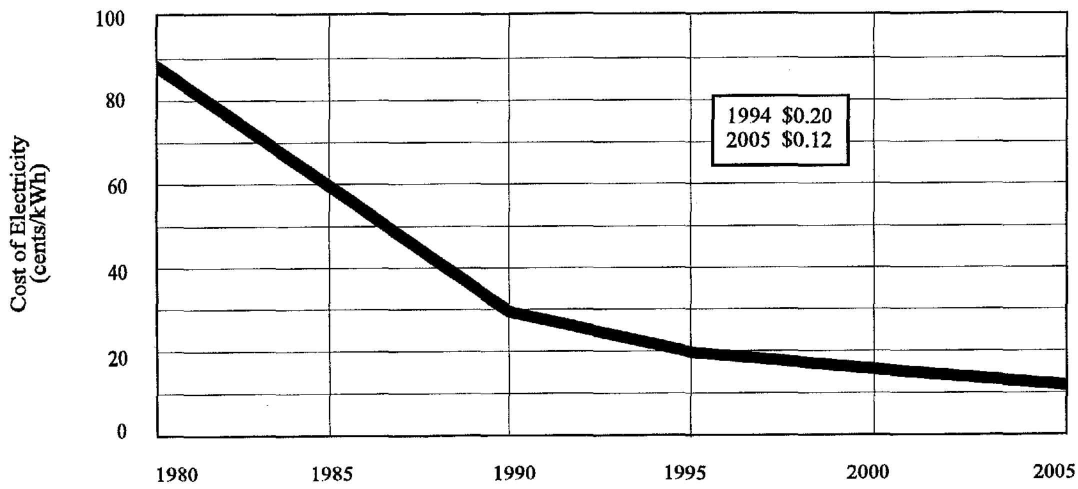


FIGURE 10

OPPORTUNITY: COST OF RENEWABLES IS DECREASING

BIOMASS

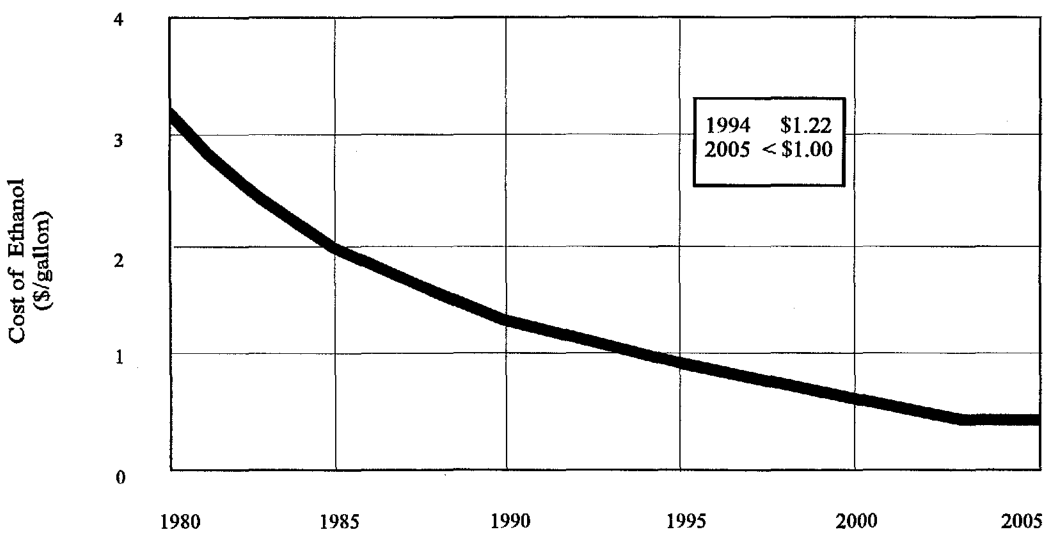


FIGURE 11

OPPORTUNITY: COST OF RENEWABLES IS DECREASING

WIND

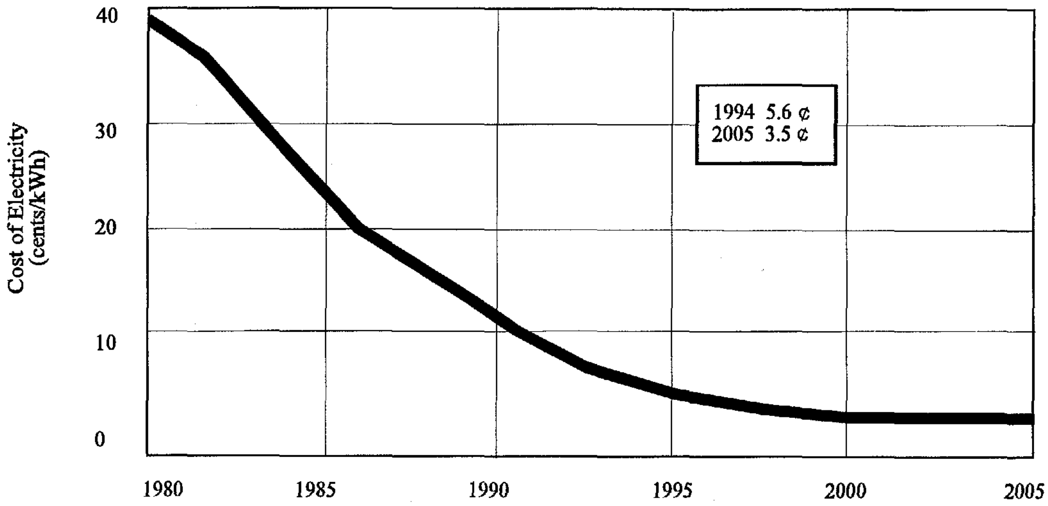
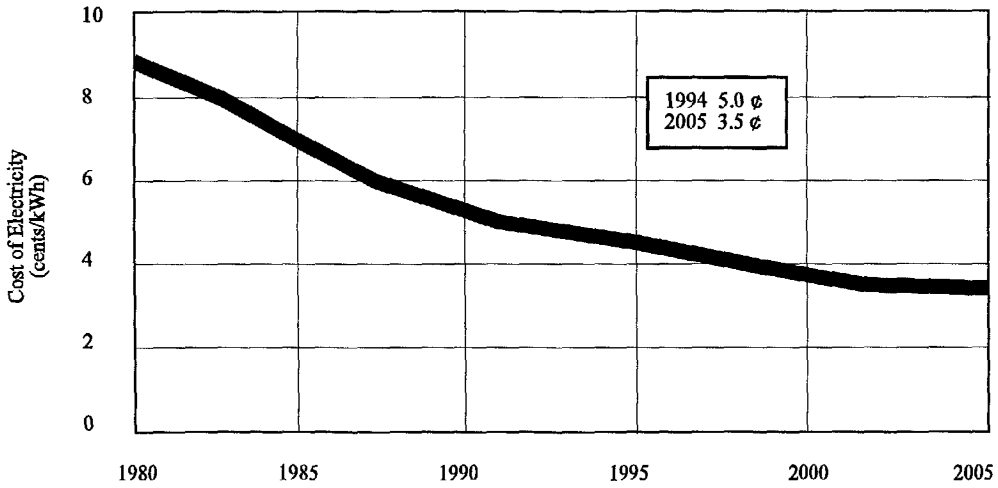


FIGURE 12

OPPORTUNITY: COST OF RENEWABLES IS DECREASING

GEOTHERMAL



IMPROVING THE ENVIRONMENT IN URBAN AREAS

Valdas V. Adamkus
Regional Administrator Region V
U.S. Environmental Protection Agency

I would like to share some thoughts with you on how we can improve the environment in urban areas. And I would like to thank Dr. James Hartnett, Director of the Energy Resources Center at the University of Illinois-Chicago, for inviting me here and giving me this opportunity.

To talk about improving the urban environment is to suggest that there is something wrong with it. Well, there certainly is! I was reminded of the fact this very morning as I was coming in from Lake Geneva on the Tri-State Tollway. To the right of me, then to the left of me, and then some distance in front of me, I could not help but notice the huge clouds of black smoke billowing from the vertical exhaust pipes of several tractor-trailers barreling toward the Loop. What these gigantic kings-of-the-road were spewing out was pure soot, or particulates as we call it, produced by burning the diesel fuel. And what this morning's observation brought clearly into focus is that air pollution remains the number one problem in most urban areas.

Twenty-four years after the first Clean Air Act was passed, over 54 million Americans still live in more than 100 cities that do not meet federal standards for clean air. This includes the Chicago area and Milwaukee, where ground-level ozone, or smog, is considered severe. And smog is not innocent fog rising from Lake Michigan. Smog saps the energies of the healthy; it aggravates respiratory problems of the sick; and it can even kill.

To help meet the federal ozone standard by the year 2007 and to deal with other air pollution problems, we have the new Clean Air Act passed by Congress in 1990. *The Wall Street Journal* called it "The Clean Air Monster." But the only thing monstrous — and irresponsible — would be to keep our heads stuck in the smog and pretend that everything is well. So the first order of business for a healthy environment in urban areas is the vigorous implementation of the new Clean Air Act; there is no other way.

Motor vehicles still represent the single largest cause of pollution in urban areas. They emit up to 50 percent of the smog-causing nitrogen oxides and volatile organic compounds, more than 50 percent of hazardous air pollutants, and up to 90 percent of carbon monoxide. Although individual cars are cleaner today, there are more people driving more cars over more miles; that is why air pollution from motor vehicles is worse than ever.

The new Clean Air Act calls for longer-lasting pollution control devices, vehicle inspection and maintenance programs in the worst-polluted areas, and cleaner fuels, among other things. Individual car pooling, commute option programs sponsored by employers, and widespread use of public transit will go a long way in reducing traffic congestion and thus improving the quality of urban air.

Beginning January 1995, reformulated gasoline — with oxygen added to promote cleaner combustion — will be required in the nation's most-polluted cities, like Chicago. Another provision of the Clean Air Act says that 30 percent of the oxygen in reformulated gasoline must come from renewable fuels. This new, reformulated gasoline will cut emissions of toxic and smog-causing pollutants by at least ten percent. And it will add only about 25 dollars per car per year. What is more, the renewables will cost nothing extra. They will be phased in at 15 percent during 1995 and 30 percent thereafter. Leaded gasoline, as you know, has already been phased out.

Diesel trucks and buses, up to now only lightly regulated, have not been overlooked by the new Clean Air Act. Starting with this year's models, engines for the new, big diesel trucks will have to cut soot, or particulate, emissions by 90 percent. Engines in urban buses built before 1994 will have to be modified to reflect the lower emission standards whenever they are replaced or rebuilt.

Diesel fuel has also been affected. Since October 1993, the sulfur level in diesel fuel used by cars, buses, and trucks has been cut by 80 percent. This should make the thick black clouds of exhaust I saw this morning a thing of the past.

You may think that EPA is picking on motor vehicles, but it is not. To meet those mandatory federal standards 12 years from now, urban air pollution is being pushed back on all fronts. Stationary sources of air pollution — from power plants to the corner gas station — will also have to cut pollution. In addition, EPA has established standards for 189 hazardous air pollutants, emitted mostly by the chemical industry that makes synthetic organics. And the volatile organics that come from consumer products, such as hair sprays and charcoal starters, may seem insignificant individually, but they do add up. What adds up, inevitably makes a difference.

On the ground, the most far-reaching and innovative program for urban redevelopment and environmental cleanup is EPA's own Brownfields Economic Redevelopment Plan, called Brownfields for short. Its aim is simple and at the same time gargantuan: to return unproductive, abandoned urban sites to productive use and to see that future development is carried out in a responsible, environmentally sound manner.

Some sites are abandoned hazardous wastes dumps being cleaned up under Superfund. Many sites are inner-city properties, shunned by prospective developers who are afraid to get stuck with possible expensive cleanup liabilities. So far, there are three Brownfields pilot projects funded by EPA: one in Richmond, Virginia; one in Bridgeport, Connecticut; and one in Cleveland, Ohio. Each city has received $200,000 for a two-year period. These modest sums will not solve all problems, but it is a start in the right direction. And great things often have small beginnings.

Each project has its own set of goals. But all three have a common denominator, too: cooperative efforts between governments, diverse community groups, investors, lenders, developers, regulators, and so on. By restoring these urban sites, all would gain. There would be new jobs, economic growth, increased property values, extra tax revenue, rejuvenated neighborhoods, and certainly not least — a cleaner urban landscape.

EPA Region V, with headquarters here in Chicago, has developed its own version of Brownfields. Our strategy rests on four basic principles:

- To promote appropriate site cleanups by encouraging parties to participate in voluntary state cleanup programs;

- To provide maximum information to private-sector parties, so that prospective buyers and lenders can make informed decisions;

- To encourage urban communities to take an active part in the cleanup process; and

- To develop partnerships with the six regional states, local governments, and key outside stakeholders.

Some of our specific goals include developing a policy on release of federal liens and claims on property, reducing the overall costs of investing in Brownfields sites, and providing feedback on federal and state legislative proposals. Specific goals also include removing environmental obstacles, such as asbestos and lead-based paint, that discourage investments in urban homes and apartments.

EPA Region V has recently endorsed and forwarded to EPA Headquarters a Brownfields grant application from the City of Chicago. The city is interested in rejuvenating its old industrial properties, especially on the southeast side. And it understands that the future of some of its communities may well depend on how the city responds to the complex challenges of a Brownfields project. But, like most cities today, Chicago is short on staff to tackle such a project all by itself.

By the way, recently EPA announced a competition for new Brownfields grants. An EPA task force made up of EPA Headquarters as well as EPA Regional experts will select five pilot projects. The winners will be announced next summer. These days, nobody has the funds to go it alone. But, by funding Brownfields projects and acting as a catalyst as well as a clearinghouse, EPA can play an important role in helping to reclaim our urban environment.

While more and more Brownfields projects come on line, we should not forget some of the other things we can do for our urban environment. The gentrification, or restoration, of waterfront areas in some cities, for instance, has already had a salutary effect.

Good examples can be seen just blocks away from here, along certain downtown sections of the Chicago River. The area was cleaned up, walkways built, trees and flowers planted. Restaurants and cafes with their charming outdoor patios soon followed. In downtown Cleveland there have been changes, too. Where the infamous Cuyahoga River, thick with oil and debris, years ago caught fire — not once but several times — today you will find smart boutiques and fancy restaurants along its banks. Buffalo, New York is another city that deserves applause. It has turned its long-neglected, blighted industrial waterfront into parks and marinas — another score for the urban environment and a marvelous job at that.

Habitat preservation in urban areas can also help prevent urban sprawl and decay. EPA does not advocate, as some critics claim, to turn every water-logged ditch into a wetlands preserve. But, there are judicious measures we can take. Here is one we took last August. EPA Region V got together with The Nature Conservancy and Forest Preserve District of Cook County. With a $59,000 grant from EPA, we decided to sponsor and expand the "Mighty Acorns" program to Southeast Chicago. The program aims to give city kids a hands-on experience in exploring, appreciating, and preserving nature. It is an unbeatable combination: a learning experience that is fun for the learners and highly beneficial for the urban environment.

Another commendable effort to preserve habitat is now at a standstill, but it is worth noting anyway. A retiring U.S. Congressman from Will County, George Sangmeister, introduced a bill recently to convert the abandoned Joliet Army Arsenal into a far-reaching conservation project. It would offer something for everyone, including a landfill and a veterans' cemetery. But at the center of the project are

19,000 acres of land to be restored as prime Illinois prairie, earmarked as the first national grassland east of the Mississippi. The bill passed the House, but was regrettably killed in the Senate Committee on Government Affairs. I hope this is only a temporary setback. I hope the bill sails through once the new Congress convenes in January. It is a unique opportunity to restore a large ecosystem in the midst of a metropolitan area.

Whatever we do on behalf of the urban environment — or any environment — our policies, plans, and actions must be tempered by what we call at EPA environmental justice. This is a concept that realizes a historic truth: that in many instances and for much too long, the poor and the minorities have been bearing a disproportionate burden of environmental pollution. What this means in stark, practical terms is that there are no garbage dumps in Oak Brook and Wilmette, where an average home costs half a million dollars. But there are plenty of dumps, including one handling hazardous wastes, in Southeast Chicago, where humble homes have been surrounded by refineries, steel mills, and assembly plants for over a century.

Last February, President Clinton signed an Executive Order on Environmental Justice, to ensure that all Americans are protected from toxic pollution — not just those who can afford to live in the most expensive, and therefore the cleanest and safest, communities. The order directs EPA and all other federal agencies to develop comprehensive strategies that will deal with environmental justice situations. It also directs all agencies to make sure that low-income and minority communities get the information they need about their environment. And that they have a say-so in matters that affect their personal lives and their community's health.

EPA Administrator Carol M. Browner has identified environmental justice as one of her top priorities and a major national strategy for the entire agency. Not surprisingly, an Office of Environmental Justice was immediately created within the EPA.

EPA has also created from within a new task force on environmental justice. Its job is to explore ways to better respond to environmental and public-health problems facing low-income and minority communities. In EPA Region V, we have appointed from our own ranks a coordinator of environmental justice. Concerns for — and sensitivity to — environmental justice are factored into all our undertakings, such as our geographic initiatives, which focus on five major, heavily polluted areas. One of those areas is Southeast Chicago, the home of some 370,000 people — 74 percent of whom are African-American or Hispanic.

Why should we care who lives where and who does what? We should care because environmental factors, especially in a congested urban setting, play a key role in human development and overall health. Environmental factors affect not only the quality of life, but duration of life itself. That is why we should care. And environmental justice embodies that care and those concerns.

Finally, let us remember that here, in the Great Lakes Basin, urban centers hold the key to preserving the entire ecosystem of the Lakes. So we must adopt an ecosystem approach to urban development and urban renewal as well. We must treat each urban area as a self-contained ecosystem — with its own air, land, water, wildlife, and human components. Above all, we must realize that all are interrelated. That when one of these components is sick or polluted, all components are affected. For if we lose the environmental battle in our urban areas, we will lose it in the countryside too.

From an economic point of view, my friends at *The Wall Street Journal* tell me that the future looks good for this region. Abundant natural resources, increased industrial productivity, vast energy output, and convenient links to world markets are cited as indicators of long-term growth. In fact, they say, the Great Lakes Basin is expected to be the fastest growing area in the nation throughout the 90s.

From my point of view, I only hope that economic growth does not outpace our efforts to protect the urban environment many of us share. Because we need both: a strong economy and a healthy urban environment that is clean and green and growing.

SESSION I: URBAN AREAS: PAST, PRESENT, FUTURE

PAST SUCCESSES AND FUTURE CHALLENGES: IMPROVING THE URBAN ENVIRONMENT

Mary Gade
Director
Illinois Environmental Protection Agency

It is a pleasure to be back with you again at the 22nd Annual Illinois Energy Conference. Three years ago, I stood in front of this conference as the new director of the Illinois Environmental Protection Agency. I told you then that, in my opinion, ozone was Illinois' most intractable air quality problem. I also said there was no issue that was taking up more of my time or that of my staff. I brooded about the difficulties of meeting the numerous deadlines of the new Clean Air Act Amendments and talked about the need to approach cleaning up the air differently — working collaboratively with impacted parties and using market-based mechanisms.

Well, three years later, I suppose there is some *small* satisfaction in knowing that I was totally on target. Ozone is still Illinois' most intractable air quality problem — although I commit to you that we will resolve it — I expect to stand in front of you with good news at the 35th Annual Illinois Energy Conference in 2007, the statutory ozone attainment deadline. It is also the issue that is *still* taking up more of my time than any other issue.

Ozone is not only Illinois' most intractable air quality problem — it is the United States' most serious air quality problem. Some 80 to 90 million Americans are impacted by it — *roughly one out of every four Americans*. Over 90 areas of the country experience exceedances of the National Ambient Air Quality Standard. Most of the problems are in urban areas like Chicago, Milwaukee, Atlanta and Los Angeles, although transport makes it a surprising problem in some largely rural areas like Muskegon, Michigan. We have been attempting to get ozone under control for decades. As a young lawyer, I worked on the State Implementation Plans to control ozone by 1982, then 1987, and now (as a grizzled regulator) by 2007. While significant progress has been made with other air pollutants like particulates, sulfur dioxide and carbon monoxide (Chicago has been in compliance since 1984), ozone remains a persistent problem — in part, I think, because we are only now beginning to understand it — how it is made, where it goes, and what its impacts are.

When I addressed you three years ago, I believed as did the U.S. Environmental Protection Agency (USEPA), Congress, and most scientists, that ozone was formed as a result of a complex photochemical reaction in the atmosphere of sunlight acting on some combination of volatile organic compounds (VOC) and nitrogen oxides (NO_X). As a consequence, the Clean Air Act Amendments of 1990 required NO_X reductions wherever possible — in the Acid Rain Program as part of the Reformulated Gasoline Program and through NO_X Reasonably Available Control Technology (RACT) on stationary sources. We were confident that by imposing NO_X controls along with some additional VOC reduction we could successfully submit a plan by November 15, 1994 and demonstrate attainment by 2007.

Then last December, in the course of the largest ozone study ever conducted, the Lake Michigan States of Illinois, Wisconsin, Indiana, and Michigan discovered that NO_X reductions in the Chicago airshed actually exacerbated ozone formation. In fact, to our amazement, we found that a 30 percent reduction of NO_X in Chicago led to a 30 percent increase in ozone formation. This called for a time out. We realized that we could not ask industries to install costly NO_X controls when these very controls would make the air quality worse. As a result, all four states currently have petitions pending before USEPA asking for a waiver from the NO_X Reasonably Available Control Technology requirements of the Clean Air Act.

This startling information meant that the entire burden for addressing the ozone problem would fall on VOC emission controls. Our modeling indicated that achieving the standard would require emission reductions on the order of 90 percent equating to approximately 1,000 tons per day. By USEPA's own admission, this would lead to the imposition of "ludicrous" measures. We estimate that we could take two million cars off the road in Chicago and still not attain the standard. And, if misery loves company, my Georgia counterpart, Harold Reheis, has modeling that demonstrates that even if he closes every factory in Atlanta and takes every car off the road, he still cannot demonstrate attainment.

In 1990, we also assumed that ozone was a regional phenomenon. In the course of the Lake Michigan ozone study, we made another astonishing finding. On days when the ozone standard was exceeded in Chicago, ozone coming in across our state borders was anywhere from 90 to 110 parts per billion. With an ozone standard of 120 parts per billion, it was clear that ozone transport plays a significant role in Chicago's ozone problems. Ozone is clearly a super-regional phenomenon involving at least half of the United States. Making Chicago industries and citizens compensate for this transport phenomenon by imposing costly, draconian, local control measures was not an option. For the first time, national measures like a 49 state low emission vehicle started making economic and environmental sense. Emission reduction controls in the Northeast have significant consequences for the Midwest and vice versa.

Just when I thought it was safe to take a deep breath, the latest finding from the Lake Michigan study indicates that while NO_X reductions in the Chicago nonattainment area will not help the problem, NO_X reductions in downstate Illinois as well as Indiana and Missouri might help. To fully assess the problem, we need more data both regionally and nationally. Attention is shifting to attainment areas and the large NO_X sources located there for possible controls to improve air quality in Chicago. This shift in focus could have significant economic consequences around the country.

What does all of this uncertainty tell us? What does it mean for developing an appropriate ozone control strategy? Complicating the dialogue is the fact that while ozone is clearly a problem, it does not seem to be the problem we originally thought it was. When Chicago was designated a severe ozone nonattainment area, the classification was based on data from 1987 through 1989, a period with over 35 ozone exceedance days. In the last five years, there have been two years with no exceedances (1990 and 1993), one year with six exceedance days, and one year with three exceedance days. This past summer, there were only two exceedance days in Chicago, with a total of ten hours over the standard.

I think that this means we have to be very judicious in designing a control strategy for Chicago — we have to have sound data justifying cost-effective approaches to the ozone problem. Some mandated measures in the Clean Air Act are simply illogical, like the Employee Commute Option program that impacts thousands of Chicago employers (estimate is 6,000) and up to two million Chicago workers. By 1996 we anticipate air quality improvements from the program on the order of 2.4 tons/day at a cost of $80,000 to $100,000/ton. By contrast, the I & M program will get 44 tons/day emissions reductions at an average cost of $2,500/ton.

The key point from our ozone experience is that public policy mandates have been predicated on what is proving to be not merely inadequate information but entirely wrong information. If there is a failing of government today, it is that our public policy formation lags by at least several years behind the development of information and is highly unresponsive to the most up-to-date information. Mere refinements in the public policy process are not likely to change this problem. We probably require significantly different ways of dealing with the environment than the command and control approaches we have relied on since the 1970s. The touchstone to this new approach is information and the ways in which we use it to bring forth the best technologies for the environment.

Some time in the future, we may have what is a unified information theory which explains such disparate disciplines as biology, social science and physics. Certainly, in just the past several decades, just in my brief lifetime, we have seen biology — and by extension much of medicine — explained in terms of information transfer. The emergence of the DNA double helix has revolutionized our thinking. It has embellished evolutionary theory, for instance, to the point that the DNA mechanism is the force which binds together all biological theory.

Now what does all of this have to do with the urban environment? The point is that the city throughout human history has, above all other things, been an information center — a medium for the development, gathering, refinement and dissemination of the best knowledge of the day. Babylon, Athens, Rome, London, Paris, and New York all come to mind. The city is the center for politics, the arts, medicine, and even cuisine. Our news is broadcast from the great cities and that is where many of our great universities are located.

But one of the unpleasant byproducts of city life is pollution. By its very nature, the city has an unnatural dimension to it. Man takes over nature and builds. But the growth of the city often outstrips the ability of the people there to cope with the dirt and disease which come with large numbers of people being in one place at the same time. The terrible situation we all witnessed in Rwanda is a good example of an instant aggregation of humans.

Few are now alive who can remember when the great cities were known for their epidemics and streets clogged with mud, trash and the assorted byproducts of urban animal life. The solution to the problem was a combination of new science and technology, the positive application of the coercive power of government and education of the public. Above all, it was this last feature, information exchange — whether it as about personal hygiene or the efficacy of switching from coal to gas — that changed things for the better. Once people learned more, they changed the way they did things.

Just this past Saturday, the New York Public Library opened an exhibit entitled, "Garbage: The History and Politics of Trash in New York City." This marvelous show demonstrates the way in which the city sought to solve its environmental problems. The key to change was the way in which information was used. It was education, tracing of disease, and the development of modern, intense management of complex collection and transport systems for garbage and sewage.

We need to look at the modern condition to contemplate the possible future for dealing with urban environmental problems as we enter the next century. If anything characterizes urban life today, it is ubiquitous information and communications. The technology of conveying and managing information is accelerating almost logarithmically. Broad band communications using fiber optics and the widespread use of personal computers and other microelectronic technology mean that almost any sort of information can and will be made available on a real time interactive basis in the near future.

This has enormous implications for the way in which we can consider the future for improving the environment of the city by the use of information and, by implication, reliance on market mechanisms as opposed to command and control.

Let us take the most recent example of how information can revolutionize environmental protection. The linkages among information and economic and environmental improvement are of utmost importance, since our ability to maintain a political constituency for pollution reduction is intimately tied to our citizens' belief that it enhances their overall well-being. We continue to see a backlash against old style environmental regulations and laws — which ignore the social and economic framework of our society. Our future success requires us to use technology and economics to make environmental improvement a part of the overall enhancement of life in our urban metropolitan regions.

We have already found that market mechanisms work, and work well. Our most ambitious foray into the use of market mechanisms, the Acid Rain Trading Program, is already being heralded by environmental groups as an unqualified success. According to testimony presented to the House Energy and Commerce Committee in October, the Environmental Defense Fund predicted that electric utilities would reduce acid rain emissions by three to seven million tons *more than required* in the first five years of the Acid Rain Program — 1995 through 1999. Compliance costs, measured by the price of acid rain allowances, are less than half of those predicted just four years ago. Other efforts are Illinois Environmental Protection Agency's successful "Cash for Clunkers" car scrappage program, our proposed VOC trading program, and the RECLAIM program now operating in the Los Angeles air basin.

The acid rain experience tells us that if we refrain from command and control and place our faith in information and markets, we may well save money, elicit technology, protect the environment, stimulate industry to be creative and perhaps even re-instill faith in the environmental mission. That would not be such a bad start.

I believe that the urban environment *is* susceptible to much more in the way of leveraging information to improve the environment. The critical piece of information has to do with costs and prices. To the extent that people have their view of the cost of environmental control and protection obscured — actively covered over or simply not explicitly revealed — they will have a more difficult time making the best choices.

For most of the past 20 years, the cost and the aggravation of the environmental progress we have made has been largely hidden from the general public. Requirements were mostly imposed on large industrial emitters, utilities, oil companies or on manufacturers of automobiles or other products. There is no doubt that emissions were reduced. And, for the most part, the costs of such reductions were passed along to consumers, without being highlighted in any explicit way.

The success of the Acid Rain Program at this point is due in great part to the way in which the allowance trading system lets decision makers compare the costs of various means of compliance.

With respect to ozone, whether it is NO_X or VOCs, it is likely that forms of trading will emerge so that the many varied emitters of these possible ozone precursors can deal with one another, calmer than with the government, to discover the least cost methods of achieving needed reductions.

Beyond that, we can expect that real time communications will be used to convey accurate, immediate pricing which will tell consumers what the real cost of electricity is — including the environmental effects — at any moment of the day. As numerous speakers at these University of Illinois conferences have explained many times in the past, the cost of generating and transmitting electricity varies dramatically from one time of the day to another or from one season to another. Real time pricing will likely change the type of average cost pricing which prevails today and will convey to consumers the real cost — including the impact on the environment.

By the turn of the century, we are likely to see peak time pricing of some sort emerge with respect to use of the roads in order both to improve utilization of limited expressway space, but also to mitigate smog problems. The same pricing system which uses electronics to better distribute traffic across the day could also be used to price auto usage at periods of high ozone formation.

Given the strides in communications and information management, it is highly likely that various combinations of pricing and trading will emerge to largely replace command and control for air pollution problems. One feature of such pricing and trading approaches is that they can be much more easily tailored to local conditions around the country. Given that air pollution is in great part a function of local weather and other conditions, the one-size-fits-all approach of environmental command and control seems much in need of replacement by a more sensitive method. Importantly, pricing and trading systems are more adaptable to new knowledge than are mandatory measures built into law.

The bottom line for all of this is that with the amazing progress of information systems and the apparent success of our current experiments in using prices and trading to address environmental problems and bring forward the least-cost best technology solutions, we have every right to expect that environmental protection, especially in the cities, will begin to organize around real time information and markets rather than conventional command and control.

We should not be passive about this. We should take it in hand and actively look for opportunities. This means revisiting the Clean Air Act to provide for more market options and to make the Act more flexible, both to deal with new scientific information and to make solutions more adaptable to local conditions.

Just as the American city at the turn of the last century brought about a revolution in the urban environment, so too should we undertake a similar task today. Just as our ancestors in New York and Chicago worked great wonders of engineering, education and acculturation, so too should we be the instruments of the information age to improving the urban condition.

CHANGING INDUSTRIAL PATTERNS IN THE METROPOLITAN CHICAGO AREA

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INTRODUCTION

The industrial base of Chicago, and most Midwestern cities, continues to change. These changes are particularly visible in the manufacturing sector where the exodus of companies has left behind abandoned factories and industrial sites that now blight the urban landscape. As urban centers have seen a steady decline in their ability to attract and maintain their manufacturing base, great interest has been placed in seeing what can be done to attract economic activity back into the urban center. For most Midwestern cities, this often means trying to either replace or stem the tide of manufacturing facilities that have left the city for "greenfields" in suburban or rural locations or have simply moved overseas. On the replacement front, to compensate for the loss of manufacturing, some cities such as Chicago have managed to expand other areas of their economies, such as business services, finance, and tourism and recreation to maintain their vitality.

This paper discusses three aspects of the changing economic landscape of Chicago and other Midwestern urban areas. First, some historical perspective will be provided on how Chicago came to be a manufacturing center and what factors since World War II have led manufacturing facilities to move away from the urban center. Second, the future prospects for manufacturing in the central city will be examined. Finally, what policies may help increase (or at very least maintain) the concentration of manufacturing in Chicago will be discussed.

THE CHICAGO ECONOMY SINCE WORLD WAR II

All economies move through stages as the needs and desires of industries change over time. Chicago, like many Midwestern cities, had a variety of location advantages, particularly having to do with transportation and labor force availability, that historically led to a concentration of manufacturing facilities within the city's boundaries. Emerging from World War II, the forces that had originally encouraged the concentration of industrial manufacturing in the city were still intact although they had already begun to weaken. Since the mid 1800s, efficient heavy manufacturing production required that bulky raw materials needed to be transported to a central location. With rail lines converging in Chicago, raw materials could be easily brought to factories and finished goods could be shipped to markets. In addition the scale and methods of manufacturing favored large multi-story plants, required large numbers of workers, and this required siting facilities in locations where population densities were high. Again this was a benefit to Chicago. Workers could often live within walking or streetcar distance of the factory that employed them. However, especially after World War II, the increasing popularity of the automobile and the building of the interstate road system changed the balance of development. As people acquired automobiles, it became less important for them to live within close proximity of their place of employment. As people moved away from the urban center, eventually many of their jobs followed them. Population began to shift out to the suburbs.

Equally important was the increasing use of trucks as the preferred means of shipping that made the advantage of being a rail hub less significant. In fact, the congestion of the city and the narrowness of city streets often made it difficult for truck traffic to access factories and actually encouraged movement to suburban areas where land was cheaper and facilities could be built to accommodate shipping by truck. The freedoms of lower labor needs and shipment by truck allowed firms to build sprawling one-story factories which were better-suited to assembly line production.

The effects of these changes on manufacturing employment in Chicago are shown in Figures 1 through 3. (All figures appear at the end of this paper). Even in 1969, slightly better than 80 percent of metro area manufacturing jobs were located in Cook County. By 1991, this figure had fallen to around 70 percent. As the figures show, this trend was even more pronounced in other Midwestern cities, particularly in Detroit and St. Louis. Moreover, this deconcentration of manufacturing jobs has not only been from central urban areas to the metropolitan fringe. Manufacturing jobs have continued their geographic movement away from the central city and have begun to abandon even suburban metro locations in favor of non-metropolitan areas. This has been part of a national trend of manufacturing jobs fleeing both the central cities and their collar suburbs. As is shown in Figure 4, the share of manufacturing jobs in non-metropolitan areas have held their own in the face of a steady decline in manufacturing jobs in general. One highly publicized local example of this is

Motorola's decision to build a $100 million cellular telephone plant in rural Harvard, Illinois. Manufacturing has continued to show a proclivity to move farther and farther from the urban center with the recent growth of manufacturing in rural areas presenting one of the more interesting trends available.

This has meant a fundamental change in the economic geography of the city. As Figure 5 shows, manufacturing employment in the Chicago metro area has fallen from around one million jobs in 1969 to just over 600,000 in 1992. Within the boundaries of the City of Chicago, the decline has been equally dramatic (see Figure 6). As early as 1976 the city had 367,000 manufacturing jobs constituting almost 30% of the total employment base. By 1992, manufacturing jobs in the city stood at just under 187,000 or 17 percent of the base. In the meantime, service employment has skyrocketed to better than 1.4 million in metro Chicago. Figures 7 and 8 highlight some of the growth that has occurred in two notable service areas in Chicago and the collar counties. As the figures demonstrate, business service and tourism income from 1969 to 1991 has shown significant growth in most Midwestern cities. It is this type of development that is replacing manufacturing as the economic engine of the cities.

Some of this decline in manufacturing employment can be accounted for by increased productivity in the sector that requires fewer workers to maintain or expand production levels, but there are other factors that account for the movement of manufacturing jobs and facilities from the city. Some factors come easily to mind. Higher labor costs, expensive land costs, fear of crime and high taxes are all seen as compelling reasons why manufacturing has moved out of the city. Additionally, there are fundamental changes in the way manufacturing is conducted that make urban locations less desirable, for example, the previously discussed effect that the choice of transportation has on manufacturing location.

But equally important have been changes in manufacturing process that have left the large scale, low skilled assembly work of the past largely anachronistic. The shift from "Fordist" mass production methods to "lean" manufacturing, emphasizing just-in-time production and inventory management, has changed the physical requirements of manufacturing. No longer are multi-story facilities, such as the Stuart-Warner auto parts plant on the north side of Chicago, the appropriately designed facilities for manufacturing. The Stuart-Warner plant closed in the early 1990s, and the site is currently being used for a condominium and townhouse residential development. Today's smaller factories are increasingly configured to operate on a single, horizontal floor plan. Unfortunately because of high land costs, urban design has historically favored building vertically. Existing multi-storied factories are often unable to be appropriately adapted to new production techniques. Furthermore, even if the physical space in the building can be redesigned to accommodate the new production methods, existing factories often lack the necessary electrical and safety standards that are needed for new production facilities. Rehabilitating these buildings to meet building codes and to operate efficiently becomes a very expensive process and often fails to provide the return on investment needed to make such an undertaking attractive. As one study by the Washington based Northeast-Midwest Institute reported, the cost of site development in an urban location can often be four times that of a greenfield location.

Labor requirements for manufacturing have also changed. In the past, urban manufacturing offered high wage jobs to semiskilled and unskilled workers. Manufacturing jobs were often a path to the middle class for this segment of the labor force. Now the complexity of manufacturing makes it essential that workers have higher skill levels, and with automation, workers are needed in smaller numbers. With many pockets of poverty, cities such as Chicago often lack the appropriately educated labor force to support modern manufacturing. Those manufacturing jobs that require only simple assembly have moved to locations where costs are the lowest, primarily in rural areas and overseas. The only forms of manufacturing that can afford the higher costs of the urban areas are highly specialized manufacturing where higher profit margins and the requirements of a highly skilled labor force make it possible and frequently necessary to operate in urban metropolitan areas. While manufacturing businesses can afford to locate their research and development and administrative functions in the city, their routinized production facilities must go elsewhere.

Finally, the current state of manufacturing in Chicago and virtually all urban areas is also being influenced by environmental concerns and uncertain environmental liabilities. Even if industrial sites are available at competitive prices in the city, the fear of uncovering potential environmental liabilities often makes investments in these sites a risky proposition. With the introduction of the type of open ended risk that has is often associated with brownfield redevelopment, it is often impossible to justify investing in an urban location when a pristine, greenfield site is available. This affects the interests of both potential site developers and of banks and financial institutions that might otherwise be interested in redeveloping these locations.

The cumulative effect of these trends is that in Chicago and other Midwestern cities, the buildings and infrastructure that currently exists were largely constructed and configured for the needs of industry in another era. This infrastructure reflects the desire to support a living and working density that may no longer be possible. Part of what makes this more acute in Chicago and other Midwestern cities is that they were particularly densely populated in comparison to cities in the South and West. In Figure 9 the relative population densities of a group of Midwest cities including Chicago are shown for the years 1969 and 1991. While this shows that population densities have been declining, Figure 10 shows that densities are still higher in these Midwestern locations than in similar "sister" cities located in the South and West. This is notable because the lower density cities in the South and West are frequently perceived as the "winners" when it comes to attracting economic growth. In the case of Chicago, this deconcentration of population is changing the economic geography from one where bedroom suburbs surrounded the central city to a metro area with many employment sub-centers. The effect this has had on manufacturing in particular can be seen in Figures 11 through 14 which show the relative density of manufacturing jobs located in Chicago to those located in several suburbs. Suburbs such as Elk Grove and Rolling Meadows have a far higher concentration of manufacturing jobs per 100 residents than Chicago. The figures also show that a similar diffusion occurs in terms of total employment and specific sectors such as retail and services, where individual suburban location demonstrate significantly more jobs per 100 residents than Chicago.

Today, Chicago's economy, while still a strong force in manufacturing, is more likely to be seen as business services and tourism and recreational center than as an industrial city. However, despite its declining status as a provider of jobs, manufacturing output will hold its own and even rise modestly over time (Figure 15).

WHAT DOES THE FUTURE HOLD?

The basic pattern of deconcentration and declining manufacturing employment is unlikely to change. Chicago will continue to reconfigure itself to accommodate growing industries in business services and the like, while the size of the city's manufacturing sector (at least in terms of employment) continues to shrink. Consider the following examples in specific industries. Figure 16 shows the largest employment sectors in the Chicago metropolitan economy in 1992 and their forecasted employment size in 2018. These forecasts are from the University of Illinois/Federal Reserve Bank of Chicago Regional Economic Applications Laboratory (REAL) input/output model. As the graph shows, none of the five largest sectors in terms of employment were in manufacturing industries. The five employment leaders are business services, wholesale and retail trade, health, education and non-profit organizations, finance and insurance and eating and drinking establishments. In total these five service industries were already employing more than 2.5 million by 1992. Contrast this to the five largest manufacturing industries (Figure 17). These are printing and publishing, electronic and other electric equipment, industrial machinery, fabricated metal, and food and kindred products. Their total employment in 1992 was barely more than 360,000, and the prospects for future employment growth appears bleak. Things even do not improve much if you try to inject some optimism into the picture by jumping ahead to 2018 and simply look at the five manufacturing industries that are expected to be the largest employers in the sector (Figure 18). First of all, only two of the five largest employers in manufacturing will actual increase their total employment from 1992 levels. Even the winners in terms of manufacturing employment will not experience employment growth. By 2018 these five large manufacturing employers will only have 240,000 employees.

This deconcentration of manufacturing in metropolitan Chicago will also affect the output of the energy sector. Figure 19 provides a forecast of output for the electricity, gas and sanitary services sector of the Chicago economy through 2018. The combination of a declining population and loss of manufacturing facilities that were large energy users, will reduce the dollar output of this sector until 2010. With new large energy using facilities, like the Motorola plant locating outside of metro Chicago, growth in energy demand will be outside of the urban area. From an energy use standpoint, one of the more interesting developments is that Motorola has been investigating purchasing their power from Wisconsin, illustrating that reducing every potential cost has been a focus of their choice of plant location.

CAN METROPOLITAN AREAS BE RECONFIGURED TO SAVE MANUFACTURING?

While most of these assertions about the movement of manufacturing away from urban areas hold, there are notable exceptions. As Figure 20 shows, within the Great Lakes Region some urban counties have gained manufacturing employment, such as Minneapolis-St. Paul, while some rural counties, particularly in Illinois, have lost manufacturing employment. What this may mean is that there is a role for local policy in being able to influence manufacturing development. However, the trend in the general market forces in assessing the chances for redeveloping manufacturing require that these expectations be realistic. At the present time, very few public or private sector analysts are conducting in-depth studies of local market forces around which new energy and new kinds of incentives could be applied to stimulate industrial development.

However, there are some common sense approaches that have been identified that would help. First, cities such as Chicago could develop a better inventory of potential industrial sites. This could include identifying their redevelopment potential as well as identifying the most appropriate use for the site. Aiding in this process would be a policy that allows flexible levels of environmental cleanups based on the intended use of the site. The desirability of returning a former industrial site to pristine condition, only to build another industrial structure on the location is questionable. Site and use specific levels of cleanup can lower the costs of site preparation and help tip the balance between greenfield and brownfield sites.

Another critical component is a more certain definition of environmental liability. Because the effects and extent of environmental liability are so open ended, it is difficult for firms to take a chance on a previously used site. Virtually every company has heard some horror story about a company that purchases a site and in the process of developing it, unearths an environmental hazard that balloons the redevelopment costs. Often there is no process by which a site can be certified as being clean. While several states have tried to help in this area by establishing differing types of certification processes for site clean-ups, the lack of clear federal guidelines tends to undermine this effort. Similarly, efforts to reduce the risk which lenders face when making loans on these urban sites could also help encourage development. Unfortunately, federal efforts to provide clearer guidelines for environmental clean-ups by amending the Superfund law, failed to make it through Congress this year.

However, the fundamental question is still to examine what urban forms may be the most achievable and how policies can help reconfigure urban centers to support this style of development. It may no longer be realistic to base economic development strategies around trying to attract low-skill, high wage manufacturing back into the city. In the first place, urban areas may simply have too many disadvantages built into their basic structure to permit this. Even more discouraging is the fact that in luring manufacturing back into the city, it is not clear that it will be able to provide the path to middle class income that it once did. With manufacturing jobs increasingly requiring higher skill levels, the current urban workforce would often be ill-suited (without significant retraining) to work in today's manufacturing facilities even if they could be reconcentrated in the cities. Those forms of manufacturing that do not require higher skill levels are certainly going to locate wherever costs are the lowest in rural and foreign locations, and even if they were brought back to the city, it is uncertain that they would offer significantly better wages than those offered by lower end service jobs such as fast food restaurants and retail jobs. It also cannot be ignored, that in light of the declining number of available jobs in the manufacturing sector, that the pursuit of manufacturing often means trying to get a larger piece of a shrinking pie.

Still, with some policy help, manufacturing can be part of the urban economic equation. However, its success will depend on carefully identifying the types of manufacturing that can succeed in city as well as assembling the appropriate sites where new facilities can be established. This includes insuring that available sites can be certified as being free of environmental liability and that the appropriate infrastructure is in place to support flexible manufacturing design. In the case of Chicago, steps can be taken to help maintain some of the city's rich manufacturing heritage but just as Chicago is no longer "hog butcher to the world," it is unlikely that it will ever be viewed as primarily a manufacturing hub again.

REFERENCES

Bartsch, Charles et al., *New Life for Old Buildings*, Northeast Midwest Institute, Washington, D.C., 1991.

Bartsch, Charles and Richard Munson, "Restoring Contaminated Industrial Sites", *Issues in Science and Technology*, Spring 1994, pp. 74-78.

Haider, Donald, "The Chicago Region: 2010" for An Agenda for Growth of the Chicago Region, *The Urban Land Institute*, Chicago District Council, February 1994.

Kotval, Zenia and John R. Mullin, "The Coming Crisis in Industrial Land: A Planning Perspective", *Economic Development Quarterly*, Vol. 8, No. 3, August 1994, pp. 302-308.

State University of New York at Buffalo, School of Law, *Recycling Industrial Sites in Erie County*, Environment and Development Seminar, May 1994.

Szatan, Jerry W. and William A. Testa, "Metropolitan Areas Spread Out", *Chicago Fed Letter*, Federal Reserve Bank of Chicago, Number 83, July 1994.

FIGURE 1

SHARE OF TOTAL METRO MANUFACTURING JOBS

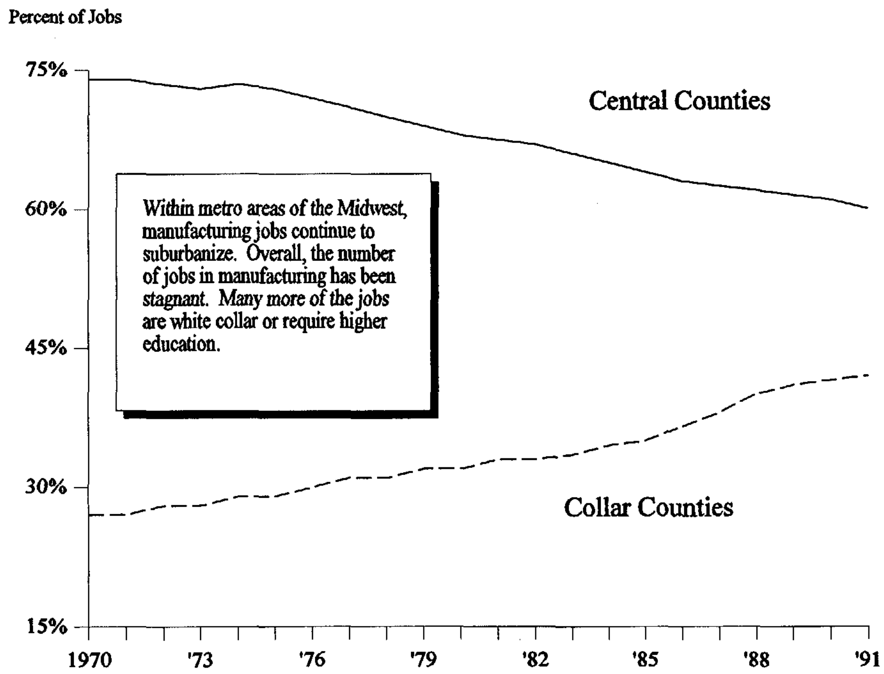


FIGURE 2

TOTAL U.S. MANUFACTURING JOBS

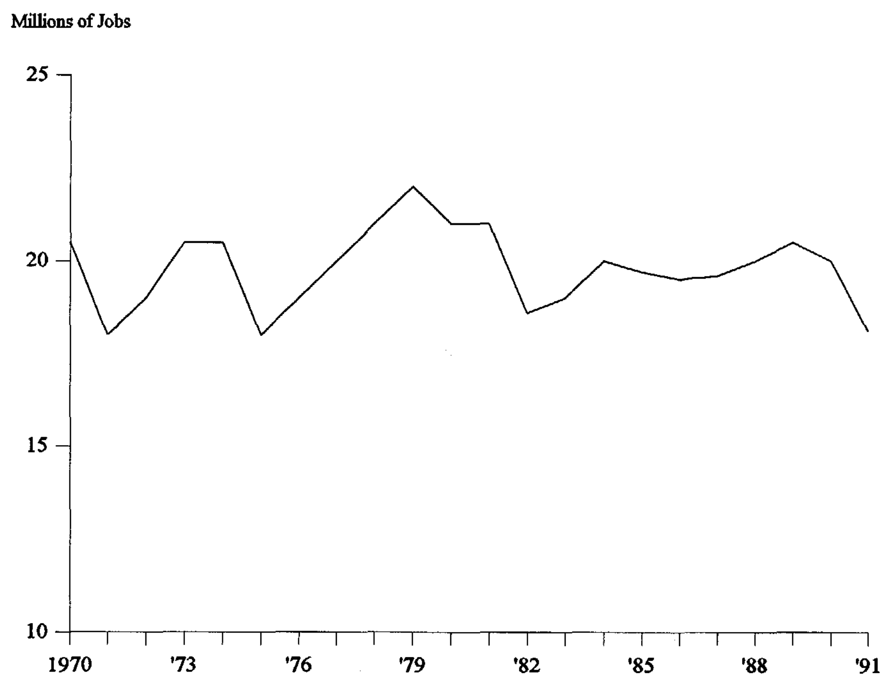


FIGURE 3

CENTRAL COUNTY SHARE OF MANUFACTURING JOBS

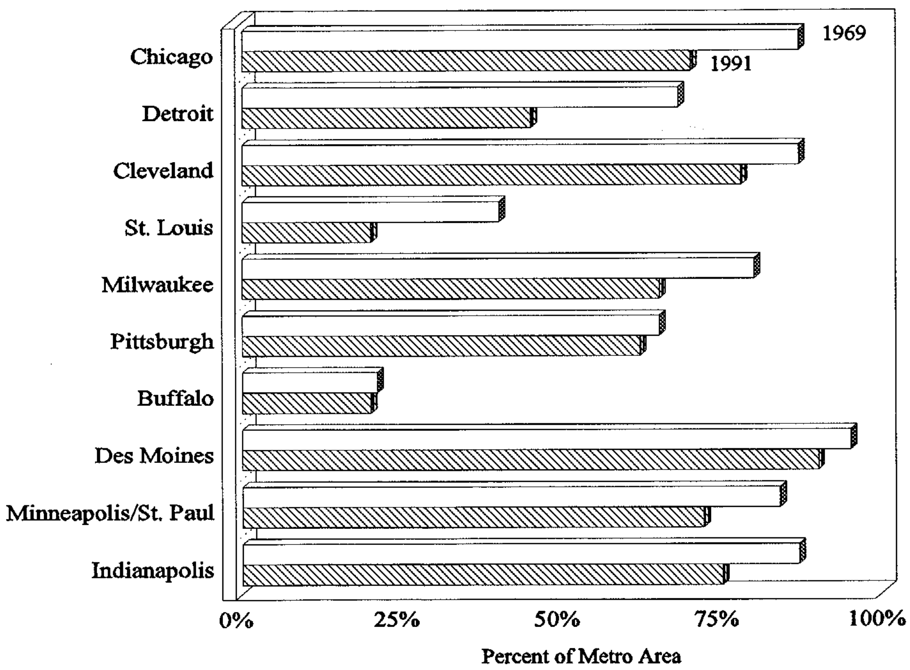


FIGURE 4

MANUFACTURING SHARE OF JOBS

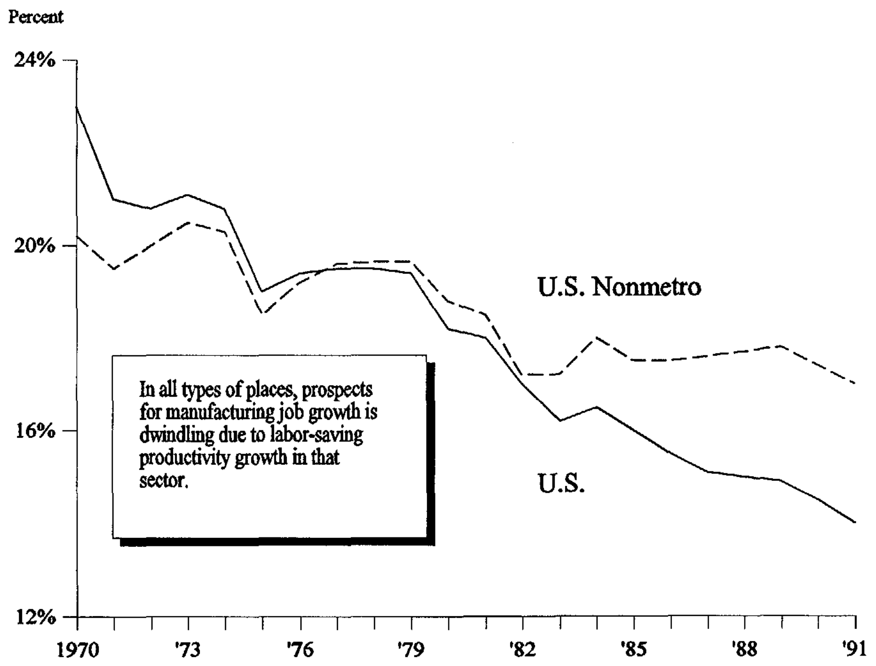


FIGURE 5

SERVICE VS. MANUFACTURING EMPLOYMENT IN CHICAGO

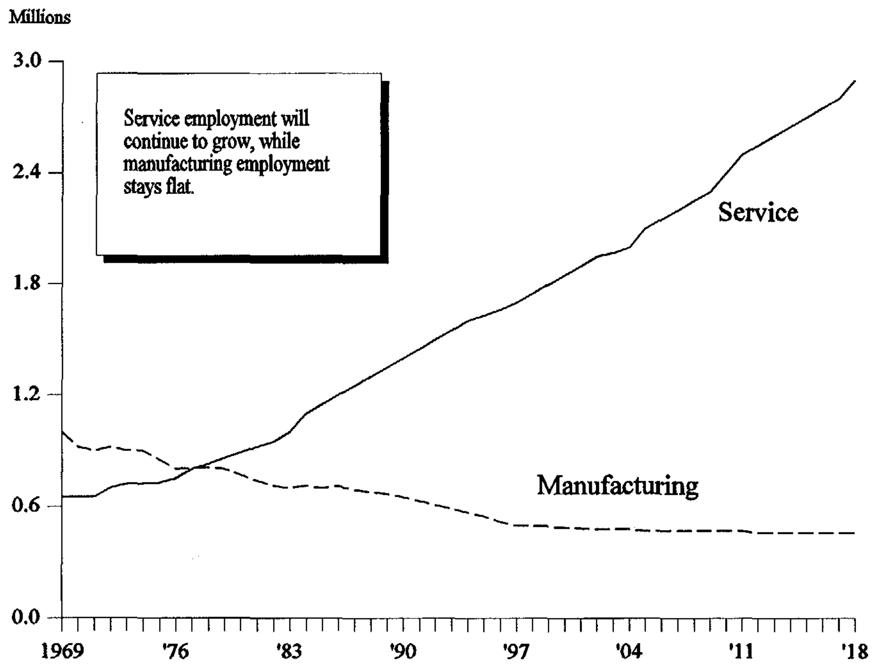


FIGURE 6

CITY OF CHICAGO EMPLOYMENT

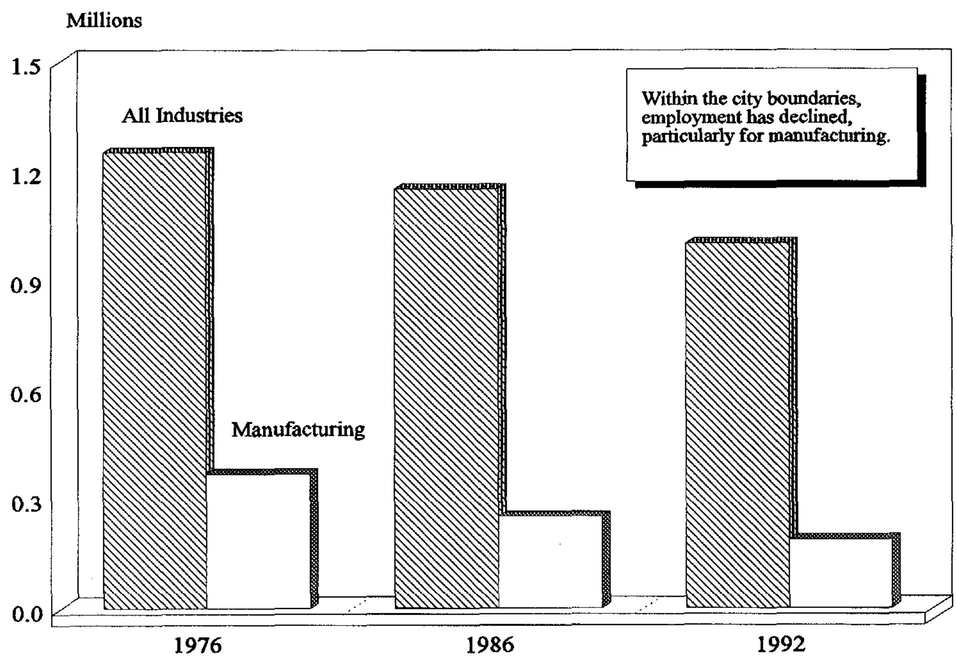


FIGURE 7

**WHAT INDUSTRIES ARE GROWING IN THE CITIES?
TRAVEL/MEETING/RECREATION INCOME, 1969-1991**

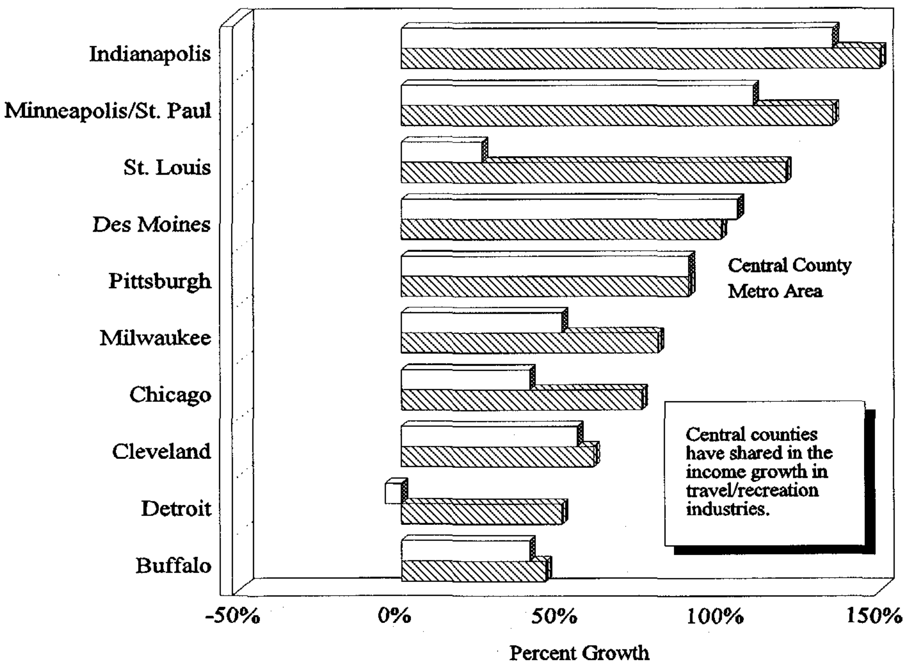


FIGURE 8

**WHAT INDUSTRIES ARE GROWING IN THE CITIES?
BUSINESS SERVICES INCOME, 1969-1991**

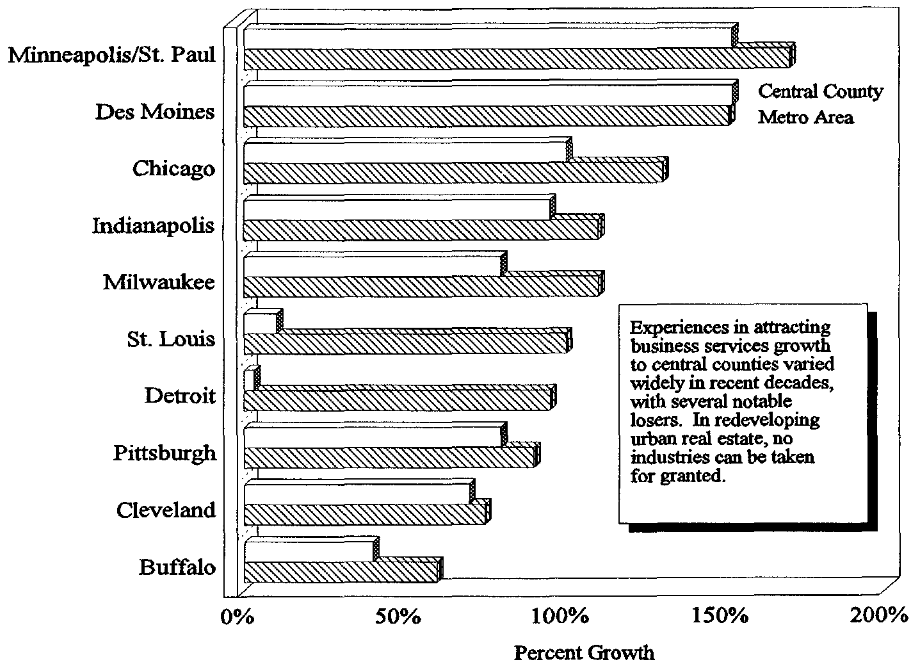


FIGURE 9

POPULATION DENSITY / 1990
METROPOLITAN AREAS

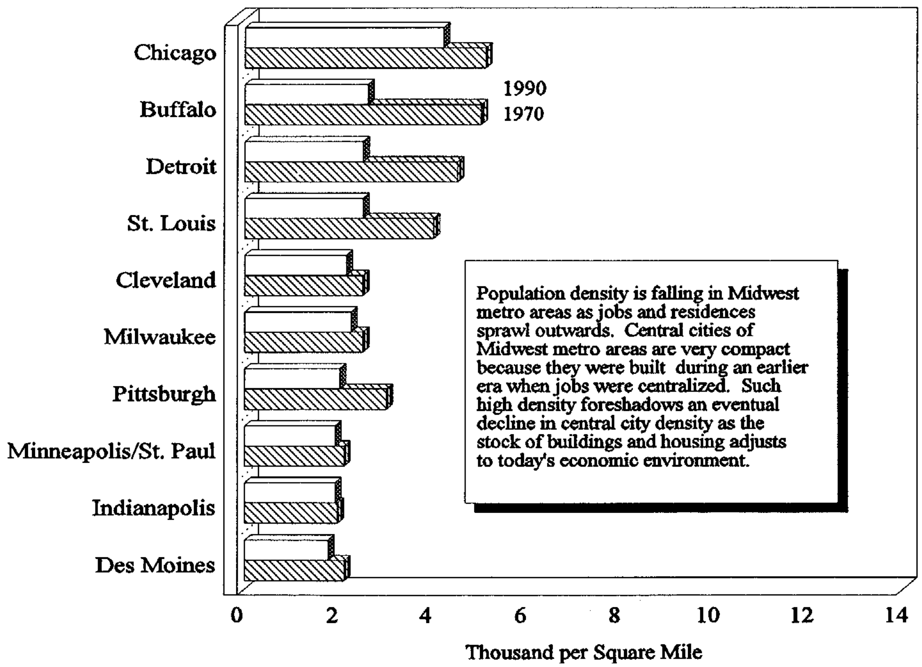


FIGURE 10

POPULATION DENSITY / 1990
SISTER CITIES

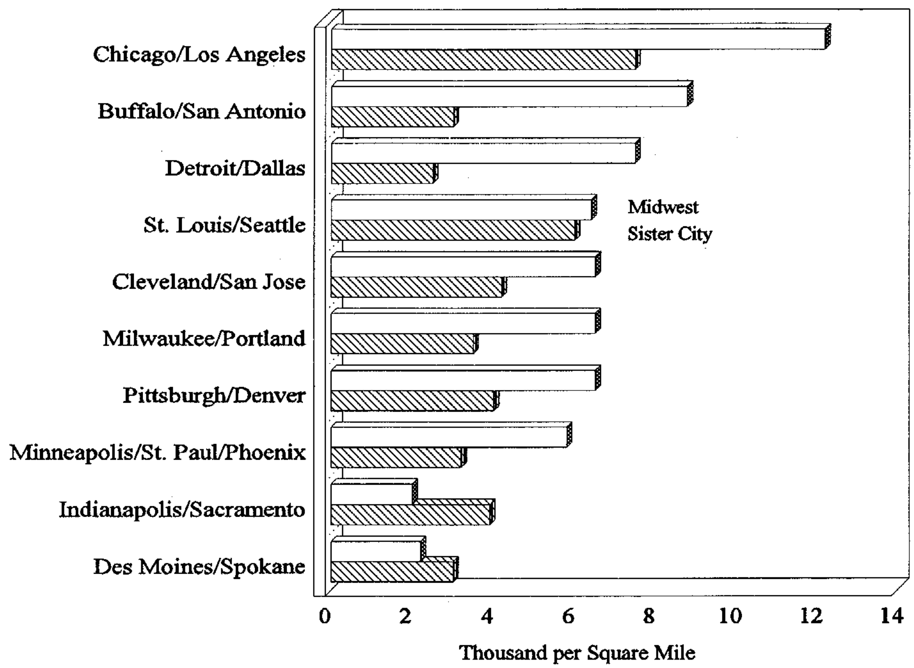


FIGURE 11

EMPLOYMENT CENTERS OUSIDE CITY OF CHICAGO
TOTAL

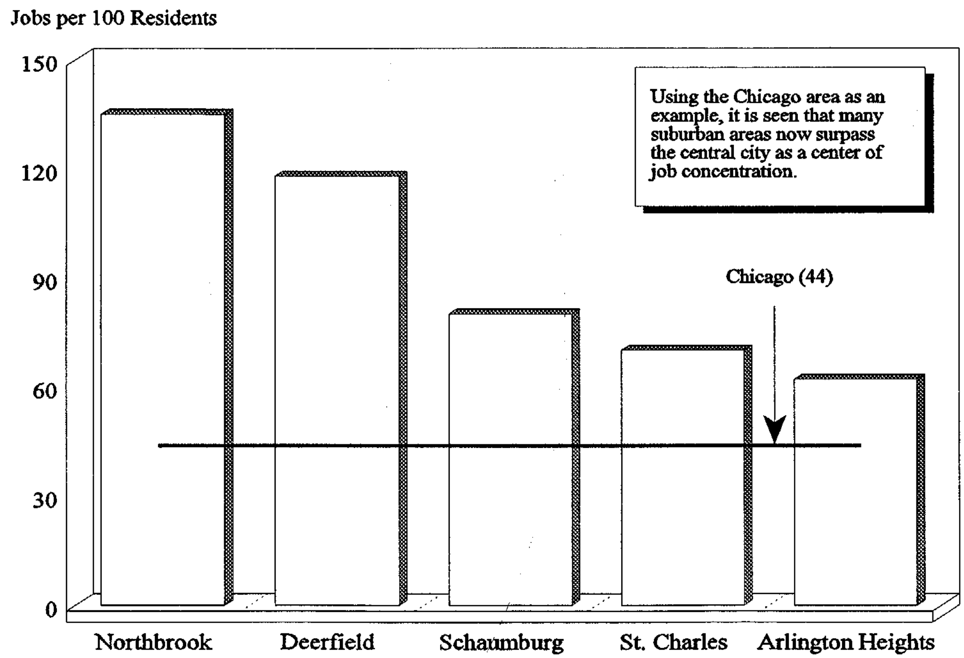
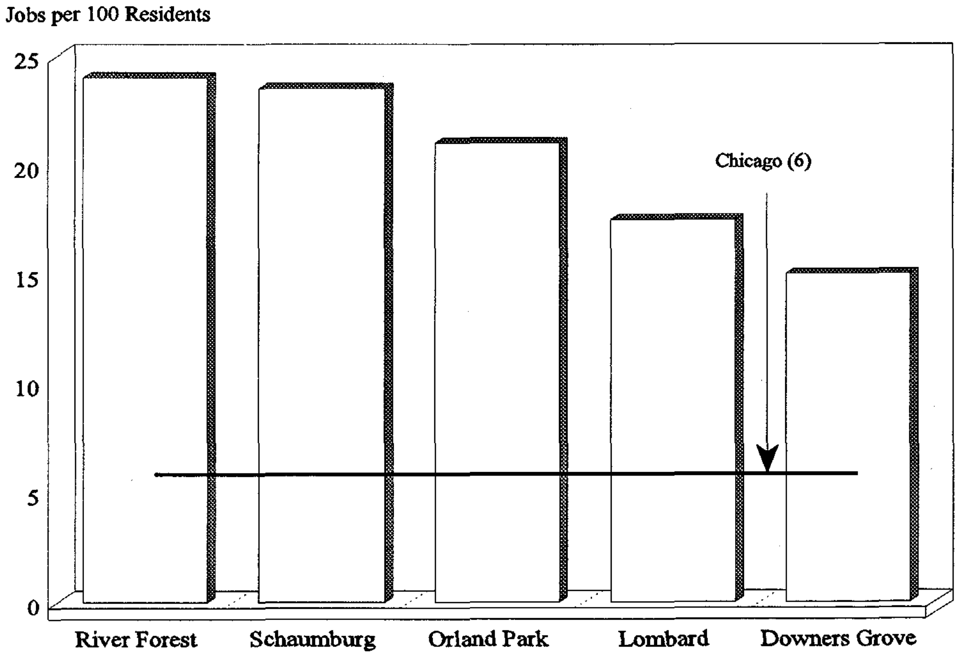


FIGURE 12

EMPLOYMENT CENTERS OUSIDE CITY OF CHICAGO
RETAIL



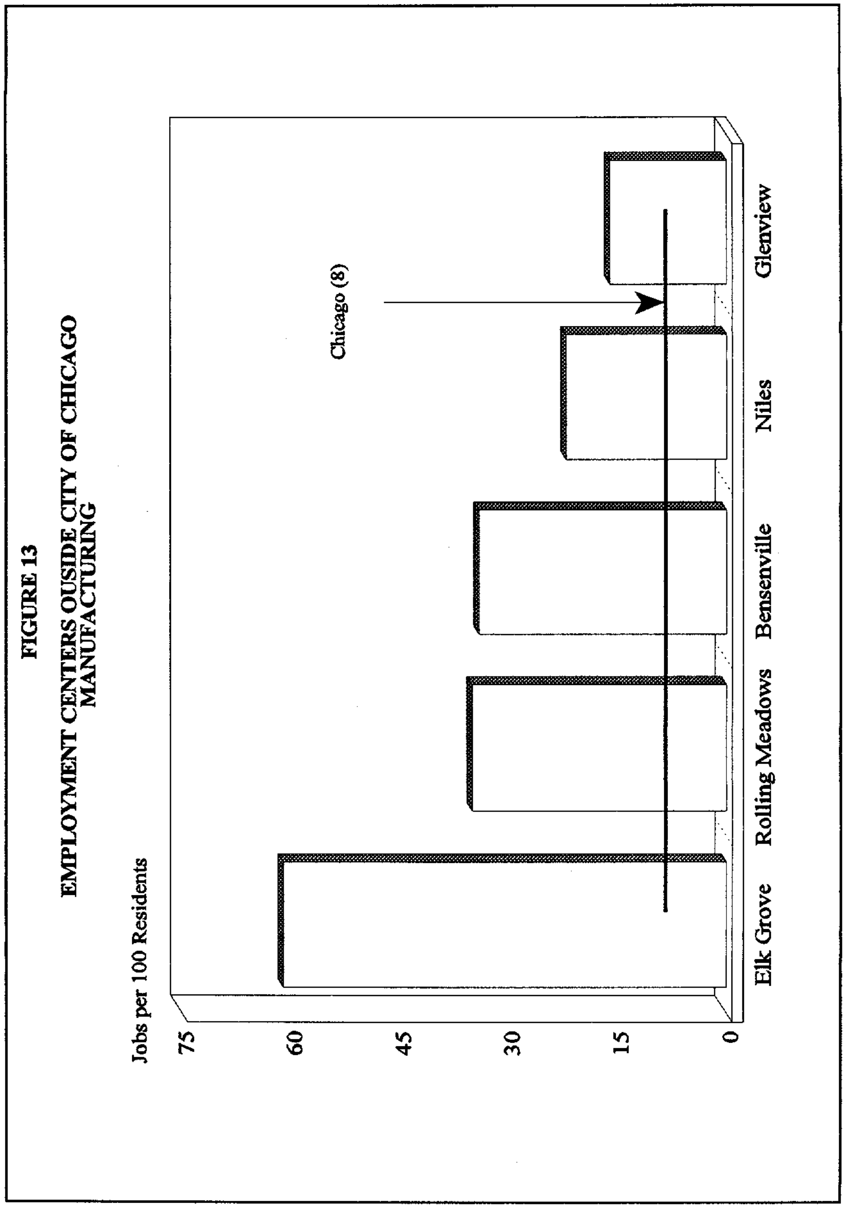


FIGURE 13
EMPLOYMENT CENTERS OUSIDE CITY OF CHICAGO
MANUFACTURING

FIGURE 14

**EMPLOYMENT CENTERS OUTSIDE CITY OF CHICAGO
SERVICES**

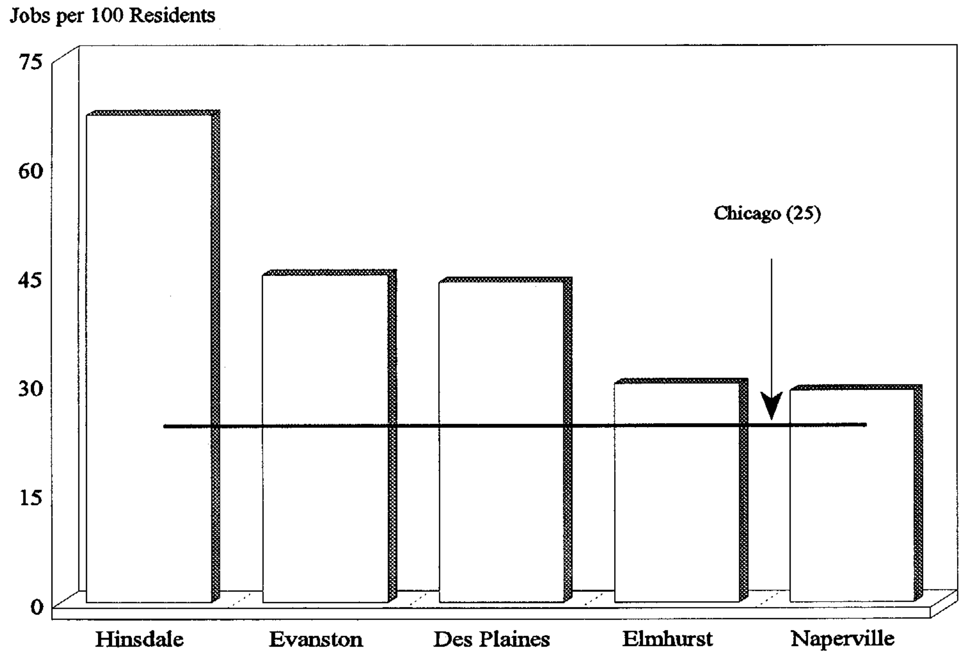


FIGURE 15

CHICAGO MANUFACTURING, SERVICE AND TOTAL OUTPUT

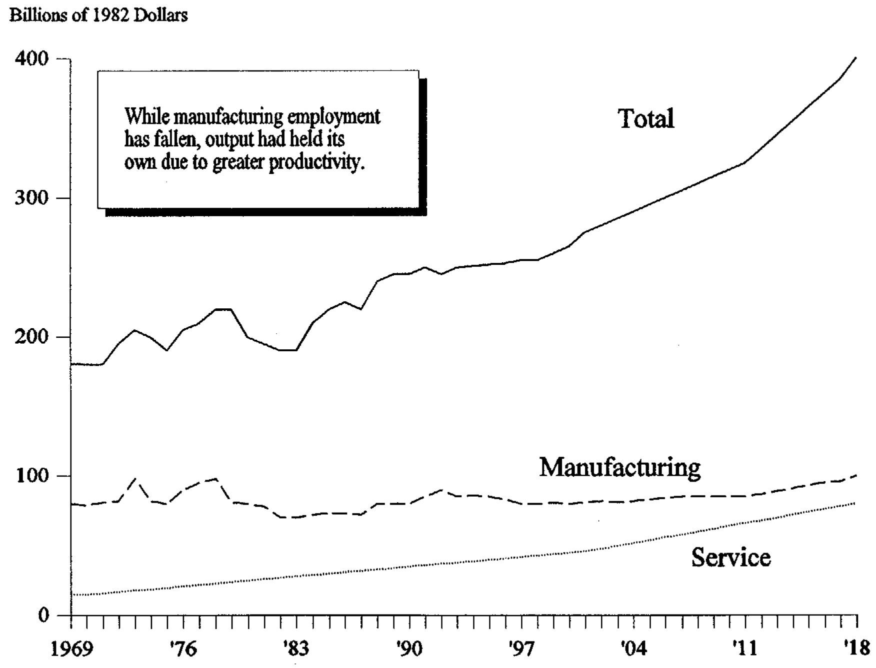


FIGURE 16

5 LARGEST EMPLOYMENT SECTORS IN METRO CHICAGO, 1992-2018

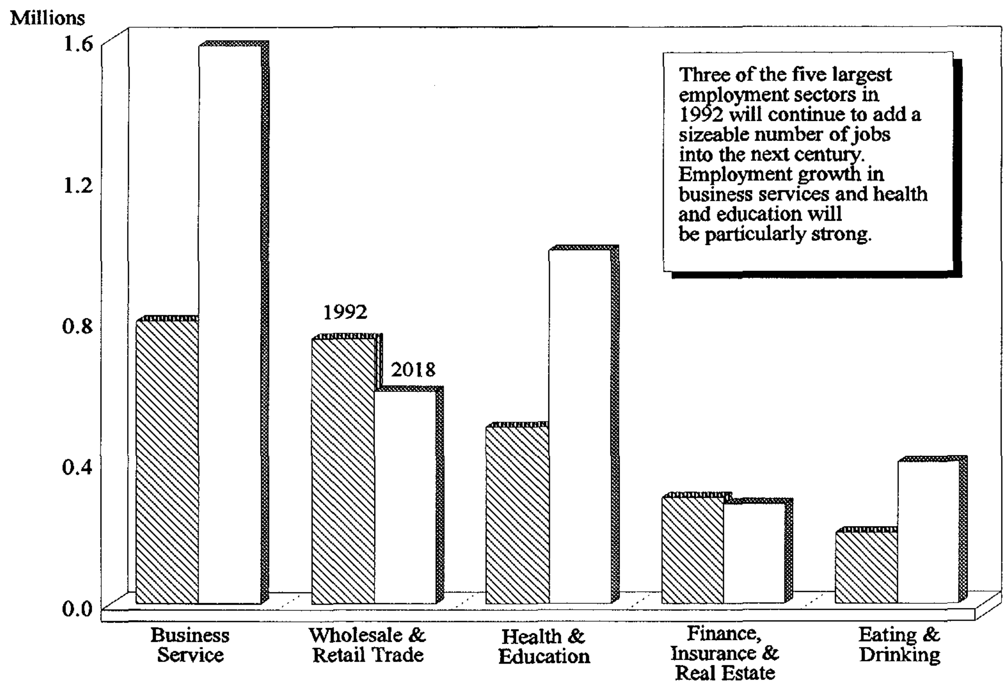


FIGURE 17

5 LARGEST MANUFACTURING EMPLOYERS IN METRO CHICAGO, 1992-2018

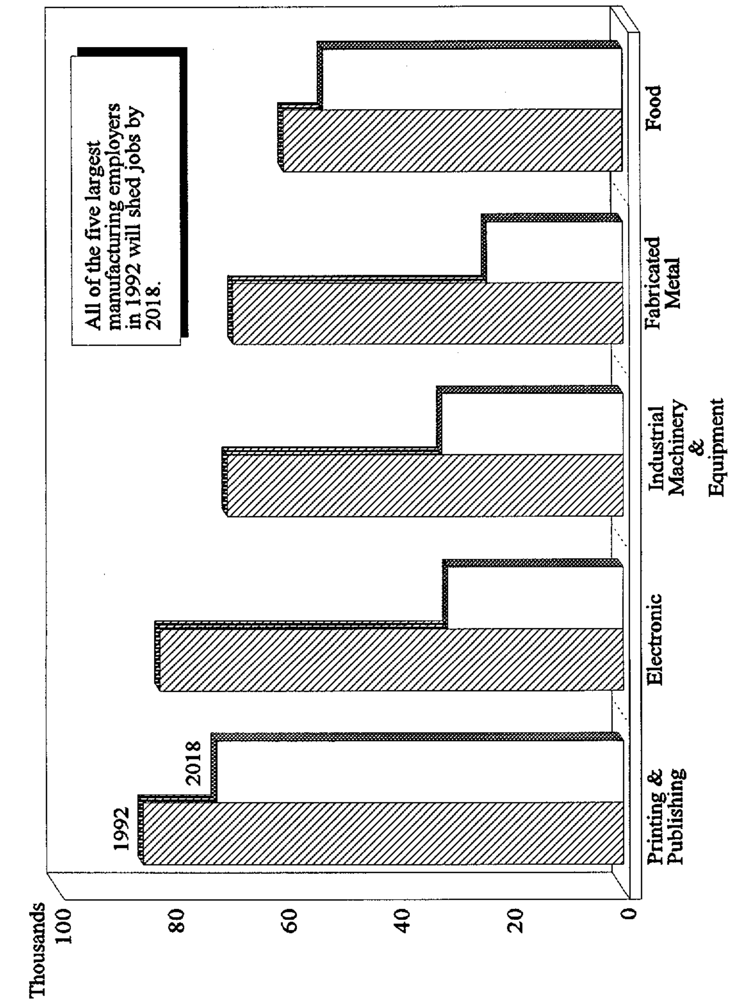


FIGURE 18

5 LARGEST MANUFACTURING EMPLOYERS IN METRO CHICAGO, 2018

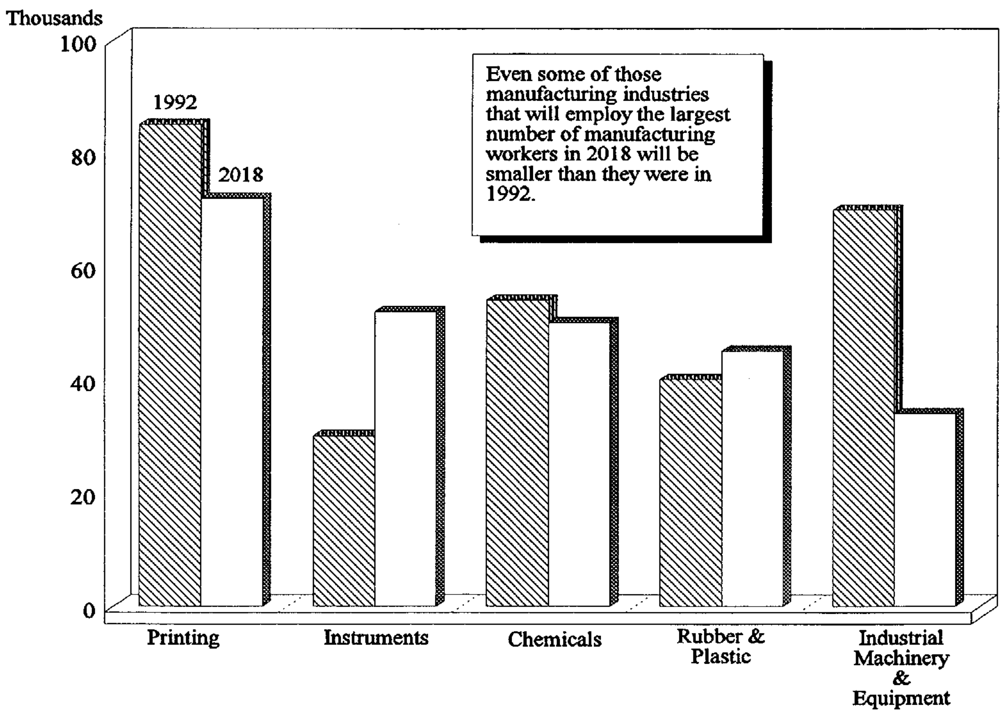


FIGURE 19

OUTPUT FOR THE ELECTRIC, GAS, AND SANITARY SERVICES SECTOR IN METRO CHICAGO

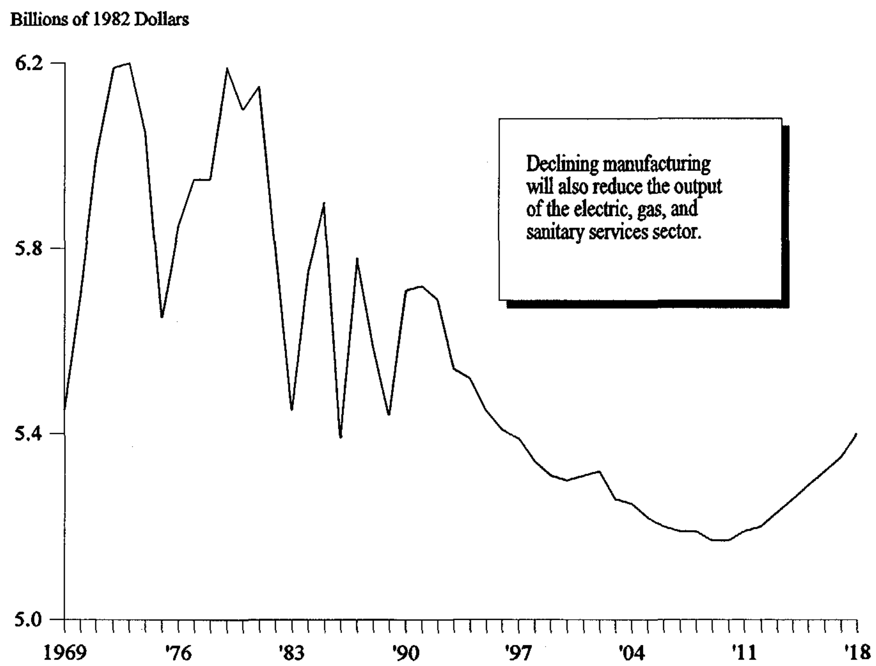
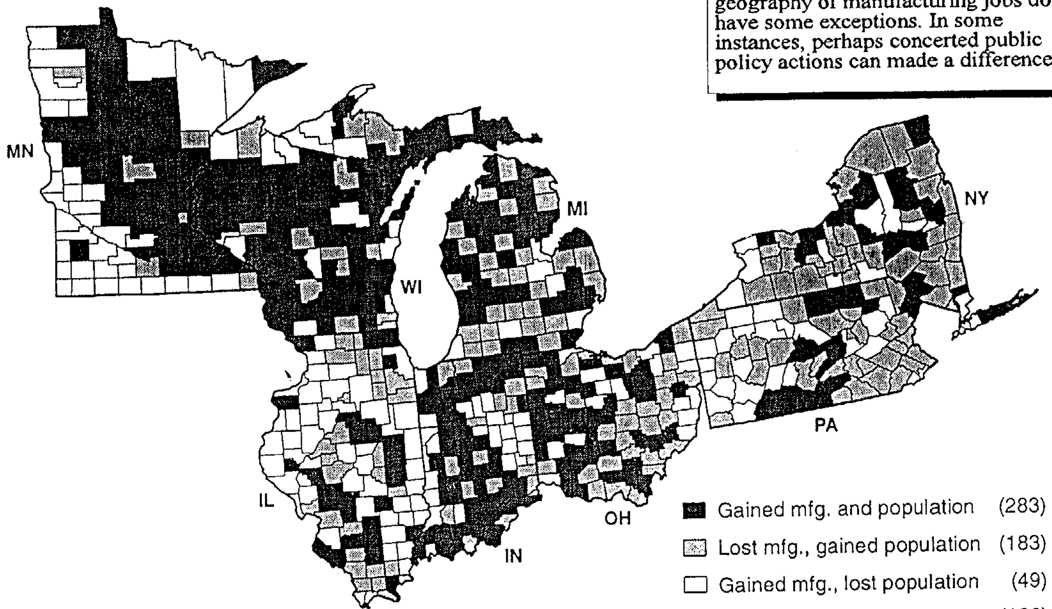


FIGURE 20

COUNTY PATTERNS OF EMPLOYMENT AND POPULATION GROWTH / 1969-1991

Generalizations concerning the geography of manufacturing jobs do have some exceptions. In some instances, perhaps concerted public policy actions can made a difference.



HISTORY OF TRANSPORTATION IN CHICAGO: ITS IMPACT ON THE URBAN LANDSCAPE

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Associate Executive Director
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INTRODUCTION

This paper presents some of my thoughts on the relationship between transportation and how we have used our land. It is as much anecdotal as insightful and I offer no excuses for that. I believe the reader or listener has heard a plethora of scientific explanations for why we consume land and how transportation is responsible for these excesses. However, I thought it would be more interesting to put the relationship in a historical context. I hope you will agree.

I have attempted to track the link between transportation and the use of land. This linkage actually involves only a few simple human factors such as a desire to pay the least amount for land, getting from place to place as swiftly as possible, being paid the most for work done and living in a country-like setting with all of the serenity that image conjures. I argue these factors are what brought us to where we are and I have not attempted to judge this as good or bad.

Since this is an energy conference, it is necessary and appropriate to mention energy now since there is precious little mention in the following text. That lack of mention is not an oversight. I contend that energy consumption or scarcity, like railroad or transit strikes have had little long-term effect on how we travel and therefore how we use land. The notion that resources were inexhaustible permeated Chicago's early history. For example, by the time the white pine forests of the north were depleted the Chicago lumber industry had changed in response to other factors making the depletion, when it occurred, a non-event. Within five years of the end of the last energy crises, vehicle miles of travel were growing faster than ever before.

Human factors appear to me to have had and probably will continue to have a more profound effect on transportation than anything else. I do not believe we know what individuals will pay in energy costs to maintain their real or perceived mobility. The real cost of fuel and vehicles is much higher (and so is transit usage) in Europe, but VMT and vehicle ownership still are growing at an astounding rate. Mobility is perceived as good, not bad. How do we convince people to limit their mobility when it is good?

BEFORE CHICAGO, 1673 — 1830

Chicago would begin its rise as a major urban place with a clean slate. It had not participated in any of the history of the country that occurred during the nearly 200 years before 1830. The French had been driven from the continental U.S., a revolution had been fought and won, and a second war with Britain had firmly established the new nation south of the Great Lakes. Except for the massacre at Fort Dearborn that was a result of the War of 1812, United States history had not impacted Chicago or Illinois. During the last 50 years of the 18th Century, Illinois population did not grow but stayed at around 2500 people. The state's population was concentrated in the south. This was because any westward travel from the east eventually involved the Ohio River which deposited would-be settlers no further north than Shawneetown. Thus, the first substantial European settlements in Illinois occurred south of St. Louis on the east bank of the Mississippi. This meant none of the political and socioeconomic history of the eastern U.S. was a factor in Chicago's development. The clean slate also applied to the topography. The Wisconsin glacier had made the northeastern part of Illinois as flat as a billiard table with no large rivers, valleys or mountains to dictate the pattern of settlement. Interestingly, the fact that Chicago was even in Illinois was the result of a last minute amendment by Illinois Congressman Nathaniel Pope, uncle of the man after whom Cook County is named. His efforts moved the border of Illinois 41 miles further north than had been previously established by the Illinois Territorial Legislature. In 1818 when Illinois became a state, Pope understood the importance to Illinois of the prospective shipping point at the mouth of the Chicago River. He had no trouble getting President Monroe to sign his amended bill because Monroe had earlier dismissed the Lake Michigan shoreline and the prairies as "worthless."

At the onset of the 19th Century waterways provided the main means of transport. As early as 1673 Marquette had learned what the Indians already understood: Chicago, the Mississippi, and Great Lakes watersheds were within a few miles of each other. In the spring one could often traverse the watersheds in a canoe on a mud lake (swamp) between what is now the Bridgeport neighborhood in Chicago and the suburb of Lyons. For the first 30 years of Chicago's existence that fact would play a major role in both the actual development and the promotion of the city as a urban place.

LOCATION, LOCATION, LOCATION, 1830 — 1870

It was not until the 1830s that the federal government decided that the Chicago region was of strategic importance to the country. They therefore determined to move the last remaining Indians out of the state. These were the Pottawatomies, who still possessed all of the northeastern corner of Illinois. The treaty, consummated in 1833, moved this last Illinois tribe west of the Mississippi along with Chief Blackhawk's people, thereby ending forever any actual or perceived threat to settlers in the area. In addition, the federal land surveyors had finished their work in Illinois and moved west. With no Indian threat and easily definable and devisable flat land — a land development and population boom resulted. In 1829 Chicago's population was 30, by 1837 when it was incorporated as a city, it had grown to 4,170. The population almost doubled in 1835 alone, the year the federal land office opened. By the late 1830s the stage was set for Chicago to become the gateway to the west. Six factors related to Chicago's location were to result in the city's population reaching nearly one million by 1870.

Boosters

In the first decades after the federal Indian treaty, civic boosters played an important role in making Chicago an urban place. They articulated its transportation advantages, helped secure the development money from New York banks, and drove home the notion that the country needed a western metropolis. Every major city had boosters but not every city's promoters were as successful as Chicago's. They, along with land speculators, drove up the price of downtown lots during 1833-1837 from $200 to $200,000. Only a part of this increase was lost in the panic of 1837. One lasting result was the concentration of activities in a central core in order to justify the cost.

Canals

It took nearly 20 years to build the Illinois Michigan Canal, but when it finally opened in 1848, it provided a commercial connection between the Great Lakes and the Mississippi watershed. Construction of the I&M Canal began in the early 1830s on a swath of land brought from the Indians before the 1833 treaty. By the time it was finally open for business, railroads were on the scene and Chicago was fast becoming a major city. Nevertheless, when linked with the Erie Canal which was opened by the state of New York in 1825, the waterway provided a low-cost means for westward migration. This flood of people deposited workers for Chicago's economy, farmers for the prairie to the west, and more New York capital. The historic southern migration routes which had bypassed Chicago and accounted for the early settling of southern Illinois would soon cease to exist, being replaced forever by the Chicago gateway.

Lumber and the Lake

By the 1840s Chicago's location had precipitated the rise of an industry that was to become unique to the world. The reasons for the existence of Chicago as lumber capital during the 1850-1870 period were its location between the prairies to the west and the white pine forests to the north. During this period white pine generally reached Chicago by lumber schooner and left by canal boat and later by rail car. Barges and rail cars could be fully used in both directions because grain moved toward Chicago. Moreover, Chicago was the only place where a whole shipload of lumber could be sold for cash, thus providing the captain with the ability to quickly unload his cargo and go back for more lumber. Chicago as a lumber capital lasted until the white pine forests were depleted and business practices had changed including the desire to "sell lumber as near the saw as possible."

Grain

Grain had a similar early history and effect on Chicago as did lumber. By 1850 more grain moved through Great Lakes ports than passed through New Orleans. Before the 1840s grain was shipped in a sack owned by the grower and remained the property of the grower until purchased by the consumer. That meant the grower took on all of the problems and liability of a shipper. Chicago merchants changed all this by eliminating the grain sack based system and assuming the transportation and exchange risks. They bought the grain, stored it in the new steam powered grain elevator/warehouse, standardized its quality, traded it as a commodity in a privately regulated central market (now called the Board of Trade) and moved it on railroads ten times faster than the Mississippi-dependent St. Louis merchants did. They created a commodity of the exchange of grain from the farm field to the food table. By 1860 farmers had limited exchange and transportation responsibility so they could concentrate on growing more and better grain.

Meat

In 1861 Chicago replaced Cincinnati as the country's largest pork packer. However, it took nearly another 20 years before the technology of refrigeration could be applied to make fresh meat a commodity. When applied to specially designed railroad cars and combined with cut-throat marketing, it was not long before the Chicago meat packers conquered the eastern beef market. Keeping the meat cool was not their only problem. Giant meat packer Swift and the other packers had to take on the railroads. Shipping the dressed and iced meat was significantly less profitable to the railroads than live beef. They finally worked out a deal with a Canadian railroad, the Grand Trunk Western (who had not been able to get into the U.S. livestock/shipping business), to get their new product to the eastern market. But by 1888 the time-honored practice of local butchers slaughtering local cattle and selling fresh beef was over; now Chicago packers dominated the fresh beef meat market east of the Mississippi.

Railroads

Before the railroads came, Chicago was already a major destination for farmers selling their produce. The other close-by communities did not have access to the inexpensive transportation to the east provided by the Chicago port and the Great Lakes. This Chicago hinterland of a few hundred miles would soon be expanded by the railroads. The first railroad arrived in Chicago in 1848. It was the Galena Railroad (predecessor of the Chicago and Northwestern Railroad) built to follow the old wagon road which served the lead mines in Galena. This was followed in rapid succession by the Illinois Central, Michigan Central and Northern Indiana, Rock Island and LaSalle, Michigan Southern, Chicago, Burlington and Quincy, Alton, Chicago Milwaukee and St. Paul, Lake Shore and Michigan Southern Railroads. Early arrival Illinois Central was designed to bisect the state from North to South with only a branch to Chicago. But when the directors, including Senator Stephen Douglas, saw what was happening in Chicago, the branch became a main line. The IC became a major lakeshore property owner after being beaten to the punch in acquiring a line further west by the Rock Island Railroad. By 1861 every major railroad that served the east coast north of Philadelphia terminated in Chicago as did all western railroads. Every railroad north of Kentucky served the city. A Chicago based railroad beat St. Louis in crossing the Mississippi by more than two decades something from which St. Louis would never recover. Chicago was no longer frontier, it was linked to the world. In 1830 it took three weeks to go from Chicago to New York; in 1860 a train regularly got you there in less than two days. The railroads more than anything else dictated that Chicago would become the gateway to the east, the metropolis of the west.

AMERICA'S SECOND CITY, 1870 — 1950

By the 1870s Chicago was ready to become an urban city and take its place with some of its older eastern counterparts as a modern national metropolis. One major impetus to this was the fire of October 1871. The Chicago Fire essentially burned down the heart of the city. In all, 18,000 dwellings, all of the Chicago River bridges, all but one of the municipal buildings and 100 percent of central area businesses were destroyed. The ten year old Chicago Union Stockyard, south of O'Leary's barn, was one of the few important exceptions. But much of what burned was flimsy makeshift construction that in the next few years would be rebuilt to much higher standards. Money to accomplish this was not in short supply as the east coast banks knew the value of rebuilding their gateway to the west. By 1880 most visitors had trouble finding evidence of the Chicago Fire but instead found a new modern thriving city, ready to begin the 20th Century.

Within the following several decades many of the major urban transportation innovations would occur: the cable car, the electric trolley, the elevated rail, and finally, the subway. All would provide the means to consolidate Chicago as the nation's second largest city and an urban place. All of these major forms of urban transportation were privately financed. Chicago would grow from about one million people in 1870 to 3.5 million by the end of WWII. Much of that growth would occur within what is now the corporate limits of the city.

In most cases, the development of the land was tied to the prevalent form of urban transportation. The horse car was the dominant urban transportation mode before and after the fire. It was not very fast, but a lot quicker than walking. It expanded the growth from the downtown core as far as eight miles from south to north. Wherever these lines went, development followed.

As it became easier for more people to reach the downtown, the value of the property in the central area increased and the need to use the land more intensely accelerated. This meant higher, more valuable buildings, which eliminated both the fashionable residences and slum dwellings from downtown. Most business that rebuilt after the fire added one story. Chicago had no buildings over eight stories in 1885, but by 1894 due to the advent of the steel skeleton construction technique, Chicago had 21 buildings that were between 12 and 16 stories high.

Chicago neighborhoods developed either as working class neighborhoods or from previously distinct suburbs. The Union Stockyards employed 32,000 workers at the turn of the century. During the latter part of the last century most workers lived in the neighborhoods around the yards. This was typical of many Chicago industries. But as workers increased their working skills and earned more, their desire for better housing resulted in greater travel distances. Faster and more frequent transit provided them their mobility. Horse car, cablecar, and later streetcar line intersections became focal points for commerce. This in turn created more passengers for the systems thereby providing the capital for further expansion. The expansion created development and the cycle continued.

The cablecar, whose time overlapped the horse car, had little expansive effect on development. It was a bit faster than the horse car but it had to shut down for several hours each day for maintenance, so it could not really eclipse the horse car as reliable urban transportation. It, not the elevated railway built in 1897, was the source of the term, "loop."

The elevated train advented in Chicago in 1892 running from Congress to 39th Street. It was built to serve the 1892 World's Columbian Exposition. About this time, the 35 original horse/cablecar companies were merged into three large competitors. This was seen as a way to make a big dent in the elevated railway's extensive business. History suggests that was not to be. Chicago's elevated rail grew to be the second largest in the country despite corrupt politics, insolvent companies, and obstruction of Illinois law, but it did not eliminate streetcars. All of the early elevated lines were built to serve the downtown but they terminated short of that goal. They were not really effective competition to the old cable cars or new streetcars which did enter downtown. That was resolved in October of 1897 with the opening of the Chicago Loop. This facility linked the South side, Lake Street Metropolitan and the Northwestern elevated lines and provided direct access to downtown. But instead of competing, they provided an interdependent system with a significant focus on the downtown. As the "Els" in the 1890s were acquiring electrically run cars, the horse and cable cars were giving way to the electric trolley.

The electric trolley or streetcar was to have the most profound effect of any urban conveyance before the automobile on Chicago's development. It further established the specialization of activities in the downtown and stretched the city's borders 36 miles from north to south. Large commercial centers were to develop within the city at places like 63rd and Halsted or Belmont and Cicero based on the access provided by streetcars. The streetcar lines typically ran on streets no more than a mile apart and intensive commercialization took place on these streets. Residents could get on or off at locations convenient to their homes or to shopping. The streetcars ran 24 hours a day on frequent schedules. They could be used to connect with another streetcar, the elevated or to ride all the way downtown. This put reliable, inexpensive and dependable transportation only about a half mile walk from the homes of Chicagoans. During its heyday from 1900 to 1950, the city's population doubled to 3.5 million. The typical family lived in an apartment or in a house on a 25 foot lot. Except for a possible summer outing all of the activities required of a typical household were probably handled within the city and in part by the ubiquitous streetcar.

Although viewed by many as a post WWII phenomenon, suburbanization in the Chicago region goes back to the extensive railroad construction period of the 1860s. There are stories of Hinsdale residents watching Chicago burn from their suburban railcars. After the fire, partly in response to graphic advertising by railroads and suburban developers, the region experienced a surge in people who worked in the city moving to the suburbs. By the 1890s, the ideal situation for a middle class businessman was to work in the downtown area with all of its economic potential, but live in the clean, peaceful country — a suburban town. Many of these suburban towns started out (and essentially stayed that way for many years) as a point to which farmers brought milk and produce for sale in Chicago. Others, like Hyde Park, were designed as an exclusive suburban community.

Hyde Park's developer took advantage in 1856 of an Illinois Central stop at 53rd Street to create a setting with the country appeal noted above. Twenty years later the town was a fully developed community with business, industry and a complete transportation system — two stops on the Illinois Central Railroad and cable car lines both to Chicago and bisecting the town. But Hyde Park became part of Chicago through annexation in 1889. The referendum was passed by the 133,000 rural residents of Hyde Park Township over the protests of the 20,000 residents of the fully developed town. Many former suburbs experienced a similar history, starting out as a suburban village but through annexation (Beverly, Morgan Park to the south; Edison Park, Norwood Park to the north are some examples) became Chicago neighborhoods. Others like Oak Park and Evanston remained as individual communities.

I AM IN LOVE WITH MY CAR, 1950 — 1970

The borders of the city had been well established by the 1930s, generally coinciding with the termini of the streetcar lines. Twenty years later, after a national depression and World War, not much change in the settlement of the region had occurred. But the forces that were described earlier would accelerate during this period and combine with other factors to radically shape the post-war urban landscape of the Chicago region. Some of these factors were as follows.

Housing

The end of WWII, the return of servicemen and the accelerated creation of families caused an incredible demand for housing in the late 40s. Estimates showed that the county would need 15 million new homes in the ten years after the war. But that kind of demand was not being met by the old style building methods of the housing industry. On March 7, 1949, Levittown opened with its assembly line construction methods and dependance on open land. Now there was a way to provide a million and a half homes per year but all of it in the suburbs. The federal government was helping this move to the suburbs. In the 1930s, in order to limit the number of foreclosures on government guaranteed loans, government appraisers began redlining older city neighborhood housing. Instead they approved lower-risk new construction loans in unbuilt areas. Mass production of housing and federal policy changed the trickle of suburban construction in the 40s to a flood by 1950.

Automobiles

The first automobiles were introduced near the start of the century and their early development paralleled that of other urban forms of transportation, such as the electric streetcar. But, while urban transit began a long decline in patronage in the 1920s, the automobile began its rise as America's favorite form of transportation. In 1928, the transit companies in Chicago carried nearly 3.7 million daily passengers, but by the late 50s that had been cut in half to about 1.7 million passengers. Part of that was because the region was expanding outward at a rapid pace. In 1916, 60 percent of the people working in the Loop lived within five miles, but by 1956, only 25 percent did. Between 1918 and 1925, annual automobile registrations increased by 850,000 vehicles. In the 20 years between 1930 and 1950, annual auto registrations in Chicago and Cook County increased by half a million vehicles. By 1950, the 151 million people in America owned 40 million cars to use in the 6,000 drive-in theaters that had replaced the 5,000 movie houses shut down in the five years following WWII. The trend that began with the Chicago Fire was now a full fledged exodus brought on by inexpensive and available housing combined with a very flexible form of transportation.

Expressway

Adding to the suburban momentum was another contributing federal policy, the Federal Aid Interstate System. Conceived before WWII and supported by President Eisenhower as a 42,000 mile military emergency facility to connect major metropolitan areas, it became, as much as anything else, an urban freeway system.

Illinois road building tended to follow a similar pattern: slow start, but once started, rapid acceleration to completion. In 1910, the roads in Illinois differed little from those of 1818, consisting mainly of dirt, mud or dust, depending on the season. But in 20 years, pushed mostly by rural interests, the state boasted the best system of concrete roads in the country. Likewise, long after expressways and tollways were operating on either coast or as close as Indiana, the Chicago region had few functioning facilities. Lake Shore Drive was an early exception, built in the 1930s to connect the Lincoln Park and South Park Boulevard systems. Another exception was the Edens Expressway (named after one of the few Chicago area proponents of the 1930 legislation that resulted in the 10,000 miles of concrete road in Illinois described above) built in part without toll revenues or federal interstate monies.

In 1954 and 1955 while Illinois' urban congressional delegation was working with other urban areas to make Eisenhower's interstate system also an intra urban system, Illinois legislators coincidentally were going ahead with plans for an Illinois tollway system that would form a ring around, but be outside the city boundaries. Chicago legislators were impeding the implementation of this system and some people were questioning the wisdom of starting a tollway system with the federal largesse on the horizon through the interstate system. The eventual compromise was a Cook County Interstate bond issue that would provide the ten percent match for the remainder of the Edens and to build the Eisenhower, Dan Ryan, Kennedy, and Stevenson interstate segments, while leaving Governor Stratton with one-half billion dollars in bonds to build his toll road. In the next ten short years, the region's urban freeway component was virtually completed.

These three things combined in the 20 years from 1950-1970 to totally alter the urban fabric of the Chicago region. The expressways in some cases eliminated Chicago neighborhoods, while indirectly promoting suburban communities. During this time, suburban towns like Hoffman Estates would be created, without the benefit of any of the traditional forms of urban transit, not even a commuter railroad. The development fingers that followed the railroads, clearly evident as late as 1956, were generally filled in 20 years later. The predominant neighborhood shopping area dictated by the intersection of streetcar lines had given way to shopping centers dependent on the automobile for access. By the end of the period huge Chicago neighborhood shopping centers like 63rd and Halsted would be fighting for their existence, while Woodfield Mall would be opening to crowds of shoppers arriving by car.

In the 20 years from 1950-1970, the population of the city had remained rather stable at about 3.5 million, but the area outside the city had increased to about 3.3 million, suburban Cook County had become home to 2.1 million residents, double the number living there as recently as 1950.

NAPERVILLE HERE WE COME, 1970 — 1995

At the beginning of the 1970s, a number of forces were converging that would alter the traditional distribution of employment in the region. Prior to the 1970s, employment was still focused in the City of Chicago. In 1950, Chicago contained about 80 percent of all jobs in northeastern Illinois and nearly 1.4 million work trip destinations, 600,000 more than it closest competitor, suburban Cook County. Forty years later Chicago would host nearly the same number of jobs, but had dropped to 40 percent of the regional job market, while the rest of the region took part in the incredible growth in employment experienced by most urban areas outside central cities. Suburb to suburb work trips now predominated. Some of the things that brought this change about are noted below.

Baby Boomers

By the beginning of the 1970s, the 30 million babies born in the post-war period had hit their peak entrance into the work force. By the end of the decade, the U.S. population would have grown by 50 percent since the WWII, but employment had increased by 65 percent, much of it from 1965-1980. This surge of 40 million employees caused by the baby boomers meant that the U.S. employee pool, and consequently the number of daily commuters, would reach over 120 million nationally by 1990. All of this was occurring while the country's population growth had slowed to about one percent per year.

Women Workers

Baby boomers entering the work force only explains part of the growth. Another important factor was the vast increase in the number of working-age women who were entering the workforce. In 1950, only one-third of eligible women were employed; by the middle of the 80s, this figure had jumped to two-thirds, representing 44 percent of the workforce with 30 million additional working women since 1950. The factors that caused this are many, but the practical result is a predominance of two worker households that produced significantly different travel patterns.

Auto Ownership

The trend of households having an increasing number of private vehicles at their disposal has not abated for nearly 70 years. The big increases after WWII have been previously noted. However, the more current trends almost make the post-war period pale by comparison. At the beginning of the 1970s, over 20 percent of households did not own a vehicle; by 1990, this figure had been more than cut in half to nine percent. By the mid 80s, 90 percent of workers had a vehicle at their disposal, which accounted for the fact that nationally more than 85 percent of commuting is made in a privately owned vehicle. This increase in vehicles during the 1970s was, to a large degree, accounted for with an expansion of the fleet, but not so with recent trends. Since the 1970s, the fleet has been aging, no doubt as national disposable income has decreased. The average vehicle is now about eight years old whereas 25 years ago it was about five years old. This is both good and bad news — it means the average auto lasts longer, but it limits the positive impact of the newer air pollution vehicle technology on the fleet.

Cost of Gasoline

The first few years of the 1970s saw the country lose a war, have a president resign and experience an energy crisis, none of which had ever happened before. Prior to 1970, the US produced all of the oil that it consumed. At that time, U.S. production peaked and the country became a significant importer of oil. This change was one of many factors that led to the two oil crises of 1973-1974 and 1979. The former was the result of a lack of enough oil to cover US demand due to a 25 percent embargo by OPEC on deliveries to this country. It had nothing at all to do with supply, but everything to do with price and, specifically, what price the producers (especially in the Middle East) were getting for their oil. In the last few months of 1973, the "take" of the oil producers jumped from about \$1.77 to \$7.00 per barrel; by the end of 1974, it would be about \$10.00 per barrel. With their take stabilized at around that level the next four years were crisis free. But a revolution cut off Iranian oil in 1978-79, squeezing the worldwide supply and promoting another significant price increase. The result was that at the end of the 70s, gasoline was selling for \$1.70 per gallon as compared with a price of about 16 cents a gallon 20 years earlier. But by the mid 80s, oil prices had again stabilized as worldwide supplies outstripped demand. In fact, the compression of demand caused by the recession of the early 80s has continued to be felt in the price of gasoline, which in the early 90s was briefly below \$1.00 per gallon. During the last 20 years, the "real" price of gasoline has decreased significantly.

Business Migration

During the past 40 years, the jobs that have been added in northeastern Illinois have had to offset about 470,000 manufacturing jobs that no longer exist. Most of this loss occurred in Chicago. The skilled laborer who worked that industry was replaced, for the most part, in the city by less skilled workers. Business responded to this by moving to the suburbs to be close to workers with skills they needed. This migration has included both businesses new to the region and those which formally were in the city. In most cases this has put both skilled and unskilled employees beyond the reach of traditional transit, reflecting the decline in the number of work trips now handled by transit compared to earlier years. Other reasons for employers to locate in the suburbs varied, such as costs, amenities, proximity to workers, but all contributed to the loss of skilled employment in the city.

As noted earlier, some suburbs started out as railroad milk or produce way stations which provided farmers with the means to get their product to Chicago. Naperville was one of these towns located on the then Chicago Burlington and Quincy Railroad and incorporated in 1840. It grew with the rest of the suburbs after WWII and was still a bedroom community at the end of the 1970s. That was before corporate America discovered Naperville. While the list of corporations with offices in town multiplied tenfold, the population was only doubling. DuPage County's oldest town became the Tyson Corners of the Midwest. The commuter railroad station was no longer the community's focal point for commuter travel because by 1990, almost 50,000 people came to work in Naperville and only about 4,000 left for work by commuter rail.

The effect all of this had on the region's landscape is extensive. While population growth in the last 20 years has increased only about 4 percent we have consumed 40 percent more land. This desire for less expensive land by development forces is not a new phenomenon. Chicago developed that way for the previous 100 years; the difference was that it occurred at a much greater density and could be served by something other than the private automobile. Moreover, with usually only one worker in the household (even with the extended families which were traditional at the time), choices on where to live were rather simple 50 years ago. Making those decisions today when two wage earners work 50 miles apart, need a day care center and want to live in reasonably priced housing, is no longer a simple decision. It is not one which suggests they have any compelling reason to rely on transit or own less automobiles.

The freeway system largely built during the 60s and only recently rebuilt is, for the most part, still focused on the central core. It may in fact be a participant in the exodus of jobs from the city, providing a means for city residents to get to suburban jobs. As was noted earlier income notwithstanding, if a person works, they most probably have access to a car. And if their work is in the suburbs, both skilled or unskilled employees have the means of getting to that job independent of the availability of mass transit.

The effect on travel associated with the cost of fuel has been studied at great length. The oil crisis that occurred during the 70s had only a short-term effect on travel. During that period transit use did not change significantly, but carpooling saw a significant increase. This corresponds to an analysis that predicts a 100 percent increase in driving cost results in a 70 percent increase in carpooling. In 1980, over one-half million work trips were accomplished in a carpool, but when the price of gasoline dropped during the 80s, carpooling also decreased. Efforts to reconfigure the provision of transit services in northeastern Illinois, once in the 1970s and again in the 1980s, seemed to have little effect on ridership. Generally, the CTA has experience a long-term decline, while the commuter rail has managed to get back to levels of the early 80s. Neither appears to have shared in the reverse commute trend.

The effect that women have had on travel is still to be fully analyzed. Current studies show women link a lot more trips to the work trip especially on the home portion of the trip. That, plus an assumption that they are more concerned with central city and off-peak transit travel, suggests that this is another factor in the movement away from transit usage.

All of this vies against any reasonable means that would change the relationship of travel and land use. Some suggest that transportation is not the problem, but the solution, that employment is spread (and that is not necessarily bad) throughout a region and single-occupant auto travel accommodates that fact. Others point out the deleterious effect this has on air quality, congestion and energy consumption and say we cannot economically build our way out of this problem with more and wider highways. Proposals for changing things by having people live and work closer together may not work as well as it did 50 years ago since multiple workers in a household and the vastly greater employment flexibility of these multiple worker families may limit their acceptability and use of such an arrangement.

Nevertheless, the negative impact on our environment cries out for at least some amelioration of the amount and way we are using urban land. Unfortunately, the past is probably of no use in finding a solution. What has happened in the last 40 years is no more than a continuation of a trend that began many years ago. One hundred years ago people wanted to have access to the best employment opportunities, while living in an idyllic country atmosphere. That continues to be the major force in the relationship between transportation and our use of the urban landscape.

BIBLIOGRAPHY

Buisseret, David. *Historic Illinois from the Air*, The University of Chicago Press, Chicago, 1990

Chicago Area Transportation Study. *Transportation Facts Volume 10 Number 6 Changes to Travel 1980 - 1990 Made to Work*, CATS, 1993

Chicago Area Transportation Study. *Transportation Facts Volume 1 Number 3 Changes from 1970 - 1980*, CATS, 1984

Chicago Area Transportation Study. *Volume III Transportation Plan*, State of Illinois, Chicago, 1962

Chicago Area Transportation Study. *Volume II Data Projections*, State of Illinois, Chicago, 1960

Chicago Area Transportation Study. *Volume I Survey Findings*, State of Illinois, Chicago, 1959

Chicago Plan Commission. *The Outer Drive - Chicago*, Chicago Plan Commission, Chicago, 1929

Cronon, William. *Natures Metropolis/Chicago and the Great West*, W.W. Norton Company, New York, London, 1991

Cudahy, Brian. *The Destination Loop*, The Stephen Green Press, Massachusetts, 1982

Douglas, George H. *Rail City — Chicago USA*, Howell-North Books, La Jolla, California, 1981

Drury, John. *Old Chicago Houses*, Bonanza Books/University of Chicago Press 1976 (Originally appearing as articles in the Chicago Daily News from 1939-1941)

Edner, Michael H. *The Scourge of the Dual Metropolis*, Chicago Tribune December 6, 1993

Federal Writers Project. *Illinois — A Descriptive and Historical Guide*, State of Illinois 1939/A.C. McClurg, Co., Chicago, 1947

Harder, Donald. *The Chicago Region: 2010*, A presentation to the Chicago District of the Urban Land Institute, 1994

Heuer, Robert. *The Ever Expanding Tollways, Mainly in the Suburbs*, Illinois Issues, Chicago, 1994

Holt, Glen and Pacyga Dommic. *Chicago: A Historical Guide to the Neighborhoods*, Chicago Historical Society, 1979

Johnson, Charles B. *Growth of Cook County Volume I*, Board of Commissioner of Cook County, Illinois Chicago, 1960

Lowe, David. *Lost Chicago*, American Legacy Press New York, 1985

Maddox, John. *Beyond the Energy Crisis: A Global Perspective*, McGraw Hill Book Company, New York, 1975

Manchester, William. *The Glory and the Dream,* Bantam Books, New York, 1973

Pisarski, Alan E. *Commuting In America — A National Report on Commuting Patterns and Trends*, ENO Foundation for Transportation, Connecticut, 1987

Stobaugh, Robert and Yergin Daniel. *Energy Future — A Report of the Energy Project at the Harvard Business School*, Random House, New York, 1979

Wrone, David R. *Illinois Pulls Out of the Mud*

SESSION II:
ENERGY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

IMPLEMENTING SUSTAINABLE DEVELOPMENT PROGRAMS IN CHICAGO

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Chicago Department of Environment

Achieving sustainable development requires a revision of our view of the nature of the city as an environment, and its relation to a larger ecosystem of which it is an essential part. The environmental health of a wilderness area is inextricably related to the environmental, and economic, health of our great urban centers. The vitality of our dense metropolitan areas, where population and economic activities are concentrated, is key to the preservation of productive farm lands, wildlife habitat, and open spaces. The social and economic crisis which grips many metropolitan centers, with attendant flight of industry and development to the so-called "greenfields," fundamentally spreads a broader crisis to our common ecosystem. This crisis is marked by the obliteration of habitat necessary for biodiversity, loss of fertile farm land, and the contamination of air, water and land, as an unescapable effect of the sprawl created by flight for the urban centers.

The deep history of this essential relationship between the urban and the natural is brilliantly portrayed in William Cronin's recent book, *Nature's Metropolis*, through an examination of the development of the City of Chicago in the 19th Century. Cronin shows the economy and environment of Chicago extended into the northern woods of Canada and the prairies of the Dakotas, linking widely disparate ecosystems through development activities, and as a result transforming them radically. This linkage obliterated any real distinction between "nature" and "culture," "urban" and "wilderness."

The removal of false conceptual distinctions between the city and nature, distinctions that are unfortunately at the heart of so much of American environmental philosophy, is key to the concept of "sustainable development." The following sets forth how the

City of Chicago is implementing this understanding of the nature of the urban environment, in pursuit of sustainable development within the city.

The Chicago Department of Environment begins with the recognition of what ought to be an obvious fact — that Chicago has, and is, an environment. It may look and feel different from unpopulated wilderness, which we usually associate with environmentalism or the ecology, but this urban environment is morally, ethically and in every other way an environment, and it is due no less respect or protection than a Redwood forest.

There is a delicate balance between the urban park and the factory, but both are crucial to the survival of our great cities. With that in mind, we have brought forward two major policy thrusts — one for restoring the green and one for reinventing the brown.

Our Brownfields Initiative, which was formally organized this year, identifies abandoned, polluted industrial sites and clears them, making way for future industrial development. Closing old, polluting companies may be beneficial in the short run, but unless the city's overall environmental policy recognizes the need for development of clean industry, the net effect is the displacement of the city's economic base to the beckoning distant cornfields.

Already, the Initiative has cleaned and readied for resale five properties, and the prospects are bright for a dozen more next year.

In less than one year of existence, the program has attracted ten million dollars in HUD Section 108 funding for future site work, and the MacArthur Foundation has enthusiastically contributed significant financial assistance for planning and community outreach. Additional support has also been offered by the US Environmental Protection Agency and Illinois Environmental Protection Agency.

A great urban center must also preserve and improve its open spaces. Our Department believes that open space must be more than well-cropped lawns and forlorn trees. That is why our Natural Resources Division has developed the most aggressive plans in fifty years for the restoration of waterways and wetlands in Jackson Park and North Park Village. When complete, these stagnant lagoons will be, for the first time in generations, active aquatic habitats — laboratories for education and training, migratory flyways, operating wetlands providing flood control and drainage, and, perhaps most importantly, beautiful community assets that remind us in no small way of our rich natural legacy.

Beyond even these goals, our Department has created the dual-purpose Green Corps from CDBG funding. The community-based individuals hired in this program do useful cleaning and greening work, helping reclaim vacant lots, planting flowers and restoring a sense of community stewardship. But the Green Corps program also provides critically needed job training, since the workers also receive invaluable instruction in plant selection, pruning, planting techniques, nursery work and related skills which will serve them after their time with the Corps.

Our Department continues the quest for less expensive, more environmentally beneficial fuels, and greater efficiency in the machines which burn those fuels. Chicago, as a result of our Department's groundwork, was recognized this year as a foremost leader in this effort by the U.S. Department of Energy when it ushered the city into the federal Clean Cities Program. Our experimentation with alternative fuels, district heating and energy systems and energy retrofits (such as the recently completed project at the Englewood Health Clinic) have been nationally recognized by the Department of Energy.

Recognizing that the environmental message is best taught to the young, the Department this year, after eighteen months of preparation, installed a solid waste and environmental issues curriculum in the Chicago Public Schools. When fully implemented next January, it will serve more than 300,000 students.

The activities we have described here are consistent with a greater appreciation for the value of the urban environment. They are being accomplished through heightened cooperation with other departments and partnerships with private corporations and the philanthropic community.

The initiatives we have begun this year show overwhelming promise, but they will require two to three years for full fruition. The cultivation of open space within the city, recovering the rich inheritance present in the park lands and our public shoreline, along side the redevelopment of industry in presently abandoned former factory sites, are critical to the viability of the Chicago environment. Moreover, it is critical to the health of the national environment. Rather than pursuing a thoughtless policy of abandoning our urban centers, leaving them contaminated and vacant, and moving on to "greenfields" to be similarly occupied, contaminated and abandoned, we are pursuing a broad-based program of treating the city as the natural habitat for human beings. We are, in short, abandoning the nomadic policy of slashing and burning, then moving on to despoil new sites. We are replacing this dead-end practice with a vision of sustainable development, where the city plays an essential part in promoting the health of the environment, for itself and the global ecosystem of which it is an essential part.

SUSTAINABLE DEVELOPMENT: A HUD PERSPECTIVE

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Sustainable development is the current term now being used to describe the environmental movement. The term's popularity can be traced to publication of *Our Common Future*, the report of the World Commission on Environment and Development (Brundtland Commission, 1987).

Sustainable development means exactly what is implied; development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987). It is another way of conveying the basic premise of "Spaceship Earth"; that our species has been given this planet to live on and we must carefully balance resource utilization if we want to endure more than a few generations, because this is all we've got. It is a natural evolution of the conservation and environmental movements into a format that recognizes that environmental issues cannot be viewed in isolation, but must be evaluated in a context of economic development (Powledge, 1993).

Sustainable development is thus a broad term that encompasses many elements, depending upon the context. Such elements can include: 1) energy, 2) economic development, 3) pollution prevention, 4) biodiversity, 5) historic preservation, 6) social equity, and 7) recycling and solid waste disposal.

* Note that the views expressed in this paper are those of the author and do not reflect those of his employer.

The common denominator behind all of these elements is the use of different time lines. Whereas most contemporary power structures utilize a fairly short-range time frame (the next election, the next annual report or stockholders meeting, etc.), and broadening one's horizons to 20 years or one's lifetime is generally considered long-range planning, advocates of sustainable development ask us to think in terms of millennia.

This conceptual framework is akin to Native American tradition; that we should view ourselves as trustees of the planet for our species (and other life forms).[1] We have a right to utilize renewable resources (e.g., solar and wind energy, plant products), wisely and to utilize non-renewable resources (e.g., steel) in a manner that promotes recycling. Today many "sustainable" products (Volkswagen's recyclable car program, for example) are engineered so that they can be disassembled once they have completed their useful life (Corson, 1994). Some also talk about licensing products, instead of selling them, so that appliances would be returned to manufacturers or retailers when the consumer is finished with them (Hawkens, 1993). Sustainability presently means using recycled materials whenever possible and avoiding products that either generate harmful byproducts and/or use a great deal of energy in the manufacturing process.

Following this line of thought, sustainability also means pollution prevention; pollution that endures will cause problems for future generations. Herbicides, for example, are contaminating drinking water in rural areas (USEPA, 1994). See Figures 1 and 2. (Tables and figures appear at the end of this paper). Some chemical use (e.g., insecticides-DDT in the 50s and 60s) has decimated many animal species, including the American Bald Eagle (Carson, 1964). Their use to temporarily increase crop yield is not a sustainable activity.

If we do not generate the pollutant then we will not have to clean it up and mankind can continue indefinitely. Many corporations have recognized the appeal of this logic and have voluntarily[2] signed up for EPA's 33/50 program to reduce their toxic emissions by as much as 50 percent by 1995 (Hoyle, 1993).

One of the cornerstones of sustainable development is energy policy, since energy use is perhaps the most defining element of our contemporary civilization. In the energy discipline, sustainability can best be paraphrased as living off one's income as opposed to depleting ones capital, or savings. In other words, using solar, wind and other renewables rather than fossil fuels. Fossil fuels are limited and will eventually be depleted, therefore they cannot be considered sustainable. It is as simple as that.

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[1]Or even the Judeo-Christian heritage when viewed as placing Adam/Man as steward in the Garden of Eden, as opposed to Ian McHarg's "multiply and subdue" imperative.

[2]Some of the appeal also stems from cost consciousness and reducing CERCLA liability.

Another element embraced by sustainable development is biodiversity. The biodiversity movement is most sharply distinguished from traditional conservationism for its commitment to the principle of preserving and managing entire ecosystems, or wildlife habitats, rather than endorsing heroic efforts to save single species (Hoyle, 1993). The thought is that we do not know now what important elements might be needed 100, 200 or a thousand years from now for each of these unique bio-systems (e.g., rain forests) that may be lost forever once they are destroyed. This paradigm better fits into the sustainability pantheon than traditional conservationism.

To some, sustainability also means promoting a sense of place (Beatley, 1993). In this scheme well organized communities are aesthetically pleasing and visually stimulating and thus encourage their residents to preserve and revitalize them. Historic preservation fits into the sustainability framework under this rubric, as does land planning. Communities that flood every few years cannot be considered sustainable.

Perhaps the most significant development that separates sustainability from its conservation antecedents is the element of social equity. The environmental movement has been criticized in the past for being "white collar" and promoting the interests of the "haves." The environmental and conservation movements have traditionally not dealt with the needs of the underclass, here in the U.S. and especially in developing countries. In *Agenda 21*, the manifesto of the World Earth Summit Conference on the Environment held in Rio de Janeiro in 1992, sustainable development was viewed as the strategy that would be needed to increase the basic standard of living of the world's expanding population without unnecessarily depleting our finite natural resources and further degrading the environment upon which we all depend (Sitarz, 1993, p. 4). The contemporary challenge, as viewed at the summit, was posed in terms of asking humanity to collectively step back from the brink of environmental collapse and, at the same time, lift its poorest members up to the level of basic human health and dignity (Sitarz, 1993, p. 4).

When framed in these terms it is difficult to imagine how anyone would oppose this world view. Yet history is replete with examples of resource exploitation and environmental disaster. What is it about our decision-making system that allows this to happen?

In the 18th Century Adam Smith wrote about the "invisible hand," the market mechanism that determined the most efficient use of resources (Smith, 1776). The collapse of the Soviet Union in our lifetime bears testimony that the free market is king, and that its power rules the world. What is it about this economic system that is inimicable to sustainable development?

Commentators have pointed to the fact that in our current system prices do not reflect actual costs. In other words, it is not so much the use of the market, as the manner in which the market is structured. In our current framework, when a company exploits resources it normally does not account for the loss of resource base or for environmental damage. Gasoline is cheap in the U.S., for example, because its price does not reflect the cost of smog, acid rain, and their subsequent effects on health and the environment (Hawkens, 1993, p.76), let alone recognize that the oil reserves are being depleted.

In most accounting practices one would deplete inventory when producing a product, or depreciate the equipment used to produce the product. If one cuts trees or mines coal, however, the depletion is not accounted for. Our current accounting systems view these transactions as *creating wealth* because no value has been put on the resources in place. This is a global problem which encourages resource exploitation. If a value was put on mineral reserves or other resources, then they would be used at a more judicious rate. Because these costs are not recognized, falling commodity prices results in *more* overexploitation to generate hard currency in developing countries.

Although some argue that there is no end in sight to our natural resources, many scientists are alarmed at the rate at which they are being depleted and give us only a few decades to seize the opportunity to avert the collapse of civilization as we know it (Union of Concerned Scientists, 1992). On average, resource use per person nearly tripled between 1950 and 1990. This growth, coupled with a doubling of human population, resulted in roughly a sixfold increase in human impact on the global environment during the four decades (Corson, 1994). Concerned scientists point to rising levels of greenhouse gases in the atmosphere, spreading acid damage to forests and lakes, depletion of the protective ozone layer, increasing fresh water scarcities, ground water pollution, soil erosion and degradation, loss of forests and wetlands, depletion of fisheries, and extinction of plant and animal species (Brown, Flair and Kane, 1992).

The framers of *Agenda 21* say that the system of incentives and penalties which motivate economic behavior must be re-oriented to support sustainability. Corporate and national accounting practices must be amended to reflect the true impact of development on the environment and the real value of natural resources. (For example, the mining of coal should be treated as the depreciation of an asset, not the generation of wealth). Green taxes should be encouraged to internalize "externalities" or spillover costs. By insuring that the environmental costs of projects and policies are considered, the protection of the environment can be given a proper place in the market economy of the world. This is because when prices rise, people have to reconsider usage patterns. This may be painful at first, but it generally results in innovations and creativity (Hawken, 1993, p. 76).

A good example is a recent study by the University of California at San Francisco which identified $7.7 billion in yearly expenses from cigarette smoke, mainly in lost wages and higher health care costs. Society as a whole would benefit from less smoking even though tobacco companies currently benefit from growing and selling tobacco and cigarettes. Pricing packs at $3.43 would have begun to reflect the true cost and transferred it from society as a whole to the group of individuals who smoke (Hawken, 1993).

In his book, *The Ecology of Commerce*, Paul Hawken argues that price must not only reflect the direct costs of production, but also spillover effects (damage caused by one production system to another system, person or place) and costs to future generations. Green taxes or their equivalent are needed to internalize costs. Otherwise when a forest products company buys logging rights from the Forest Service at pennies to the dollar and then clear-cuts the area, leaving it degraded for the next hundred years, the "profit" from the sale of the wood goes to the corporation, but the loss of habitat and biodiversity is borne by society (Hawken, 1993, p. 82).

HUD'S RECORD ON SUSTAINABLE DEVELOPMENT

In order to properly evaluate HUD you first have to form an image, an icon if you will, that represents HUD. HUD is not a monolithic structure of uniform philosophy, but is more akin to the mythical, many-headed Hydra of Greek mythology. HUD is an amalgam of many programs, with three major program areas (Housing, Public Housing, and Community Planning and Development) each subdivided into many fiefdoms, and each of these are relatively free to formulate their own policies. When we think of the Hydra we can begin to understand how the same agency that promotes "community viability" and "sustainable communities" allows single-family new construction to occur with virtually no environmental review in floodplains, wetlands, and other environmentally sensitive areas.

If is fair to say that there is little formal recognition or encouragement of sustainability in mainstream programs where the bulk of HUD funding and attention is centered. Most programs encourage reducing construction costs and do not recognize long-term savings in operating costs. Public housing programs, for example, use a total development cost (TDC) cap as a maximum construction cost. One cannot use a life cycle analysis to justify exceeding this cap. Similarly, our FHA mortgage insurance programs are capped by mortgage limits which restrict the amount that HUD will finance. Thus any expense beyond these limits would have to be financed in cash by the developer. Additional construction costs that would save energy use over the life of the project would be discouraged if the construction costs were already near the statutory limits (as is usually the case).

Another serious violation of sustainability tenets occurs in the brownfield/greenfield arena. Some HUD policies encourage new development in suburban "greenfields" at the expense of urban "brownfields." This is because HUD financed, single-family development is no longer subject to environmental review (58 FR 41328), and it is the single family developments that set the patterns of land use in suburban areas. The brownfield/greenfield argument is that while individual developers are steered (the market mechanism again) to suburban parcels by low cost land and the fear of liability for environmental cleanup (CERCLA and LUST), society is forced to bear the costs of new infrastructure (roads and utilities), habitat destruction (biodiversity) and farmland loss while existing infrastructure in our urban areas goes under-utilized. Continued sprawl also encourages wasteful energy patterns, not the least of which is adversely affecting our ability to use mass transit.

This is not to say that HUD totally ignores sustainability. All multifamily projects, and all locally administered HUD funds (through CDBG and HOME) must receive an environmental review. Environmental review recognizes some components of sustainability. It considers such sustainable development issues as floodplains, wetlands, noise, site contamination, etc. In a special purpose grant for a water distribution system in rapidly developing Monroe County, Illinois, for instance, the environmental review is prodding local officials to revise their Comprehensive Plan, subdivision, zoning and health ordinances to ensure that development is properly managed in environmentally sensitive karst geology areas that will be served by the new water distribution lines. In many other areas multifamily projects routinely avoid floodplain and wetland areas.

HUD also uses the Model Energy Code for new construction. This flexible code typically calls for R-19 in walls and R-38 in ceilings in northern Illinois.[3] In five states HUD is experimenting with Energy Efficient Mortgages, where larger mortgages and/or higher ratios are permitted for energy efficient new homes. In public housing energy audits are required and Energy Performance Contracting (EPC) is being promoted (the Chicago Office hosted a region-wide conference in October 1994). Under EPC public housing authorities (PHAs) are encouraged to reduce utility costs by choosing energy service companies that will fund improvements in exchange for splitting the savings with the PHAs. Other institutionalized measures include the use of individual utility allowances for tenant based rental assistance (vouchers and certificates) which encourage low income tenants to conserve energy, and a statutory preference for reusing and rehabilitating older housing in the program areas.[4]

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[3]It is actually a flexible code that allows builders to choose the unique combination of measures that will meet a certain performance standard. It's also interesting to note that HUD Housing staff have been critical of use of the code, claiming that its extra cost is keeping buyers away from FHA financing.

[4]Although implementation of this preference has been impeded in recent years by lead based paint and asbestos requirements.

There is also an Office of Community Viability within HUD's Community Planning and Development Division that actively promotes sustainable development. One of the activities funded was a Sustainable Development Cities project which focused on energy conservation activities in San Jose and San Francisco in California and Portland, Oregon. More notable has been a DOE/HUD joint initiative that seeks to lower the more than $1 billion being spent annually by the federal government on energy costs for subsidized and public housing.

HUD's CPD Division also funds local governments who design and run their own programs. The City of Chicago, for instance, is allocating millions of dollars to an effort to cleanup older "brownfield" industrial areas in order to promote their redevelopment.

HABITAT DEMONSTRATION

Despite this relative lack of concern to sustainability (or room for improvement) in most HUD programs, there is still hope. Since HUD is not a monolithic structure, there is room for flexibility and initiative at the local level. I would like to tell you a little bit about such an effort in Chicago. Its participants are hopeful that this modest effort will, like its predecessor, change the face of public housing in America.

Over 25 years ago Alexander Pollikoff, a public interest attorney from Chicago, looked at high rise public housing units in racially segregated neighborhoods and was inspired to try to change the system. He brought his case (Gautreaux) to the U.S. Supreme Court, won, and in 1974, the high court's ruling was enacted into law. The Housing and Community Development Act of 1974 prohibited the use of elevator buildings for public housing (absent a determination of no practicable alternative) and, likewise, prohibited development in minority areas. In Chicago, the U.S. District Court took development responsibilities away from the Chicago Housing Authority and gave it to a court appointed receiver, The Habitat Company. Habitat began developing public housing units in 1987 and by 1994 had developed approximately 1,500 units.

In early 1993 HUD contacted USEPA and expressed a desire to facilitate a sustainable development demonstration for low income housing. We wanted to demonstrate, in the spirit of *Agenda 21* that sustainable development was not just for the middle and upper classes. USEPA helped kick off this effort in April 1993 by bringing in Joe Lstiburek and Betsy Pettit of "Greensense"[5] for a one-half day seminar for USEPA employees and one-half day for the targeted participants of the HUD demo. HUD environmental staff had targeted Habitat, since it was managing

[5]They are now affiliated with Building Science Corporation in Chestnut Hill, Massachusetts.

CHA's scattered site development program. The development program consisted of hundreds of units, and it was felt that an experiment with 25 units would make more sense, rather than with a smaller housing authority where 25 units could form their entire development program.

It was also felt that it would be appropriate that Gautreaux serve as a vehicle for demonstrating sustainable development, since the original Gautreaux litigation attacked high rise public housing as unfit, resulting in a change in national policy. Since sustainability deals with the concept of sound design that is long lasting, it seemed apt that this be extended beyond building scale and neighborhood (racial) to other salient features.

In October of 1993 Habitat conducted a tour for USEPA of its current developments, so everyone could see what was on the table. The participants then agreed to designate one of Habitat's 25 unit turnkey developments on the southeast side of Chicago[6] as the demonstration case. A turnkey project is where Habitat specifies the sites, but then each applicant (contractor) bids with their own design and budget. Generally the lowest bid by a qualified bidder is awarded the contract and then bears responsibility for construction until completion, when they are ready to "turn the key" over to the PHA.

Subsequently USEPA allocated funds so that Lstiburek and Pettit could review and revise a standard RFP (request for proposal) to include sustainable development components (mainly energy efficiency and building materials). Energy efficiency is an important element in low income housing because it affects operating costs. Since most low income homeowners pay their own utility bills, a reduction in energy costs is usually equivalent to an income supplement. Even in public housing, where the PHA (and, in turn, the federal government) pays the utility bills, a reduction in cost would allow the government subsidy to go further.

Habitat got a little gun shy at this point, and reserved the right to go with a conventional proposal if all of the sustainable development ones came in over budget. USEPA then sponsored a two day seminar (September 29-30, 1994), with the University of Illinois's Energy Resource Center, DOE, HUD and the AIA Committee on the Environment, that educated architects and contractors (hopefully including potential turnkey developers) on sustainable development techniques. The RFP was scheduled to be issued on November 18, 1994. Anyone interested in the RFP should contact me at 312/886-7353.

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[6]This was also significant because it could be incorporated into USEPA's Southeast Side Initiative. With the demise of US Steel, the southeast side went into decline. Redevelopment was seen as an element of the renaissance of this area.

We stand on an exciting threshold. If we have only one or two enlightened developers who can put together a proposal within the budget then we can change the face of public housing development in America. But we do not know that yet. Stay tuned.

POSSIBLE FUTURE HUD INITIATIVES IN ILLINOIS

The local HUD office here in Chicago is considering a number of sustainable initiatives in addition to the Habitat demonstration. These include:

- Model Energy Code

  As noted above, use of the Model Energy Code for all new construction.

- Energy training

  Last year the Chicago Office, USDOE, and the University of Illinois Energy Research Center developed a two day course on "Energy Savings Opportunities in Housing Rehabilitation." We will continue to offer this course to our clients. We are also working with DOE to offer other types of training to HUD staff and clients in our public housing programs (including PHAs), loan management programs (including building owners and managers), and CPD programs (including local government officials and their subgrantees — not-for-profit rehabbers).

- Enforcement of HUD's Cost Effective Energy Conservation and Effectiveness Standards

  24 CFR 39 contains standards that are required for all HUD-funded rehab. Once these standards are updated by HQ (contract in process) the field office will monitor their compliance to ensure that energy conservation is included in applicable rehab activities.

- Support for Chicago Brownfield Initiative

  The City of Chicago has earmarked a few million dollars of HUD money to clean up industrial areas and re-market them. The MacArthur Foundation is also funding a Brownfields forum to explore innovative solutions to these types of issues. HUD will actively support these efforts.

- Single Family Subdivision Review

  A proposal is being circulated in the Chicago Office to voluntarily resurrect single family subdivision review, so that environmentally sensitive subdivisions can advertise to consumers who want to buy green.

- Energy Performance Contracting for Public Housing Authorities

  Under this program PHAs are allowed to keep the energy savings (for up to 12 years) accrued when a private energy service company performs, with private money, rehab that saves energy. The PHA uses part of these savings to pay the company, and gets to keep up to half of the savings. In October 1994, the Chicago Office held a conference to promote this effort and we will be following up on this throughout 1995.

- Exploring the Use of Historic preservation Tax Credits in Public Housing

  These tax credits may be used, as part of an overall program of rejuvenation and restructuring, to inject additional capital into public housing developments built in the 40s. They have never been used before, however, for public housing.

BIBLIOGRAPHY

Beatley, Timothy and Brower, David J.; Sustainability Comes to Main Street, *Planning*, May 1993.

Brown, Flaven and Kane; *Vital Signs 1992*, New York, WW Norton, 1992.

Brundtland Commission; *Our Common Future*, World Commission on Environment and Development, New York, Oxford University Press, 1987.

Carson, Rachel; *Silent Spring*, 1964.

Corson, Walter H.; "Changing Course: An Outline of Strategies for a Sustainable Future," *Futures*, March 1994, pp. 206-223.

Gore, Albert; *Earth in the Balance*, 1992.

Hawken, Paul; *The Ecology of Commerce, a Declaration of Sustainability*, Harper Business, 1993.

Hoyle, Russ; "Resurrecting Biodiversity" from *Gale Environmental Almanac*, Gale Research Inc, Detroit, Washington, London, 1993.

National Commission of the Environment; *Choosing a Sustainable Future*, Island Press, Washington DC, 1993.

Sitarz, Daniel, editor; *Agenda 21: The Earth Summit Strategy to Save Our Planet*, Earthpress, Boulder, CO, 1993.

Union of Concerned Scientists; Press Release; November 18, 1992.

TABLE 1

ELEMENTS OF SUSTAINABILITY

- Energy
- Economic Development
- Social Equity
- Pollution Prevention
- Biodiversity
- Recycling and Solid Waste Disposal
- Land Planning
- Historic Preservation

TABLE 2

HUD SUSTAINABLE DEVELOPMENT INITIATIVES IN CHICAGO

Underway

- MEC for New Construction
  - FHA, PH, CDBG, HOME
- Energy Training (w/DOE) for HUD Staff and Clients
  - FHA and Building Managers
  - PH and PHAs
  - CPD and local governments, not-for-profit rehabbers
- Chicago Brownfields Forum
- Energy Performance Contracting in Public Housing

Exploratory Stage

- CEECS Enforcement
- Greenstar Subdivisions
- Historic Tax Credits for Public Housing

FIGURE 1

HERBICIDES IN MIDWESTERN DRINKING WATER

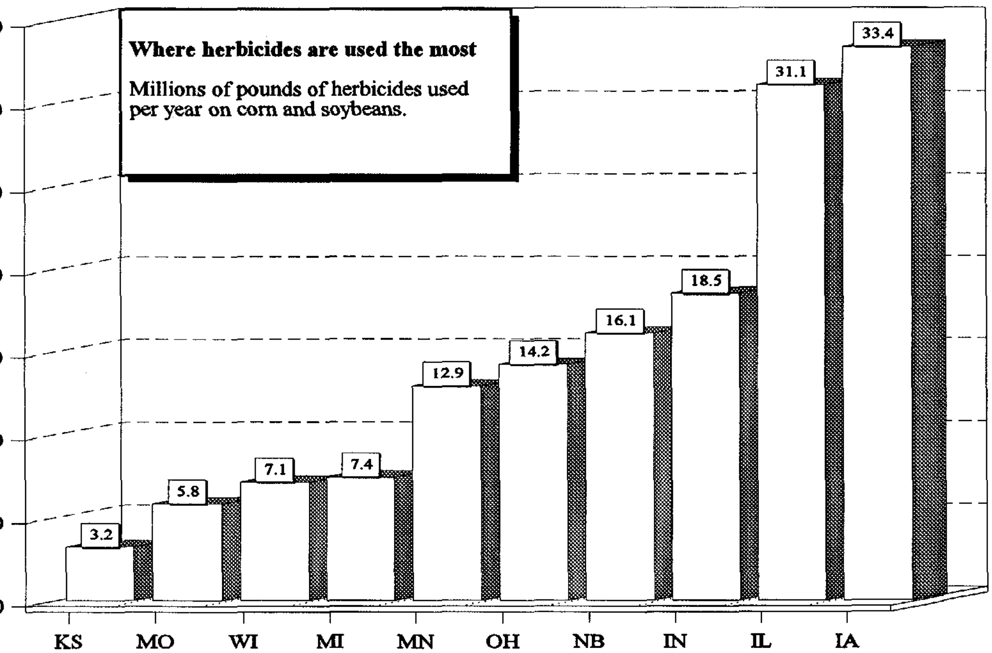
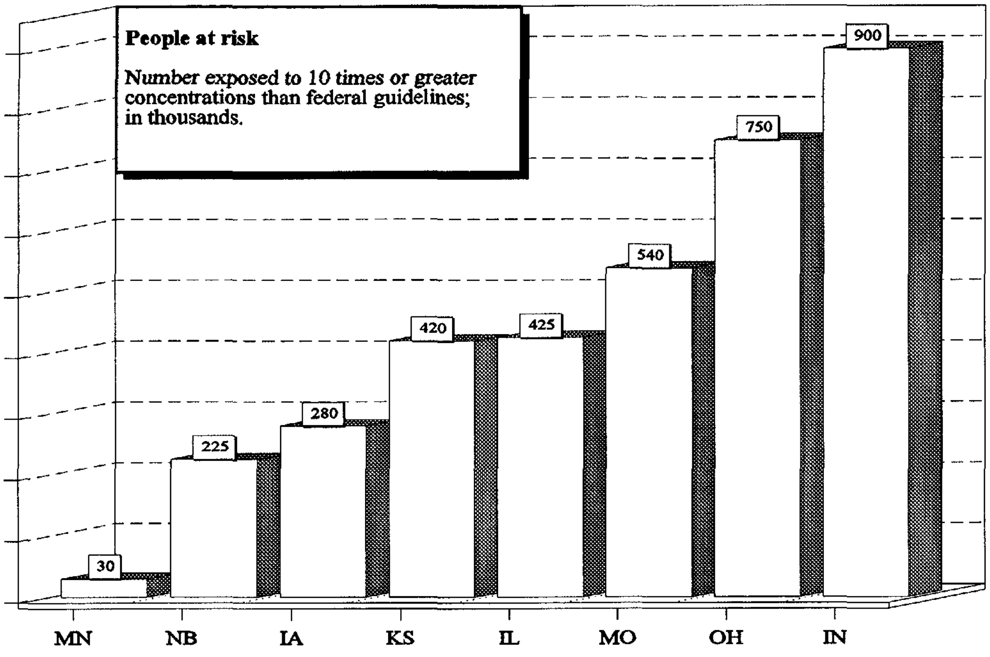


FIGURE 2

HERBICIDES IN MIDWESTERN DRINKING WATER



SESSION III: IMPROVING URBAN ENERGY AND ENVIRONMENTAL PERFORMANCE

DSM AND ELECTRIC UTILITY COMPETITIVENESS: AN ILLINOIS PERSPECTIVE

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INTRODUCTION

A predominant theme in the current electric utility industry literature is that competitive forces have emerged and may become more prominent. The wholesale bulk power market is already competitive, as non-utility energy service providers already have had a significant impact on that market; this trend was accelerated by the Energy Policy Act of 1992. Although competition at the retail level is much less pervasive, electric utility customers increasingly have greater choice in selecting energy services, particularly larger customers. These choices may include, depending on the customer, the ability to self-generate, switch fuels, move to a new location, or rely more heavily on demand-side management as a means of controlling electric energy use.[1] Thus, it is clear that electric utilities find themselves in a much more competitive environment than just a few years ago.

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[1]Not included, but recognized as a possible option in the future, is that of selecting from among alternative suppliers of electricity, i.e., retail wheeling.

While some changes in the Illinois regulatory structure may be in order to respond to (and perhaps to accommodate) increased competition, the public interest goals which are the basis for the existing regulatory structure would appear to require the retention of some degree of regulatory oversight, including that associated with least-cost planning.[2] However, at this point it is not at all clear what the industry of the future will look like, and no attempt is made herein to render a prediction.[3] Undoubtedly, the precise form of the electric utility industry of the future will have a major impact on how least-cost planning is conducted, including the extent and manner in which DSM programs are utilized.[4]

However, if changes brought about by competition are deemed substantial enough to warrant a significant modification to the regulatory structure, the associated adjustments will likely take place over a period of several years. During this transitional period, investor-owned electric utilities in Illinois will likely remain regulated monopolies with an obligation to provide least-cost service to most or all of their customers. Meeting public interest goals (including those associated with least-cost planning) during this transitional period while accommodating beneficial competition will clearly be a key challenge facing regulators. Rather than speculate on the precise form of the industry of the future, this paper is premised on a simple assumption that at least for the foreseeable future, Illinois will experience a general continuation of least-cost planning requirements along with the existence, and possible continuing emergence, of competitive forces within the electric utility industry.

This paper explores the subject of how demand-side management (DSM) programs, which are often developed by a utility to satisfy resource requirements as a part of its least-cost planning process, can affect the utility's ability to compete in the energy services marketplace. In this context, the term "DSM" is used in this paper to refer

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[2]Illinois is currently engaged in a non-adversarial process dedicated to the examination of competition in the electric industry and its regulatory implications, referred to as the Regulatory Initiatives Task Force. This process is convening before the IRP Policy Committee of the Illinois Commerce Commission.

[3]A great number of papers have recently been published which attempt to project what the industry will look like in the future, given the emergence of competitive pressures, and what the future holds for utility-sponsored DSM programs under various scenarios of increased competition. For example, see: Eric Hirst, *Electric Utility DSM Programs in a Competitive Market*. Oak Ridge National Laboratory, Report #ORNL/CON-384, April 1994; Northwest Power Planning Council, *Restructuring of the Electric Utility Industry: Implications for the Goals of the Northwest Power Act*. January 24, 1994; James Newcomb, *The Future of Energy Efficiency Services in a Competitive Environment*. E Source, Inc., 1994.

[4]Most industry observers agree that the existence of retail wheeling would have a critical impact on utility DSM programs. See: Hirst at 7-8; also, see Steven G. Kihm and Dan W. York, "A Critical Review of Retail Wheeling". *Proceedings, Fifth National Conference on Integrated Resource Planning*, May 1994, pp. 404-423.

to those demand-side services and programs which provide resources to the utility's system.[5] Depending on one's perspective, DSM programs (so defined) can be viewed either as an enhancement to the competitive position of a utility by enabling it to provide its customers with a broader menu of energy services, simultaneously satisfying the objectives of the utility as well as those of the customers, or as a detractor to a utility's ability to compete. In the latter case, the concern is with respect to the potential for adverse rate impacts on customers who are not participants in DSM programs. Adverse rate impacts are, of course, one of the most oft-cited barriers to the adoption of DSM resources in least-cost planning. The paper consists of an identification of the pros and cons of DSM as a competitive strategy, the tradeoff which can occur between the cost impacts and rate impacts of DSM, and an examination of alternative strategies for maximizing the utilization of DSM both as a resource and as a competitive strategy.

CHARACTERISTICS OF A COMPETITIVE UTILITY

In the context of the least-cost planning process, the utilization of DSM resources has generally been directed at the primary goal of minimizing the cost of providing (adequate and reliable) service. While this may well remain a central reason for utility pursuit of DSM resources, the emergence of competitive forces has created a need for utilities to be more attuned to, and responsive to, the characteristics and needs of their customers. Thus, while supply-side strategies will be directed toward competing with the potent non-utility generation industry, effective demand-side strategies will need to emphasize a transition to a customer-focused, service-oriented philosophy. A "competitive utility" will be one which can offer its customers *value* as perceived by the customer (not the utility).[6] The need for electric utilities to become "customer-driven", "market-oriented", or "service-oriented" is a common theme in the current industry literature.[7]

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[5]While the term "DSM" is sometimes defined broadly to include load-building as well as load-reducing strategies, the limited focus of this paper is on the utilization of DSM resources (load-reducing DSM) as a competitive strategy.

[6]The term "value" is used herein to refer to the provision of desired energy services at the lowest possible cost.

[7]See: Maize, Kennedy and John McCaughey, "DSM at Mid-Passage: A Discussion of the State of the Art and Science of Demand-Side Management in Electric Utilities". *The Quad Report*, Special Report, Spring, 1993. Also: Limaye, Dilip and Todd Davis, "The Benefits of Demand-Side Management in a Competitive Electricity Market". *Proceedings of the Sixth National DSM Conference*, March 1993, pp. 319-323. Farha, Gary and Dilip Kamat, "What Marketing Should Mean to Electric Utilities". *Public Utilities Fortnightly*, May 15, 1993, pp. 18-23. Campbell, Richard, "Competing in a Market Environment: What Utilities Must Consider". *Public Utilities Fortnightly*, May 15, 1993, pp. 27-29.

This theme is based on the logic that, by segmenting its customer markets and providing highly differentiated and integrated products and services based on the needs of its customers, a utility is maximizing customer value and thus strengthening its competitive position. This can be accomplished through the provision of technical information services and the offering of DSM incentives which not only reduce the customer's energy costs through the promotion of energy efficient technology, but which lead to improved productivity, improved product quality, and/or compliance with increasingly stringent environmental requirements.[8] Since DSM programs can and do play an important role in the enhancement of customer value, the utilization of DSM resources offers a utility the potential to simultaneously attain goals associated with both least-cost planning and competitive concerns.[9] Some industry analysts have even predicted that in the future, competitive forces will motivate utilities to develop and maintain the capability to effectively deliver DSM services more so than regulatory requirements associated with least-cost planning.[10]

While there is little debate that becoming customer-focused makes sense in a more competitive energy services marketplace, there is considerable disagreement regarding whether retail customers are more interested in minimizing the unit price of electricity, or in minimizing the total cost of electric service (which is a function of price and quantity). Many, though certainly not all, utilities have taken the position that customers are focused on price minimization,[11] which suggests that DSM programs should be de-emphasized since they tend to raise near-term rates (while

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[8]Scheihing, Paul, and N. Richard Friedman. "Industrial Electric Motor Systems: A Comprehensive Approach to DSM and Energy Efficiency". *Proceedings: Sixth National DSM Conference*, March 1993, p. 176.

[9]Limaye and Davis state: "DSM options can increase the menu of services offered to the customer and improve the customer's competitive position. This makes the utility's products and services more attractive to existing and potential customers, and provides the potential for increased market share and profitability." See Limaye and Davis, p. 321.

[10]Phil Hanser of the Electric Power Research Institute recently stated the following: "Just like Sunkist oranges, electric utilities will want to demonstrate to customers that their product or service is better than the competitors' service . . . In the long run, utilities will rediscover their customers. And DSM programs are essentially customer programs. That will end up motivating them to do DSM, as opposed to regulatory requirements. And it will be cost-effective." IN: Maize and McCaughey, p. 10. Also, Veronica Rabl, EPRI's Director of Customer Services, stated at the Sixth National DSM Conference: "One way or another we are going to see increased competition in the marketplace, and that is going to translate into increased focus on the customer. All of you who have been active in DSM will be ready for that new era."
IN: *Electric Utility Week*, April 5, 1993, p. 18.

[11]For example, in comments filed with the Illinois Commerce Commission, one utility stated that "In a competitive market . . . price, not cost of service, is the primary driver — the market (demand and supply) sets the price, and the aspiring supplier must produce his product or service at a cost at or below that price, or exit the market." Comments filed March 15, 1994 by Illinois Power Company for consideration by the Commission's IRP Policy Committee, pp. 5-6.

reducing costs). However, as many observers have noted, price is only one of several important considerations, along with minimizing the cost of service, reliability, convenience, product quality and improved productivity for industrials, and so on.[12] In fact, customers are presumably interested in price minimization *because* it can translate into the minimization of the cost of electric service. This is likely to remain the case under conditions of increased retail competition. As stated by Gallagher:

> . . . experience in other competitive industries has demonstrated that smart consumers shop for value, not just price. Even under a regulatory structure that encourages retail competition among electricity suppliers, customer electricity bills will still be based on the price of power multiplied by the quantity consumed. Consumers should recognize that the energy service/power company that offers services that combine reasonable rates and energy efficiency resulting in a lower overall bill is offering more value than the power company that provides lower unit rates but a higher overall bill for energy services (because they failed to consider the efficiency of the customer's usage).[13]

While price represents an important determinant of the value received by utility customers, it is only a part of the picture.

HOW DSM CAN IMPROVE UTILITY COMPETITIVENESS

As indicated, the improvement in customer service, and hence customer satisfaction, which is brought about by the utilization of DSM programs which are well-designed, targeted, and implemented, is potentially an important means of improving the utility's competitiveness in the eyes of its retail customers. Additionally, when DSM is viewed as a potential least-cost resource, to the extent that the utility is able to identify and implement cost-effective DSM programs, it is improving its ability to compete in wholesale markets with potential non-electric utility resource options, on

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[12]Northwest Power Planning Council, p. 18; Hirst, p. 15; Newcomb, pp. 4-6; and James Gallagher, *Why Do DSM?: The Role and Impact of Utility Demand-Side Programs in a More Competitive New York Electricity Environment*. New York Department of Public Service, Office of Energy Efficiency and Environment, April 19, 1994, p. 21.

[13]See Gallagher at 21. A similar conclusion was reached by Newcomb based on his analysis of competitive restructuring in other industries: "In the telecommunications and natural gas industries — both loosely described by some observers as having evolved into 'commodity markets' — leading companies are prospering by providing highly integrated packages of customer services. Pure price competition is giving way to sophisticated bundling of service attributes to respond to customer needs." (p. 4)

both the supply-side and on the demand-side. Thus, DSM offers the utility a way of not only promoting customer satisfaction and thus reducing the likelihood that customers will look elsewhere for energy services, but it also offers a way of effectively competing with potential alternate resource suppliers to its system.[14]

To some extent, electric utilities are facing the specter of competition for the provision of energy services in all sectors. But there is little doubt that the greatest competition currently exists in the large industrial sector, where customers have a much greater potential to self-generate or move off-system. While it is true that most utility DSM efforts thus far have focused more on the residential and commercial classes than on the industrial class, examples can be found of utility DSM programs which were effectively used to address industrial customer concerns with the cost (and quality) of electric service.

For example, the New England Electric System (NEES) has targeted large industrial customers with energy audits and rebates. As a result of this program, a Milton Bradley plant was able to achieve a 21 percent bill and energy savings and a 20 percent demand savings, through the installation of efficient lighting measures, injection molding blankets, and variable speed drives. This assistance has been credited with helping the plant to stay in business. Another example is the retention of a Kraft General Foods plant by Boston Edison (BECO). BECO was able to link this customer with several technical experts, who performed a detailed audit. This project resulted in a 33 percent reduction in energy consumption, and reduced the cost of plant operation such that 180 jobs were ultimately retained.[15]

These and other successful utility industrial DSM programs are designed to capitalize on the linkage between energy efficiency and non-energy benefits. In the industrial sector, energy costs are generally less critical to corporate goals than productivity, product quality, environmental compliance, reliability, and so on. Thus, a key to implementing an effective DSM program for this sector is to demonstrate to the customer the linkage between energy efficiency improvements and these broader

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[14]This perspective is advocated by Cheryl LaFleur, Vice President of Retail Marketing at Massachusetts Electric Company: ". . . we believe our experience with DSM is preparing us for a more competitive environment . . . The more efficiently electricity is used, the greater share of the energy market it will get, and the utility with the best combination of low-cost commodity and sophisticated DSM services will out-compete most of its rivals . . . DSM is 'de facto' part of our competition with other energy providers, where keeping electric applications as efficient as possible makes electricity as competitive as possible." As quoted from *The DSM Letter*, December 6, 1993, p. 1.

[15]Barkovich, Barbara. *Testimony before the New York Public Service Commission in Niagara Mohawk Power Corporation Case Nos. 92-E-0108, 92-E-0109, and 92-G-0110*. Filed on behalf of Pace Energy Project and Natural Resources Defense Council, October 5, 1992, pp. 11-12.

corporate goals.[16] A later section of this paper will review in more detail the experience to date with industrial DSM programs and emerging trends in this area.

As suggested by the cited case studies, the utilization of DSM to improve a utility's competitive position can have a direct impact on the economic climate for doing business in a utility's service area. To the extent that a utility is able to improve its own competitive position by effectively designing, marketing and delivering DSM programs, it can also positively influence the competitive position of those businesses whom it serves, which will have long-run economic benefits not only for those firms, but also for the utility and the service area economy as well.

HOW DSM CAN ADVERSELY AFFECT UTILITY COMPETITIVENESS THROUGH RATE IMPACTS

Along with a real potential for minimizing the cost of providing electric energy service overall, and for certain customers in particular, often comes another, undesired impact associated with DSM — a potential for rate increases, at least in the short-run. It has been generally acknowledged that cost-effective DSM programs can, depending on the particular programs being offered, reduce total energy costs while increasing rates. This has raised a concern with nonparticipant rate impacts arising from DSM programs.

The concern with nonparticipant rate impacts has often been raised by certain large industrial customers and their representatives. A primary concern expressed by these customers is that they are relatively sophisticated when it comes to energy efficiency, and they have often already made all cost-effective investments in energy efficiency at their own expense. Thus, utility DSM programs have little to offer them. Meanwhile, other customers, notably their competitors, do stand to gain from participating in utility programs, which means that the already efficient industrial customers may be required to subsidize those customers (including their competitors) who are less efficient, through higher rates resulting from DSM program implementation.[17] This is raised as an anti-competitive effect of DSM programs.[18]

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[16]See Newcomb, pp. 26-27.

[17]Hughes, John, "DSM: When Should Industrials Just Say No?". *Proceedings of the Sixth National DSM Conference*, March 1993, p. 228.

[18]Ibid., p. 227. While this argument may be legitimate as it relates to the issue of fairness, it fails to consider that DSM services may be able to aid in preventing an industrial competitor from leaving the system, where the customer's departure would likely result in even greater rate impacts on remaining industrial customers than would DSM services directed at that customer's retention. In addition, the common association of the threat of bypass with DSM-induced rate impacts implicitly assumes that the potential bypasser would not be able to receive direct benefits from DSM programs which outweigh any DSM-induced rate increases, which may or may not be true depending on the customer, and that the increase in rates from DSM programs is significant enough to warrant bypass, where such was not already the case with no (additional) DSM programs. For example, see: Edward Kahn, "Integrating Market Processes into Utility Resource Planning", *The Electricity Journal*, November 1992.

Thus, in this situation, the utility's DSM-related services may be perceived as pro-competitive for those firms who would be eligible to participate in utility-sponsored DSM programs, and as anti-competitive by those firms who would not be able to participate (due to their having previously made all cost-effective energy efficiency investments). This creates an obvious dilemma for the utility intent on maintaining its competitive position and providing its customers with the services they desire. The utility's response to this dilemma is undoubtedly related to whether the utility perceives itself as primarily a low-price commodity supplier in retail markets, or as a low-cost energy service provider in those markets.

MINIMIZING COSTS VERSUS RATES: ASSESSING THE TRADE-OFF

The problem with the debate over cost versus rate minimization is that it is almost always discussed at a conceptual or philosophical level, and little or no attention, let alone quantitative analysis, is afforded the relative magnitude of the cost versus rate impacts arising due to DSM programs. To address this issue, Hirst attempted to quantify the tradeoff between the cost and rate impacts of DSM.[19] Hirst used a dynamic utility planning model to estimate the effects of utility DSM programs on total resource costs and rates. He analyzed three utilities, including a "typical" utility based on data obtained from the Energy Information Administration, a "surplus" utility that has excess capacity, and a "deficit" utility that is capacity-constrained.[20] He also assumed that the utility pays 100 percent of the costs of the DSM measures; this represents a worst-case scenario from a rate impact perspective. In all cases, a supply-only plan was compared with resource portfolios utilizing varying levels of DSM.

With respect to the tradeoff between costs and rates, Hirst found in his study that:

1. In general, DSM reduces electricity costs and raises rates;

2. Typically, the percentage reduction in costs far exceeds the percentage increase in rates (for his "typical" utility, total resource costs dropped five percent, while rates increased one percent);[21]

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[19]Hirst, Eric. "Definitions and Tradeoffs: Cost-Effectiveness of Utility DSM Programs". IN: *Proceedings of the 1992 ACEEE Summer Study on Energy Efficiency in Buildings*. Volume 8, pp. 89-97.

[20]Ibid., p. 90.

[21]Were this study to be repeated today, the author has predicted that he would get different results, as he would assume that DSM costs more and saves less than he assumed three years ago, and also he would assume lower avoided supply costs. Personal communication with Eric Hirst, August, 1994.

3. Expensing, as opposed to capitalizing, DSM program costs reduces the total resource cost-effectiveness of DSM programs and also aggravates rate impacts; and

4. In cases where the cost per kWh of DSM programs is very low, both costs and rates can be reduced.[22]

A similar study was conducted by the Bonneville Power Administration (BPA) as part of its bi-annual resource planning process.[23] BPA examined total societal costs and rate impacts associated with a variety of resource plans over several growth scenarios. Upon comparison of a "high conservation" resource plan, which relies primarily on acquisition of DSM, with a "reference" supply-side only plan, BPA found that the high conservation plan decreased societal costs about 2.8 percent, but it also increased rates by almost as much (assuming base case load growth).[24] However, when BPA backed the acquisition of DSM down to more moderate levels, both societal costs and rates decreased (2.6 percent and 1.6 percent, respectively). Although these results are consistent with Hirst's findings in that as more DSM is implemented costs tend to decline and rates tend to rise, the BPA results also suggest that in some cases a substantial cost reduction due to the utilization of DSM (2.6 percent) can be realized simultaneously with an appreciable reduction in rates (1.6 percent). However, if DSM is implemented at extreme levels, rate impacts can result which compare on a percentage basis to the reduction in costs.[25]

More recently, Pye and Nadel reviewed data from ten existing studies on the rate impacts of DSM programs. One hundred-and-eight DSM programs were included in the studies reviewed. While the authors caution that different methodologies were employed in these studies, the authors reported that DSM program rate impacts varied between -2.8 percent and 9.4 percent, with a median rate impact of 1.7 percent.[26] In a study which shows how DSM rate impacts may vary over time,

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[22]Ibid., p. 96.

[23]Bloyer, Daniel and Michael Bull. "Least Cost Planning at the Margin: Externalities vs. Rate Impacts". IN: *Proceedings of the 1992 ACEEE Summer Study on Energy Efficiency in Buildings.* Volume 9, pp. 33-42.

[24]Ibid., p. 37.

[25]It appears that the BPA analysis was designed to examine more extreme cases than the Hirst analysis. For instance, the resource plan which resulted in rate increases nearly as high as the decrease in costs relied almost exclusively on DSM resources. This underscores the tradeoff which exists between costs and rates.

[26]Pye, Miriam, and Steven Nadel. "Rate Impacts of DSM Programs: Looking Past the Rhetoric." *Proceedings, Fifth National Conference on Integrated Resource Planning.* National Association of Regulatory Utility Commissioners, May 1994, pp. 548-568.

Subbakrishna reports that the cumulative rate impact of utility DSM programs in New York is projected to rise to 5.4 percent in 2000, but is then expected to drop off to 1.4 percent on 2012, while average bills decline by ten percent.[27]

While these studies are quite useful in terms of their implications for DSM programs and the potential impacts of those programs on costs and rates, numerous factors must be taken into account in order to determine what those impacts would be for Illinois utilities. One obvious factor is the relative magnitude of the DSM resource being implemented. Another is the relative cost-effectiveness and relative energy/peak load impact of the particular DSM programs being implemented. Related to these factors is another — the timing of the need for additional resources on a utility's system. These and other factors, when taken into account at the plan level, will determine more specifically what cost and rate impacts could be expected for any given utility system.

To provide an Illinois-specific example of the relative cost and rate impacts of DSM, in its Final Amended Least Cost Plan, Illinois Power Company (IP) conducted an analysis of the present value of revenue requirements (PVRR) and average rates (PVRR/kWh) for several alternative resource plans.[28] In terms of the cost and rate impacts of DSM resources, three of the more relevant alternative plans were a supply-side only plan, which included only utility-sponsored supply-side resources (minimizing PVRR subject to this constraint), a plan which minimized PVRR, and which included both DSM and customer-owned generation (in addition to utility-owned supply-side resources), and a Company-preferred plan which minimized PVRR except that customer-owned cogeneration was deferred. (The latter two plans both included DSM.) The resulting PVRRs and PVRR/kWh rate impacts, along with the percentage changes from the supply-side only plan, were as follows:[29]

Plan	**PVRR ($ Million)**	**PVRR/kWh ($/kWh)**
Supply-Side Only	29,732	.1050
Company-Preferred Plan (Min PVRR w/ Cogen. Deferral)	28,552 (-4.1%)	.1046 (-0.38%)
Min. PVRR w/o Cogen. Deferral	28,388 (-4.5%)	.1054 (+0.38%)

[27]Subbakrishna, Nagendra. "Long Term Rate and Bill Impacts of DSM in New York State." Data presented at the Fifth National Conference on Integrated Resource Planning, May 1994.

[28]Illinois Power Company, *Final Amended Least Cost Plan*, filed with the Illinois Commerce Commission in December, 1993. Chapter VI. Note that the PVRR includes utility costs only; it does not include costs borne by the customer, as do societal and total resource tests.

[29]Ibid., Tables VI.15, VI.22, and VI.5.

IP's analysis raises some interesting points. First of all, the incorporation of customer-owned cogeneration into the resource mix has an impact similar to that of DSM, in that it reduces both PVRR and sales. In comparing the supply-side only plan with the Company's preferred plan, which includes DSM and a reduced amount of customer cogeneration ("with deferral"), PVRR decreases (around 4 percent), while at the same time rates also decrease (.38 percent). Thus, the effect of including DSM and a reduced amount of cogeneration is to reduce both costs *and* rates. Only when the addition of customer-owned cogeneration is accelerated, as in the "without deferral" plan, does a rate increase accompany a drop in PVRR. Thus, it appears that the effect of DSM resources on IP's rates is positive, i.e., rates actually *decrease* with the incorporation of DSM into IP's resource mix in the amount selected by the utility.[30]

To compare the relative direction of the changes in costs versus rates for Commonwealth Edison, DENR estimated these variables for Edison's 1992 "Base Plan" (the Company's original preferred resource plan, which includes DSM) and for a "Supply-Side Only Baseline Expansion Plan," which was also modeled by Edison for its 1992 Least Cost Plan.[31] Although the magnitude of the changes in PVRR and PVRR/kWh were not determined due to the fact that the information in the Plan only included PVRR for production costs and for capital costs associated with new resources, the results of this analysis suggest that both costs and average rates would decrease as a result of DSM being added in the amount selected by Edison's integration model for the 1992 Plan.[32] These results appear to conflict with those obtained by Edison, which indicated that while PVRR would drop, rates would increase from the DSM programs included in its 1992 Plan.[33]

Finally, DENR also examined the changes in costs versus rates for Iowa-Illinois Gas & Electric's (IIGE) 1992 Electric Energy Plan. This analysis compared costs and

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[30]However, it is possible that if enough additional DSM was added, rate impacts could become negative, given the generally similar effect on sales between DSM and customer-owned cogeneration.

[31]Commonwealth Edison Company. *1992 Least Cost Plan*. Edison updated its 1992 Plan with its *1993 Supplement to July 1992 Least Cost Plan*, filed in October, 1993. Data in the 1993 Supplement were insufficient to facilitate an updated comparison of costs versus rates. Given the rather significant change (increase) in the level of planned investment in DSM between the two plans, the relationships between cost and rate impacts from the 1992 Plan may not hold true for the 1993 Update.

[32]For DENR's analysis, the Company's discount rate of 10.41% was used. The period analyzed was from 1993 through 2014. Pursuant to discussions with Edison personnel, PVRR and energy sales data for the base and supply-side only plans were taken from pp. VI-D-209-210 and III-F-13 of the 1992 Plan, respectively.

[33]See 1992 Least Cost Plan, pp. VI-F-3 through VI-F-6.

rates which would result from a plan which includes only supply-side resources to the costs and rates resulting from IIGE's originally proposed plan which included DSM programs (both as modeled under the base forecast). The results indicate that the DSM resources in the original proposed plan would have reduced PVRR by around one percent, while producing a rate increase which is roughly an order of magnitude lower.[34]

The above results strongly suggest that it is important to properly analyze the relative magnitude, and direction, of the impact to costs and rates due to DSM before debating further the rate impact problem. It appears that, at least at the levels of implementation currently (or recently) planned by some of the State's utilities, the net effect of DSM programs on rates may be negligible. The tradeoff between costs and rates identified by Hirst and others may still occur at higher levels of implementation; however, based on the available evidence from Illinois thus far, the DSM rate impact issue appears to be less than a threat to the competitive position of Illinois' electric utilities.

ALTERNATIVE STRATEGIES FOR MAXIMIZING THE UTILIZATION OF DSM BOTH AS A RESOURCE AND AS A COMPETITIVE STRATEGY

The following section attempts to identify a number of possible strategies which *may* offer utilities the potential to simultaneously utilize DSM as a resource consistent with least-cost planning goals, and as a competitive strategy. The particular strategies which may be most effective in serving these dual objectives will likely vary with the utility, and will be dependent on a number of factors, such as the relative weight to be given to least-cost planning goals versus improving competitiveness, the extent and nature of regulatory oversight of least-cost planning, the relative extent and nature of retail competition believed to be present in a given utility's service territory, and the results of further evaluation of those strategies which are as yet untested. Rather than suggest which of these strategies should be pursued by any given utility, and to which degree, the limited purpose of this section is to lay out some possible strategies which may be able to facilitate the attainment of both least-cost planning requirements and the enhancement of the utility's competitive position, and which would appear to merit further consideration.

This is not represented as being a complete list; for instance, some obvious strategies for using DSM to achieve goals associated with planning and competition, such as time-of-use and interruptible rates, are not discussed because they have generally been in use for some time and are already quite common. Additionally, re-

[34]For this analysis, DENR used the Company's discount rate of 9.24%. The period analyzed was from 1993 through 2013. The annual PVRR and energy totals used for this analysis were taken from Table 6a-1, P. 4 of 6, Volume II, Main Report of IIGE's 1992 Plan.

optimization of existing program designs based on utility-specific market research and program evaluation has also become a standard practice of most utilities engaged in DSM planning, and is an intuitively obvious activity for utilities in today's competitive marketplace. Also, much is currently being written about the value of real-time pricing and information in today's utility industry; so aside from noting the potential of this new service, no further mention will be made.

It should be noted that a number of strategies exist which may tend to accomplish one set of objectives, but work against the other. For example, one common strategy for addressing utility concerns with increased competition in the industry is to rely on a nonparticipant, or rate impact, test for screening individual DSM resources (where allowed by regulators), so as to keep near-term rate increases to a minimum. However, given that many cost-effective DSM programs tend to exhibit negative rate impacts when screened individually, this would limit the number of cost-effective DSM programs which are selected as resources, which goes against the central purpose of least-cost planning (i.e., minimizing the cost of providing reliable electric service).[35] Similarly, a utility may decide to defer or reduce DSM program implementation from the implementation schedule which would be most economical, in order to moderate near-term rate impacts. However, this also tends to reduce the extent to which cost-effective DSM resources are incorporated into a utility's least-cost plan, some of which may be lost opportunity resources which are economically available only for a limited duration. This again goes against the attainment of planning goals associated with cost minimization and the general promotion of economical energy efficiency.

Too often, we see DSM policy developed with undue emphasis on one set of goals or the other; too little recognition is given to the fact that both planning goals and competitive forces are likely to coexist to some extent. While regulators and utilities do need to grapple with the above types of tradeoffs in conjunction with least-cost planning, the thrust of this paper is to examine strategies which may be able to simultaneously contribute toward the attainment of goals associated with planning and competition.[36] The focus here is on using DSM strategically in furtherance of both planning goals and improved competitiveness, as opposed to simply reacting in response to one set of goals or the other.

The balance of this paper consists of a description of twelve alternative DSM strategies which the author believes may hold *potential* to achieve these dual goal

[35]Even where a utility's aggregate analysis of rate impacts at the plan level indicated that the net rate effect of all DSM programs was positive, individual programs may nevertheless exhibit negative rate impacts.

[36]To the extent that some of the strategies identified in this paper are successfully utilized in the manner intended, these policy tradeoffs, and the tradeoffs between the goals of planning and enhanced competitiveness in general, become less critical.

sets. Of the twelve strategies, one (Section A) relates to DSM cost recovery, another (Section B) to general cost allocation, one (Section C) attempts to link program design and rate design, and the others (Section D) can be loosely classified as DSM program design alternatives.

A. Capitalization of DSM Costs

Most DSM resources provide benefits over a relatively long period of time — say, five to 30 years. Under traditional cost recovery associated with supply-side resources, costs that produce long-term benefits are usually capitalized over the period in which the associated supply-side resource is expected to provide benefits. This suggests that the program costs associated with DSM programs which will provide long-term benefits should also be collected over the period during which benefits are realized. This can be accomplished by capitalizing those program costs. However, in Illinois, DSM program costs are currently recovered through expensing.

As indicated, Hirst recently conducted a study which demonstrated the rate effects of capitalizing versus expensing DSM program costs.[37] His study showed that when utilities expense DSM program costs, as is frequently the case, adverse rate impacts are both more immediate and greater overall than when those costs are treated in a manner consistent with supply-side investments, i.e., rate-based.[38] This is because when the DSM costs are expensed, they appear immediately in the price of electricity; in contrast, when they are capitalized and included in the rate base over a longer period of time, they do not affect rates as dramatically. This suggests that it is important for utilities to treat DSM investments in a manner comparable to investments for supply-side resources, as a means of avoiding unnecessary rate impacts due to DSM. However, in Illinois some parties have questioned the allowability of capitalizing DSM costs under current Illinois law.

B. Allocating the Costs of DSM Programs during Rate Cases

The extent to which DSM-induced rate impacts are imposed upon any given class of customers depends in large part on the manner in which those costs are allocated to the various customer classes during rate cases. A number of possible DSM cost allocation strategies are available, each of which reflects a different weighting of regulatory objectives related to efficiency and equity.

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[37]Hirst, pp. 8.89-8.97.

[38]Interestingly, Hirst also found that TRC cost-effectiveness was reduced when DSM costs were expensed.

A recent study conducted for the National Association of Regulatory Utility Commissioners (NARUC) examined alternative allocation strategies for DSM costs.[39] This study emphasized the important role of cost causation in allocating the costs of DSM programs, and the importance of allocating DSM costs in a manner consistent with supply-side cost allocation. The authors stress that for costs related to DSM programs which have been implemented to provide resources to the system under a least-cost planning framework,

> . . . cost causation is generally not related to participation in, eligibility to participate in, or the receipt of benefits from such programs. Such expenditures would not have been incurred except for their contribution to meeting system-wide or regional kW and kWh requirements.[40]

In other words, under a cost causation-based allocation, DSM costs should be allocated based on the demand and energy consumption which caused the need for the resource, just as with supply-side resources. Such an allocation would promote economic efficiency.

In reality, this cost-based allocation often must be traded off with other ratemaking objectives, such as equity concerns for various customer classes, as is the case with supply-side cost allocation. For while cost-based allocation is viewed as equitable by some, several other notions of equity exist. These alternative notions of equity are often rooted in a concern with rate impacts on nonparticipating customers.

The authors of the NARUC study identified four alternative concepts of equity which could be used as the basis for allocating DSM costs: 1) cost causation; 2) equal *opportunities* to participate in DSM programs; 3) direct allocation to *actual* participants; and 4) allocation to participating customer classes.[41] Based on these alternative concepts of equity, the authors identified and examined several alternative cost allocations. These alternative allocations ranged from a marginal cost-based allocation of DSM costs based on their treatment as a residual expense during reconciliation of marginal with embedded costs, to allocation based on the use of demand allocators (per kW), energy allocators (per kWh), the use of both energy and demand allocators, the use of customer allocators, and allocations to

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[39]Centolella, Paul, Steven Mitnick, Barbara Barkovich, Katherine Yap, and David Boonin. *Cost Allocation for Electric Utility Conservation and Load Management Programs*. Published by National Association of Regulatory Utility Commissioners. Subcontract No. ORNL/95X-SH985C, Oak Ridge National Lab. February, 1993.

[40]Ibid., p. 3.

[41]See Centolella, et al., pp. 64-68.

participating classes, either in proportion to the relative DSM budgets for each class or in proportion to each class' DSM savings.[42]

While all of these alternative allocation methodologies have their strengths and weaknesses, the authors concluded that the preferred approach to DSM cost allocation (at least in marginal cost jurisdictions) is that of the marginal cost approach. This approach would allocate DSM costs in proportion to each class' marginal cost revenues. This approach is said to be consistent with a strict concept of cost causation, and is easily accomplished by subsuming these costs in the reconciliation of marginal cost revenues and revenue requirements.[43] However, the authors also cited a growing trend toward the use of allocation methodologies which allocate DSM costs to participating classes, which is generally done to protect certain other (nonparticipant) customer classes. The authors cited several concerns with these participating class allocation strategies:

1. To the extent that DSM programs are implemented to provide resources to serve the system, these allocations are inconsistent with the allocation of supply-side resource costs, with cost causation principles, and with economic efficiency considerations;

2. Such allocations may actually lead to *higher* rate increases for nonparticipants *within* the participating customer class; and

3. Classes which are initially being protected from rate increases with such allocations may become more active in DSM programs in the future, and thus may face higher costs under such allocation methodologies as the utility becomes more sophisticated in developing a balanced DSM portfolio.[44]

In addition, it is significant that in California, DSM costs are allocated in direct proportion to each class' marginal cost revenues as a means of addressing the rate impact concerns voiced by industrial customers. Thus, both economic efficiency and the equity concerns of these customers have been substantially

[42]Ibid., Chapter 7.

[43]Ibid., pp. 89 and 99. This reconciliation is accomplished by setting revenue requirements for each class based upon an equal percentage of marginal cost revenues. With respect to lost revenues, however, the authors note that "Lost revenues represent the opportunity to recover fixed costs for expenditures and investments largely not related to conservation and load management programs." (p. 102) For lost revenues, it may be appropriate to recover lost revenues from a prior period in proportion to the allocation of fixed costs recovered through rates, on a per kWh basis (or on a per kW basis, to the extent that lost demand charges occur).

[44]Ibid., pp. 99-100.

satisfied at the same time.[45] So even though cost causation-based allocations may be warranted based on efficiency grounds, this may also remedy the concerns of some customer groups with DSM rate impacts. However, equity concerns may still be raised on behalf of nonparticipants in cases where participating customers are receiving large incentives for program participation, and where the basis for the equity concern is some other concept of equity than cost causation. Additionally, *inter*class allocation strategies do not address *intra*class equity issues.

Whereas the NARUC study concentrated on the allocation of direct DSM costs (administrative program costs and customer incentives), and to some extent lost revenue recovery, two recent studies of DSM cost allocation drew attention to the redistribution of cost responsibility which results when DSM-induced adjustments are made to class demand and energy allocators during rate cases (in order to reflect DSM demand and energy impacts at the class level).[46] The associated reduction in the value of the demand and energy allocators for the participants' class means that other classes pick up the fixed cost responsibility avoided by the participants' class.[47] In other words, the authors of these studies are contending that participants' classes receive a long-term benefit from DSM programs which is often overlooked in debates regarding equity impacts of those programs, and they both propose allocation strategies which take this benefit into account.

Chernick proposes that direct DSM costs be allocated to participant classes, while Fry and Elliot propose that in rate cases class allocators be developed based on baseline ("pre-DSM") class demands — as supplied by both kilowatts and megawatts. Each of these proposals would shift some of the cost responsibility for DSM programs back onto participant classes and away from nonparticipant classes. This may exacerbate intra-class equity issues, however. The NARUC study rejected the notion that the shifting of fixed cost responsibility due to DSM programs results in a cross-subsidy from

[45]Ibid., p. 34. Much of the equity concern voiced by industrial customers is effectively removed by this allocation approach, since there is no longer any cross-subsidy to other classes (at least with regard to the DSM costs being so allocated). See also, interview with John Fox, the former director of PG&E's DSM programs, in the Quad Report, June 1993, p. 4.

[46]Chernick, Paul. "The Allocation of DSM Costs to Rate Classes." *Proceedings, Fifth National Conference on Integrated Resource Planning*. National Association of Regulatory Utility Commissioners, May 1994, pp. 328-344. Also: Terry Fry and Beth Elliot, "DSM Cost Allocation and Energy Price Increases: Can We Throw Out Just the Bathwater?" *Proceedings, Fifth National Conference on Integrated Resource Planning*. National Association of Regulatory Utility Commissioners, May 1994, pp. 345-355.

[47]Prior to the rate case, this avoided fixed cost responsibility due to DSM programs is what is referred to as "lost revenues."

nonparticipating to participating customer classes, and did not appear to consider it to be relevant in selecting cost allocation strategies.[48]

These studies raise a number of complicated issues. While it is beyond the scope of this paper to attempt to resolve these issues, and the resolution of these issues may be necessary before a cost allocation strategy can be selected, it is clear from these studies that regulators have a wide variety of alternative DSM cost allocation strategies available to them, from which they may select the strategy which satisfies their determination as to the relative weight which should be given to efficiency and equity considerations (including the alternative notions of equity which may be identified). In selecting a proper strategy, commissions should establish allocation principles for DSM costs, and they should consider the costs and benefits (both long-term and short-term) resulting from alternative allocations by class, as well as possible effects of alternative allocations on participation levels.

C. Promoting Energy Efficiency in the Industrial Class through the Use of Rate Differentials

Mendl recently proposed that as an alternative to conventional utility-sponsored DSM programs, rate differentials could be used to provide industrial customers with an incentive to become energy-efficient (or to reward them for being energy-efficient).[49] Under this proposal, customers would be offered two rates, a lower "energy-efficient rate" and a higher "non-qualifying rate." Industrial customers would qualify for the lower, energy-efficient rate if they have implemented a minimum level of cost-effective energy-efficient measures, as determined through an energy audit. Thus, even if customers had previously implemented energy efficiency measures (prior to the availability of the energy-efficient rate), they would be eligible to participate.[50] The audit would be conducted by non-utility experts and would include process improvements as well as non-process. Rate levels would be designed to be revenue neutral within the industrial class.

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[48]In the NARUC study, the authors state: "Rate increases to nonparticipants are simply the redistribution of responsibility for fixed costs to reflect changes in loads. This redistribution . . . does not result in nonparticipants being asked to absorb costs incurred to serve other customers and thus does not imply the existence of a subsidy." (p. 71)

[49]Mendl, Jerry. "Innovative Implementation of Industrial Demand-Side Management through Efficiency-Differentiated Rates". *Proceedings, Fifth National Conference on Integrated Resource Planning*. May, 1994, pp. 356-368.

[50]Being required to subsidize inefficient customers when the subsidizing firm had already made energy efficiency improvements without utility assistance is a major concern of some industrial customers with conventional DSM programs.

As represented by its proponent, this method offers a number of advantages, including:

1. It is cost-based;

2. It is consistent with the general least-cost planning requirement that utilities should utilize economical resources;

3. It uses rate design to convey a strong price signal to industrial customers;

4. It promotes fairness because the cost-causer is the cost-payer;

5. It eliminates cross-subsidies by customers who had previously implemented energy efficiency toward customers who have not; and

6. It rewards customers for being energy-efficient.[51]

Given that this is a new concept for promoting energy efficiency, many administrative questions need to be addressed, and pilot testing will be needed to determine to what extent industrial customers will accept this concept. However, the concept appears designed to directly address many of the concerns of large industrial customers with conventional utility-sponsored DSM programs.

D. Program Design Alternatives

1. Utility Financing (Shared Savings)

One program design strategy that is increasingly being looked at by utilities and regulators as a means of reducing nonparticipant rate impacts is the utility financing, or shared savings, approach. Under this approach, the utility covers the up front cost of installing the DSM measures, and the customer then is expected to repay all or part of this cost over a certain period of time (while affording the customer a positive cash flow), either through an energy service charge on the customer's bill or as a loan repayment. Through the use of this method, the utility is often able to significantly reduce the initial barriers to participation, while at the same time reducing or eliminating the loss of revenues that would have otherwise accumulated due to the customer's reduction in usage. On the down side, depending on the extent of the repayment required, this approach runs the risk of greatly reducing the net incentive which the customer would otherwise stand to receive, which may adversely affect participation levels in the program. Additionally, potential for increased administrative costs associated with individualized billing, enforcement of repayment obligations where

[51]Ibid., p. 368.

customers have moved, and other factors, underlie concerns with the feasibility of this approach. As the experience with the financing approach is thus far somewhat limited, these questions can only be answered through additional utility program research and implementation.[52]

A variant of the utility financing approach was recently proposed by Blank.[53] Blank proposed what he refers to as a "bonus payment" approach to program design, in which the utility would pay the entire incremental cost associated with the DSM measures, plus a bonus payment which would compensate the customer for utility access to perform the installation, other transaction costs, and so on. Thereafter, the utility would collect a significant share of the bill savings through an energy service charge on the customer's bill, thereby minimizing lost revenues, the primary source of nonparticipant rate impacts (once rates are adjusted). The customer's bill would, however, still be lower than it would have been absent the program; this, in addition to the 100 percent coverage of the incremental cost and the bonus payment.[54] In essence, this approach would front-load the benefits to the customer, thereby improving the attractiveness of participating; meanwhile, the utility gets to recover a significant portion of the future bill savings, which it (theoretically) values more highly than does the customer.

While the ultimate attractiveness of Blank's proposal to customers has been the subject of considerable controversy,[55] the bonus payment approach does represent a novel approach to utility financing. As stated by Blank, the bonus payment approach is:

> . . . based on the idea that utility customers use high implicit discount rates to evaluate the costs and benefits of energy efficiency investments. Given these high implicit rates, utilities can potentially benefit all stakeholders by providing those customers installing efficiency measures a greater portion of the benefits of DSM up-front.[56]

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[52]See Centolella et al., p. 75. Several utilities are currently running, or are considering implementing, this approach for their industrial customers, such as PacifiCorp, Niagara Mohawk (see discussion in Section C), and Southern California Edison.

[53]Blank, Eric, *Paying for Utility DSM Programs: Controlling Rate Impacts without Harming Program Participation*. Land and Water Fund of the Rockies, February 1993.

[54]Ibid., p. 13.

[55]For example, see: Maniatis and Pfeifenberger, "Debunking 'Transfer Losses'", *The Electricity Journal*, June 1993, pp. 3 and 82, and also: Chernick and Wallach, "Is There a Transfer Loss in Utility DSM?", *The Electricity Journal*, July 1993, pp. 34-41.

[56]Blank, Eric, "Bonus Payments Solve a Real Problem", *The Electricity Journal*, July 1993, pp. 41-44.

Ultimately, the question of the effectiveness of the bonus payment approach as a program design strategy is, as with utility financing program designs in general, currently an empirical question, which should be resolved through utility research and experimentation, rather than through the outcome of a theoretical debate.[57]

2. Wisconsin Electric's Nonresidential End-Use Pricing Experiment

Wisconsin Electric (WEPCO) is currently conducting an experimental "end-use pricing" project for several of its commercial customers. Under this novel approach, WEPCO assumes responsibility for the purchase, installation, and maintenance of specified end-use systems. The customer pays a fixed fee for the service provided, over a multi-year period. The customer is thus freed from responsibility for maintenance, paying for electricity consumed by the equipment, or worrying about equipment breakdowns. At the end of the service contract, the customer can either purchase the equipment or enter into a new agreement with the utility.[58]

For its part, the utility has a strong incentive to focus on energy efficiency, as the customer is not responsible for paying the utility for the electricity consumed by the equipment. Early accounts in the trade literature suggest that end-use pricing is beneficial from WEPCO's (financial) perspective as well as the customer's.

What may make this program design strategy attractive to customers is not having to worry about ongoing maintenance, and having predictable energy costs. Business customers can thus focus on their primary business, and let the utility worry about providing the energy service. The concept appears particularly well-suited to commercial refrigeration and HVAC systems, given their complexity. As with the energy service charge concept, end-use pricing is in need of further utility research and experimentation before its appropriateness on a larger scale can be determined.

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[57]As yet the bonus payment approach has not been tested. In addition to the fundamental question of customer response, Blank cites several potential problems which could arise. See Blank, *Paying for Utility DSM Programs*, pp. 21-22.

[58]The DSM Letter. "DSM That Pays and Stays: Wisconsin Electric Moves into the Grocery Business". August 30, 1993, pp. 1-2. Also: The DSM Letter. "Wisconsin Electric's Pilot End-Use Pricing Project Shows Early Success". February 28, 1994, p.4.

3. Niagara Mohawk's Subscriptive Service Proposal for Large Industrial Customers

In response to the rate impact concerns of its large industrial customers, Niagara Mohawk (NiMo) recently proposed a controversial Subscriptive Service program which would enable these customers the option of forgoing participation in the utility's DSM rebate programs, in return for which they would be freed from any responsibility for rebate and incentive costs associated with these programs. (They *would* still be required to pay for administrative costs and lost revenues associated with DSM programs). In lieu of the traditional DSM programs, customers who opt for the Subscriptive Service program would still be eligible to participate in a shared savings DSM program, which would collect the full costs of DSM measures from the participating customers.[59] This proposal of NiMo was opposed by the Pace Energy Project, the Natural Resources Defense Council, and the State Department of Law. It was supported by the Commission staff and several industrial intervenors.

During oral arguments, the proponents presented some modifications to the proposal, which were designed to respond to concerns raised at an earlier Commission session: 1) as a condition for participating in the Subscriptive Service, a customer would have to undergo, and pay for, a detailed energy audit with regular reports as to measures implemented and savings; 2) NiMo would increase its energy conservation goals by 20 percent for its nonresidential customers, with the increment to be obtained from its Subscriptive Service customers; and 3) the Company would face a financial penalty of $1 million if it fails to meet this higher DSM goal.[60]

In the final order, the Commission adopted the Subscriptive Service program, and added several additional modifications to the proposal: 1) NiMo shall specify detailed, minimum requirements for comprehensive audits of process and premise energy use; 2) Subscriptive Service customers will be allowed to shift back to the rebate program at any time, provided that they pay all retroactive charges they would have paid had they remained in the rebate program; 3) there must be an open and cooperative effort, with all interested parties, to evaluate the program; 4) both the Company and the staff have obligations to inform the Commission on the degree to which the program is succeeding or failing, and the Commission retains the authority to terminate the program at any time if it has reason to conclude that the DSM

[59]New York Public Service Commission. *Opinion 93-3*. (Cases 92-E-0108, 92-E-0109, 92-G-0110, and 91-M-0329.) Issued February 2, 1993, pp. 58-59.

[60]Ibid., pp. 84-85.

goals are being undermined; and 5) the Commission reiterated that this is only an "experiment"; it will not be extended to other utilities or customer classes, and it has a three-year duration.[61]

In an attempt to clarify the Commission's ruling, Chairman Bradford stated that the decision should be viewed as an attempt to get *more*, not less, energy efficiency at less cost. He also acknowledged the importance of DSM as an effective response to concerns about jobs and the economy, and he reiterated that the experimental nature of the program would allow the Commission to terminate it at any time.[62] The reaction of large industrials to the decision has been positive; they feel that cross-subsidies due to DSM programs were hurting their competitive edge, and favored inefficient firms who would stand to get a subsidy to accomplish what more efficient firms already did on their own.[63] While the opponents to the new service remain skeptical of its prospects for success, NRDC has since acknowledged that with the many changes and clarifications, the new service is not at all what it initially appeared to be, and that it contained several important features which reinforce New York's commitment to DSM.[64]

There can be no question that the Subscriptive Service program evolved out of a unique set of circumstances in NiMo's service territory, including local economic conditions and NiMo's DSM program experience, among others. Nevertheless, the results of this experimental approach to providing DSM services for large industrial customers, both in terms of the contribution of resources from this sector, in terms of its rate impacts for both industrial and other customers, and any other results, will yield important insights as to the potential for this approach in other jurisdictions.

4. Targeting Comprehensive, Process-Oriented DSM to Large Industry — Experiences and Lessons Learned

One approach to maximizing the utilization of DSM as a competitive strategy which is receiving increased attention is to target comprehensive, process-oriented DSM programs to industrial customers. Given the large share of

[61]Ibid., pp. 87-89.

[62]See: "Clarifying the New York PSC's Ruling on Niagara Mohawk's Industrial Conservation Programs — A Conversation with Chairman Bradford". *The Electricity Journal*, March 1993, pp. 76-77.

[63]See: "PSC Approves Controversial DSM Waiver Option for Industrials in Niagara Case". *Electric Power Alert*, February 3, 1993, p. 14.

[64]Cavanagh, Ralph and Ashok Gupta, NRDC. Memo to participants in the Third Annual Energy Efficiency Advocacy Workshop, Boston, Massachusetts, April 1993.

electricity consumption by industry (estimated at 35 percent at the national level),[65] and the strong possibility that a significant percentage of the energy efficiency potential in this sector remains to be captured due to the short (one to three years) payback threshold used by many industrial firms to make investment decisions,[66] it is somewhat ironic that utility DSM programs have generally not effectively targeted industry. Those programs that are available to industrial customers tend to be combined commercial/industrial programs which promote basic lighting, motors and HVAC measures, as opposed to efficiency improvements in industrial *processes*, even though it is estimated that over 90 percent of the energy use in the industrial sector is due to process loads.[67]

A large reason for this avoidance of DSM programs targeting industrial process loads is the diverse nature of industrial processes. Most industrial process improvements require specialized engineering analysis and oversight, and most utilities lack the full spectrum of necessary capabilities to provide these specialized services.[68] As a result, utility DSM programs which have been made available to industry (typically C&I programs) have been general programs designed more around the needs of commercial customers.[69]

Another barrier to the development of effective DSM programs for industry is that many industrial customers have concerns about shutting down process lines in order to install new equipment.[70] Additionally, the utility often fails to effectively convey to the industrial customer the linkage between energy

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[65]Jordan, Jennifer and Steven Nadel, "Industrial Demand-Side Management Programs: What's Happened, What Works". *Proceedings, 1992 ACEEE Summer Studies on Energy Efficiency in Buildings*. Chapter 5, pp. 121-130.

[66]The most common payback range cited for industrial customers is one to two years. This range was identified by several energy managers of Illinois industrial firms in a meeting at DENR held on April 6, 1993. Also, see: Winslow H. Fuller, "Industrial DSM — What Works and What Doesn't", *Proceedings of the 1992 ACEEE Summer Studies on Energy Efficiency in Buildings*, p. 80.

[67]Nadel, Steven, "Utility Demand-Side Management Experience and Potential — A Critical Review". *Annu. Rev. Energy Environ*. 1992. 17:507-35. Also, Jordan and Nadel at 122.

[68]Nadel, pp. 528-29. In addition to a lack of the necessary technical capability for analyzing diverse production processes, it is often difficult for the utility to obtain data needed, due to proprietary concerns of customers, the costs associated with gathering the needed data, and other considerations. See: Wikler, Greg, Ahmad Faruqui, Robin Way, and Paul Meagher, "Designing Successful Industrial DSM Programs", IN: *Proceedings of the 1992 ACEEE Summer Studies on Energy Efficiency in Buildings*. Volume 5, pp. 249-259.

[69]Jordan and Nadel, p. 121.

[70]Nadel, p. 528.

efficiency improvements and the implications that these improvements hold for the competitive position and profitability of the business.[71] (In and of itself, saving energy is rarely an important priority for an industrial firm.) Also, industrial customers are often discouraged from participating in utility DSM programs because of the extensive lag between the initial agreement to participate and the actual installation of DSM measures, or because the program is too complicated.[72]

From the growing base of literature on industrial DSM, several important characteristics of successful industrial DSM programs are identified. Perhaps the most important of these is the need for the utility to understand the needs of the individual industrial customer.[73] Industrial customers are more interested in improving productivity, product quality, compliance with environmental regulations, and ultimately their competitive position and profitability, than in becoming more energy-efficient per se. The utility must understand the industrial processes of its customers to be able to identify for these customers the linkage that exists between efficiency and these other factors. In order to possess this capability, the utility needs to hire process-specific expertise, either through contractors or through hiring in-house staff with sufficient process-specific experience.[74] The assistance which the utility can provide by bringing in an expert in process efficiency is often cited as the key to program success.

The need to be more customer-focused thus extends beyond simply trying to get businesses to adopt DSM measures which serve the utility's goals. To be truly successful, the utility must understand the competitive environment in which the individual firm operates. Several utilities have recognized that to be competitive, they must help their industrial customers to be competitive

[71]See Wikler, et al., p. 251.

[72]See Fuller, pp. 79-80.

[73]Jordan and Nadel, pp. 127-128; Wikler et al., pp. 256-257.

[74]Given the diversity of industrial processes, and the process-specific experience required in order to conduct detailed industrial process energy audits, it is common for utilities to utilize contractors with such experience rather than to attempt to develop their own in-house staff. For example, see Charles Tremel, "Customer Partnerships — The Magic of Successful Industrial DSM", IN: *Proceedings of the Sixth National DSM Conference*, p. 166. Also, see Jordan and Nadel at p. 127. Additionally, Charles Bartsch and Diane Devaul state: "In some cases, teams of professionals with different types of technical expertise will be needed to evaluate waste streams, energy usage, productivity, and quality control improvements . . . Utility personnel generally are not capable of these multi-pronged assessments. By hiring contractors, the utility can obtain the needed expertise as well as distance itself from the assessment, making the audit more credible to the firm." See *Utilities and Industries: New Partnerships for Rural Development*. The Aspen Institute, Washington, D.C., 1992, p. 49.

in their own right. This requires that the utility understands more than a customer's energy consumption characteristics and processes. The utility needs to work with the industrial customer in order to understand its overall position in a competitive marketplace.[75] By forming a "partnership" with the industrial customer and the appropriate experts, the utility can work closely with the customer to identify cost-effective strategies for using energy efficiency to attain multiple objectives, all of which are directly related to the central goal of improving the firm's competitive position.[76]

Additional program features which have been associated with successful industrial DSM programs include: a) target process loads as well as non-process loads; b) marketing techniques which feature frequent and direct personal contact with the appropriate decision makers, which clearly define potential project benefits for the customer, and which are oriented to the customer's capital budgeting cycle to the extent possible;[77] c) marketing efforts which are targeted at particular markets within the industrial sector;[78] d) program flexibility, as is often achieved through a "custom" type of program designed to fit the opportunities and needs of individual customers;[79]

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[75]An example of this is Northeast Utilities, which modified its Energy Action program goals to include efforts to make "vulnerable" industries more competitive. This is accomplished by prioritizing customers with the potential to self-generate and industries that are struggling to compete in their respective markets. See Jan Sayko, "Marketing DSM to Industrial Customers Using the Energy Action Program". *Proceedings, 5th National DSM Conference*, p. 39.

[76]An example of this approach is that of Pennsylvania Electric Company, which has developed an extensive network of outside experts in efficient building and systems design, manufacturing technology assessment, plant operations analysis, environmental compliance, and total quality management. See Tremel, p. 166.

[77]Jordan and Nadel at 128; Wikler et al., p. 258. Both papers cited note that trade allies are frequently critical to getting the message out about programs.

[78]As noted by Wikler, et al.: "Given the huge diversity among industrial customers, it is preferable to avoid treating all industrial customers the same. Segmentation schemes . . . provide the opportunity to identify groups of customers that have generally common characteristics and needs. Targeting particular industrial markets with DSM programs that match the markets' needs can be an effective way to increase customer acceptance." (p. 257)

[79]Jordan and Nadel note that both custom and prescriptive rebate programs play important roles in stimulating industrial energy efficiency improvements: "By offering high participation for particular measures and by getting customers accustomed to working with the utility, prescriptive rebate programs can be a positive complement to a custom rebate program. If the two types of rebates are offered in conjunction with each other, the program will most likely reach more customers than if only one type of rebate is offered. Customers passing through the prescriptive portion of the program may decide to move on to more process-oriented, custom-type projects. Such is the case with Wisconsin Electric's Smart Money for Business program . . ." (pp. 128-129)

e) customer financial incentives which bring the project's payback to within the customer's acceptability range (typically less than one to three years);[80] f) program designs which are not overly complicated, but which are sensitive to the unique needs and characteristics of the industrial sector;[81] g) program administration which minimizes the time between initial customer enrollment in the program and measure installation and receipt of rebates;[82] and h) target new facilities and major process changes in order to maximize cost-effectiveness and minimize lost opportunities.[83]

Given the notable absence of many of the above features in previous utility DSM programs, it is not surprising that industrial customers tend to oppose the notion of utility-sponsored DSM programs. Industrial customers tend to view the utility as lacking sufficient technical capability to be able to tell them anything they don't already know. Only by adopting a partnership approach with the customer, and by bringing into the relationship the necessary technical expertise, can the utility begin to develop the necessary customer support and trust that is crucial to program success. Utilities need to involve industrial customers in program design, so that the resulting programs better serve their needs. This process will undoubtedly take time, more than is available in a typical one-year pilot program. However, several utilities are beginning to realize success in their efforts to enhance the competitive position of their industrial customers through the adoption of the above program approaches. Utilities, and ultimately their industrial customers, clearly have much to gain by building the capability to effectively deliver DSM programs to the industrial sector.[84]

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[80]For example, see Sayko, p. 41. Also: Jonathan Linn, "Energy Management Programs for Large Commercial and Industrial Electric Utility Customers". *Proceedings, 4th National DSM Conference*, pp. 64-3, 64-5.

[81]Wikler et al., p. 257; Fuller, p. 80.

[82]Jordan and Nadel, p. 128; Fuller, p. 80.

[83]Wikler et al., p. 257-8; Barkovich testimony, p. 15.

[84]Gallagher notes that DSM programs targeted at potential bypass candidates may help to retain customers, which would not only benefit the participating customer by enhancing the value of service, but it would also result in a positive rate impact for *nonparticipants* relative to the case where the bypass had actually occurred. See: James Gallagher, *Why Do DSM? The Role and Impact of Utility Demand-Side Programs in a More Competitive New York Electricity Market*. New York Department of Public Service, April 19, 1994, pp. 7-8.

5. Market Transformation Strategies

A number of approaches to the promotion of energy efficiency are designed to effectively accomplish a wholesale transformation of the market by making more energy-efficient products and practices widely available, or conversely, by making *in*efficient products and processes *un*available. Conceptually, once a market has been transformed, the need for utility incentives may be reduced significantly, although keeping up with technological advances in energy efficiency may require some ongoing involvement. Two good examples of these "market transformation" strategies are energy-efficient building codes and equipment standards. In Illinois, energy codes and standards are currently under study.

Recently, several new and innovative DSM market transformation strategies have gotten underway around the country with the direct involvement of utilities. In a noted departure from the conventional approach to utility DSM, which involves retail-level incentives to individual customers and the associated capital- and staff-intensive program infrastructures, these new market transformation strategies seek to influence the market through the collective market intervention of utilities and other market players.[85] In this fashion, these strategies may be able to reduce the level of utility expenditures on DSM programs over time, thereby alleviating rate impact concerns directly attributable to those expenditures, while encouraging the transformation of certain market segments toward increased energy efficiency. However, depending on the particular market transformation strategy being employed, utility customers may or may not readily associate such efforts with their local electric utility; thus, customers may not be as cognizant of the utility's contribution to value as with other strategies discussed in this paper.[86]

Some of these programs are designed to stimulate manufacturers to develop more energy-efficient technologies. The most widely publicized program of this type is the Super Energy-Efficient Refrigerator Program (SERP), also referred to as the "Golden Carrot" refrigerator program. Under this program, utilities and several other public and private organizations banded together under the auspices of the Consortium for Energy Efficiency (CEE) to offer a pool of about $30 million to the manufacturer who could most

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[85]Northwest Power Planning Council. *Acquiring Energy Efficiency More Efficiently*. October 26, 1993, p. 5.

[86]The customer's association of the local utility with market transformation efforts is dependent on many factors; the linkage will likely be much greater when the particular strategy being employed is implemented regionally (e.g., multi-state, utility service area, etc.).

quickly, reliably and cost-effectively produce and distribute a super-efficient, non-CFC refrigerator.[87]

Other programs are designed to encourage the increased production, marketing and utilization of efficient equipment which is already commercially available. A good example of this approach is the collaborative manufacturer rebate program for compact fluorescent lamps, recently proposed by CEE for the U.S. and Canada. Under this concept, utilities offer a rebate to compact fluorescent lamp manufacturers (who are awarded blocks of rebates through an RFP/bidding process), which is used to reduce the wholesale price of the product to retailers. Because the utility rebate is applied before distributor and retailer markups (which may approach 80 to 90 percent of the wholesale cost), the price leverage of each utility incentive dollar is maximized.[88] This approach should maximize cost-effectiveness through the minimization of program administrative and incentive costs, it should minimize consumer costs (and hence significantly increase participation), and it should lend consistency to the demand for compact fluorescent products. Where it has been implemented by individual utilities, this approach has been found to be attractive to manufacturers and retailers alike. Another, similar initiative currently being developed by CEE is for high efficiency commercial air conditioners.[89]

Another market transformation strategy being pursued in the Midwest seeks to promote collaboration among utilities, manufacturers and distributors, industrial end users, and other market players in the improvement of motor-driven system performance and energy efficiency. This effort, the Midwest Motor Systems Consortium, is currently being implemented under U.S. DOE's Motor Challenge Program. Two of many issues being looked at with this group are: 1) how to achieve a degree of marketing consistency among utility efficient motor rebate programs offered throughout the region, so that manufacturers and distributors can better serve their markets in a manner consistent with the objectives of utility DSM programs; and 2) how to expand the focus of utility DSM efforts to address the significantly greater energy

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[87]L'Ecuyer, Michael, et al. "Stalking the Golden Carrot: A Utility Consortium to Accelerate the Introduction of Super-Efficient, CFC-Free Refrigerators". *Proceedings, ACEEE 1992 Summer Study on Energy Efficiency in Buildings*, p. 5.139.

[88]Consortium for Energy Efficiency. "Residential and Small Commercial Energy Efficient Lighting Program". Draft - December 1, 1993.

[89]Consortium for Energy Efficiency. "High Efficiency Commercial Air Conditioning (HECAC) Initiative Program Description". January, 1994.

efficiency savings potential associated with entire motor-driven systems, as opposed to just motors.[90]

Finally, by coordinating utility DSM programs with existing or anticipated energy codes and standards, it may be possible to minimize in certain markets the need for continued utility financial assistance. Such coordination can be done prior to the effective date of new codes and standards by promoting efficiency levels anticipated under the new codes or standards, before they become effective; this has the effect of conditioning the market before such requirements become mandatory. Additionally, once codes or standards are effective, utility programs can provide incentives for incremental efficiency gains above those required from any existing codes or standards, while simultaneously providing training assistance for code compliance. Such coordinated efforts will minimize any redundancy between utility DSM programs and government codes and standards, and will facilitate more effective implementation of any state or local energy codes which may be in effect in the future.

6. Limiting Utility Incentives for Large Industrials to Longer-Term Payback Projects

As indicated, large industrials typically make investment decisions based on a one to three year payback. As stated by John Hughes of ELCON:

> . . . Industrials routinely make countless investment decisions . . . All projects are screened by a common payback period (or hurdle rate) because there is not enough capital to fund all worthy investments. Only the most cost-effective projects are chosen . . . A company effectively has volunteered to take a hit on its bottom-line if it makes any investment whose payback exceeds the hurdle rate (i.e., where the payback period is longer than the threshold requirement and which may only be two or three years). This becomes a voluntary competitive disadvantage if its competitors did not take an equivalent hit."[91]

The consistency with which the one to three year payback criterion is identified as the primary basis for investment decision-making among industrial firms suggests that prudent, competitive firms would tend to make

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[90]Meeting Notes, Midwest Motor Systems Consortium, January 13, 1994, Chicago, Illinois and August 9 & 10, 1994, Southfield, Michigan.

[91]Hughes, John. "The Anticompetitive Effects of Industrial DSM Programs". *Proceedings, Fourth National Conference on Integrated Resource Planning*, Burlington, Vermont. September, 1992, p. 117.

energy efficiency investments with short (less than one to three year) paybacks, but would not make investments in energy efficiency projects with a longer payback. This suggests that utilities could target longer payback projects by limiting eligibility *to* these projects and by providing incentives which were sufficient to bring the payback to within the firms' payback threshold of one to three years. Focusing on these types of projects would partially address the complaint voiced by some industrial firms that they would be at a competitive disadvantage if their less energy-efficient competitors were assisted with efficiency upgrades, when they (the more efficient firms) had already completed such upgrades at their own expense. Since by their own acknowledgement, the more efficient firms would in most cases not have made the longer payback efficiency investments, they would also be eligible for utility assistance with these types of projects.

This approach would also minimize free ridership, since longer payback projects would be much less likely to occur absent utility financial assistance, while the shorter payback projects would often occur without such assistance, assuming that customers had the wherewithal to identify such projects. Under this approach, utilities could still provide a strong informational-technical assistance component to assist businesses in identifying viable, cost-effective projects with short paybacks, to minimize the possibility that cost-effective energy efficiency opportunities are left behind due to the focus on longer-payback projects/measures.

7. Integrating DSM Services with Rate Incentives Associated with Economic Development, Uneconomic Bypass Mitigation, and Load Retention Efforts

In Illinois, utility efforts to promote economic development, limit uneconomic bypass, and retain existing customers have generally been in place for some time, and utility promotion of such efforts has recently increased. In most cases, these efforts are pursued independently from utility DSM promotions. The concept of offering customers who are eligible for economic development, bypass, or load retention rate incentives a broader portfolio of energy services which includes DSM program offerings may offer the utility a way to maximize the attainment of the primary objective of these efforts, while simultaneously meeting new resource requirements in a manner consistent with least-cost planning. For example, by providing such customers with detailed information on available DSM programs and related support services, the utility could provide the customer with an opportunity to select additional cost-cutting measures; alternately, the utility could establish energy efficiency criteria as a prerequisite to participation in rate incentive programs.

Several recent examples have already established a precedent for this type of linkage between economic development/bypass rates or other types of services, and participation in DSM programs. For example, the Massachusetts Department of Public Utilities recently directed utilities to inform economic development rate customers about utility DSM opportunities, and to encourage them to participate.[92] Also, in response to the competitiveness concerns of large industrial customers, the New York Public Service Commission adopted the previously described Subscriptive Service program, which allows those customers the option of foregoing participation in traditional DSM programs and the associated payment of DSM incentive costs, provided that they agree to conduct, and pay for, a detailed audit of process and premise energy use; those customers are also offered an opportunity to participate in a shared savings DSM program.[93] Additionally, the California Public Utilities Commission required Southern California Edison to offer energy efficiency services in conjunction with its self-generation deferral rate.[94]

8. Geographic Targeting of DSM to T&D Capacity-Constrained Areas

Several utilities are beginning to target DSM programs to areas on their systems where growth-related T&D projects can be deferred. Geographically targeted DSM programs can thus provide an added benefit to the deferral of generating capacity at the system level, by simultaneously maximizing the deferral of T&D capacity, and thereby offer the potential to increase cost-effectiveness and reduce rate impacts relative to the more conventional, system-wide programs. Although targeted DSM planning for T&D deferral is more difficult than conventional, system-level DSM program planning for a number of reasons, early efforts have been encouraging. Thus far, the most highly publicized geographically targeted DSM project is the Model Energy Communities Program being conducted by Pacific Gas & Electric Company in its Delta District.[95]

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[92]Massachusetts Department of Public Utilities. *DPU Docket 93-41*, Order dated August 31, 1993, pp. 22-24.

[93]New York Public Service Commission. *Opinion 93-3*. Issued February 2, 1993, pp. 58-59, 87-89.

[94]Hirst, Eric. *Electric-Utility DSM Programs in a Competitive Market*. Oak Ridge National Laboratory, Report # ORNL/CON-384, April 1994, p. 12.

[95]Orans, R., C.K. Woo and J.N. Swisher. *Targeting DSM for Transmission and Distribution Benefits: A Case Study of PG&E's Delta District*. Final Report, May 1992. Electric Power Research Institute Research Project 2548-9. TR-100487.

9. Targeting Utility Facilities

Implementing DSM measures in the utility's own facilities offers the utility the opportunity to become more efficient without incurring any lost revenues. Thus, cost-effective utility facility energy efficiency improvements allow the utility to reduce its operating costs without imposing any negative rate impacts on customers. Utility facility DSM also provides a unique opportunity as a demonstration of state-of-the-art energy efficiency technology, which can be used to educate customers on the benefits of energy efficiency while giving utility personnel direct experience with DSM technologies.[96]

CONCLUSION

The central purpose of this paper was to explore the potential of DSM both as a least-cost resource alternative and as a competitive strategy for electric utilities, in an interim environment characterized by some degree of tension (real or perceived) between least-cost planning requirements and competitive forces. The paper purposefully avoided any attempt to gauge the extent to which competition will develop, as well as any attempt to project what the least-cost planning process of the future will look like (and indeed, whether a formalized planning process would even exist). However, in all probability the immediate and foreseeable future will be characterized by the existence of both least-cost planning regulation (in some form) and some degree of competition (at the wholesale, and to some extent retail, levels). In this context, the focus of the paper was to identify and review DSM strategies which may potentially enable utilities to position themselves more competitively, while still meeting the goals of least-cost planning, to the extent that the attainment of those goals is reliant on the utilization of cost-effective DSM as a system resource.

The available evidence from Illinois suggests that rate impacts resulting directly from the implementation of DSM programs may be inconsequential in the foreseeable future relative to the cost-reducing impacts of those programs. While this should dampen the pronounced concern expressed by some of the State's utilities with DSM rate effects, a reasoned approach to DSM planning in today's increasingly competitive electric energy services marketplace is for utilities and their regulators to pursue DSM strategies which may offer resource potential while simultaneously enhancing the utilities' competitive position.

The research conducted by DENR suggests that there are a fair number of alternative DSM strategies that may be utilized by utilities and regulators which could facilitate

[96]New York State Department of Public Service. *New York DSM in Transition*. Office of Energy Efficiency and Environment, April 18, 1994. Final Report.

consistency with least-cost planning and which could simultaneously enhance the utility's competitive position in the marketplace. These might include:

1. Capitalization of DSM costs

2. During rate cases, consider alternative DSM cost allocation strategies

3. Promote energy efficiency in the industrial sector through the use of rate differentials

4. Program design alternatives:

   a. utility financing (shared savings)
   b. Wisconsin Electric's end-use pricing experiment
   c. Niagara Mohawk's Subscriptive Service program
   d. targeting comprehensive, process-oriented DSM to large industry
   e. market transformation strategies
   f. limiting utility DSM incentives for large industry to longer-term payback projects
   g. integrating DSM services with economic development, uneconomic bypass, and load retention efforts
   h. geographic targeting of DSM to T&D capacity-constrained areas
   i. targeting energy efficiency improvements to utility facilities

Finally, although many of the strategies discussed in this paper have targeted those customers (e.g., large industry) who are generally considered to have the greatest capability to select alternative energy sources/services, it is important to consider what impacts these targeted strategies may have on the utility's "captive" or "core" customers, i.e., customers who do not presently have the same degree of choice in selecting an energy provider (typically residential and small commercial customers). To the extent that the goals of least-cost planning remain in effect, the obligation to provide these customers with least-cost energy services will compel utilities to design complementary DSM programs for them.[97] In addition, some have speculated that expanded use of information and control technologies will eventually afford greater choice in energy services selection for core markets as well.[98] This underscores the importance of developing competitive DSM strategies for all customer markets in step with the emergence of competition in the industry.

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[97]Along these lines, a frequently proposed mechanism for promoting general ratepayer equity in planning (and one advocated in the past in Illinois by the Department) is to offer the opportunity to participate in DSM programs to as many customers as possible. While this may enhance a utility's competitive position in the eyes of some customers, it is more generally intended to promote the simultaneous attainment of equity and efficiency, and hence is not identified as an explicit strategy in this paper.

[98]Northwest Power Planning Council, p. 16.

REPORT CARD ON LOW LEVEL OZONE IN URBAN AREAS

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INTRODUCTION

It has been four years since the Clean Air Act was amended in November of 1990. Much work has been done in this time, and we are beginning to see real air quality benefits. Although we have not completely licked the urban ozone problem yet, we have made a lot of progress. All of the urban areas which have been required to reduce their ozone levels have done a good job of lowering their emissions. While the urban areas have not all been able to meet every federal deadline, the areas have all been able to achieve the control milestones before the mandatory Clean Air Act sanctions have taken effect. Some areas are even ready to declare their ozone problems solved.

Before I go into detail about progress in ozone control, let me give an overview of the urban areas in question and their requirements.

OZONE NONATTAINMENT AREAS

While the ozone layer in the stratosphere is beneficial to life on earth, ground-level ozone is not. Ozone causes breathing problems in people and animals, damages plants, and even accelerates the breakdown of materials such as rubber. Urban areas in which monitored data has revealed violations of the National Ambient Air Quality Standard for ozone have been designated nonattainment under the Federal Clean Air Act. The Clean Air Act, as amended in 1990, introduced the concept of ozone nonattainment area classifications. Each area is classified based on the severity of its pollution problem, as shown by the monitored data in the area. The nonattainment area classifications were based on air quality data measured in the years 1987 and 1988. The classifications are Marginal, Moderate, Serious, Severe, and Extreme. The only Extreme area in the United States is the Los Angeles area.

For each classification, the Clean Air Act sets forth a date, known as the attainment date, by which the area is supposed to meet the air quality standards. Moderate areas, such as St. Louis and Louisville, are expected to attain the ozone standard by 1996. The Chicago and Milwaukee areas, which have been classified Severe, are expected to attain the air quality standards by 2007. There are two different Severe categories. The difference between them is that the areas with the worst air quality problems have been given an extra two years to attain the ozone standard.

In the Midwest region, there are approximately 23 nonattainment areas which were designated in 1991 as Marginal or worse. Chicago, Gary, and the Milwaukee area are Severe nonattainment areas. Grand Rapids and Muskegon, Michigan, are Moderate areas. Also considered Moderate areas are St. Louis, Missouri; Louisville, Kentucky; Detroit, Michigan; Cleveland, Cincinnati, Toledo, Dayton, Ohio; and Kewaunee, Manitowoc, and Sheboygan Counties in Wisconsin. Marginal areas include Jersey County, Illinois; South Bend, Indianapolis, and Evansville, Indiana; Columbus, Canton, and Youngstown, Ohio; and Walworth and Door Counties, Wisconsin.

Before I describe the control measures required by the Clean Air Act for these nonattainment areas, let me briefly explain about the formation of ozone.

FORMATION OF OZONE IN THE ATMOSPHERE

Ozone is not directly emitted into the atmosphere but instead is formed from the oxygen molecules in the atmosphere by their interaction with sunlight. The summertime is the most critical time of year for ozone formation because of the high air temperatures and greater amount and duration of sunlight. Ozone formation peaks in the middle of the day and drops off considerably at night. Obviously, we cannot change the fact that the sun comes up in the morning, so in order to control the formation of ozone, we have to control the pollutants that figure into the reactions that form ozone. These pollutants are called ozone precursors. The main ozone precursors are oxides of nitrogen, usually referred to as NO_X, and volatile organic compounds, or VOCs. Controlling the amount of ozone precursors emitted, and even controlling the time of day that the precursors are emitted, helps to lessen the amount of ozone formed at ground level in urban areas.

Nitrogen oxides are emitted from the combustion of fossil fuels, which means that electric utilities and automobiles can be major contributors. One difficulty in controlling ozone in urban areas comes from the way oxides of nitrogen react in the atmosphere. Some components of NO_X aid in the formation of ozone. Other components, however, actually work to break down ozone. While reductions in volatile organic emissions lower ozone concentrations both in urban areas where most are emitted and in downwind areas, reducing the NO_X emissions in urban areas can have the effect of actually increasing ozone concentrations in those urban areas. NO_X reductions tend to be most effective in controlling ozone far downwind of the NO_X emission points.

Volatile organic compounds are emitted in automobile exhaust, from the evaporation of gasoline, and from many industrial processes, both large and small. There are over 250 different VOCs released by human activity, and most of these can lead to ozone formation. In an urban area such as the City of Chicago, VOC emissions come from many different sources. The most important contributor of ozone precursors in the Chicago area is vehicular traffic. Automobiles contribute 36 percent of the total VOC emissions in this area. Point sources, such as steel mills and large chemical plants, make up about 26 percent of the total emissions. About 20 percent of the total VOCs are emitted by area sources. "Area sources" are small industrial operations, such as dry cleaners, gasoline stations, and auto body shops. These facilities individually contribute relatively small amounts of ozone precursors, but the emissions from the total number of these sources in an urban area can have a significant impact. Off-road mobile sources such as lawn mowers, construction vehicles, and farm equipment make up about 11 percent of the Chicago area's VOC emissions. Finally, about eight percent of Chicago's total ozone precursors are biogenic, which means they come naturally from plants and animals.

Because ozone is formed in the presence of VOCs, and VOCs are emitted by so many different sources, it is VOC emissions upon which the mandatory Clean Air Act requirements have focused.

MANDATORY OZONE CONTROL REQUIREMENTS

To help control the formation of ozone in nonattainment areas, the Clean Air Act mandates a set of control measures for each nonattainment area by classification. The control measures are cumulative; in other words, Severe areas must promulgate the Severe area control measures in addition to the measures required for Serious, Moderate, and Marginal areas.

The mandatory requirements for all areas include a comprehensive inventory of all VOC, NO_X, and carbon monoxide emissions for the entire nonattainment area; requirements for major sources to submit statements certifying their annual VOC and NO_X emissions; the implementation or enhancement of Reasonably Available Control Technology (RACT) requirements, which set forth VOC emission controls by source category; and New Source Review program amendments to account for the changes in major source definition made by the Clean Air Act. New source requirements now affect smaller sources in areas with higher ozone classifications.

Moderate areas must submit a plan, including adopted rules, that will achieve a 15 percent reduction in VOC emissions for the nonattainment area. In these areas, Stage II gasoline vapor controls must be implemented. Stage II controls involve equipment on gasoline pumps to capture fumes that would otherwise be released to the air during automobile refueling. Moderate areas must also have a basic automobile Inspection and Maintenance (I/M) program. All nonattainment areas classified moderate and above are required to submit a demonstration showing that, with the mandatory control measures and additional area-specific control measures as deemed necessary, the area will reach attainment by the statutory deadline.

Serious and Severe areas must develop a plan that accounts for a three percent VOC emission reduction for every year from 1996 to the area's attainment date. These areas are required to implement an enhanced I/M program and a clean fuel fleet program. The clean fuel fleet program affects centrally fueled vehicle fleets such as bus or taxi systems. Thirty percent of all newly purchased vehicles in such fleets must be powered by clean fuels such as methanol, natural gas, or electricity. Severe areas are also required to develop measures to offset the effect of expected growth in future vehicle usage.

All areas have submitted their 1990 emission inventories, emission statement requirement regulations, RACT fixups and catchups, which bring the areas into compliance with federal VOC RACT requirements; New Source Review programs; Stage II regulations; regulations to offset expected growth in automobile use; and Employee Commute Options regulations. Most areas have either submitted their I/M regulations or have at least obtained the necessary legislative authority to develop the program. Many areas have not submitted NO_X RACT rules, but some areas are applying for a waiver of this requirement. Most areas have not yet submitted their 15 percent VOC reduction plans or their Clean Fuel Fleet plans. Sanctions clocks for these requirements have started, but the areas are in good shape to submit their rules before sanctions are applied.

REDESIGNATIONS — A MEASURE OF SUCCESS

One measure of our success with ozone control is the fact that several of the areas designated nonattainment in 1991 are now meeting the ozone standards. They have monitored no ozone violations for the past three years. When these areas are redesignated to attainment, they will be referred to as maintenance areas, because they must continue to maintain the ozone standard. If violations of the ozone standard occur later on in these areas, contingency measures will take effect to eliminate the problem. Contingency measures differ from area to area, but they often consist of stricter VOC controls. Federal Register notices have recently been published redesignating the South Bend and Indianapolis, Indiana Marginal nonattainment areas. The redesignations are effective November 30, 1994. The Detroit area has been proposed by the United States Environmental Protection Agency (USEPA) for redesignation. Jersey County, Illinois has submitted a redesignation request. In addition, all of the nonattainment areas in Ohio are expected to submit redesignation requests soon.

On the downside, some areas in the region have experienced ozone violations this year. St. Louis, Louisville, Chicago, and Milwaukee are all still having trouble meeting the ozone standard. It is important to remember that under the Clean Air Act, these areas still have time to work on their ozone problems. St. Louis and Louisville must attain by 1996, and Chicago must attain by 2007. If necessary, St. Louis and Louisville may be able to apply for a short extension on their attainment dates, or they can be bumped up to the next higher classification. This would also give them more time to meet the standards, but it would add more mandatory ozone control measures. The states are currently busy working on ozone control measures for these areas, and they are using photochemical grid models to help them determine what controls will be needed to meet the standard.

The Clean Air Act requires that areas classified as Serious and above, and also all multi-state Moderate areas, must use the Urban Airshed Model, a state-of-the-art multi-level, gridded photochemical model, to demonstrate that their ozone control programs will be adequate to attain the ozone standard. In the Midwest, the Chicago, Gary, and Milwaukee areas, St. Louis, Louisville, and Cincinnati were required to use the Urban Airshed Model. The Detroit area opted to use the Urban Airshed Model as well.

Let us take the Lake Michigan area as an example and look at the work the states are doing to address their ozone problems.

THE LAKE MICHIGAN AREA

The Lake Michigan region has experienced very high ozone levels. It includes the densely populated Chicago and Milwaukee urban areas, as well as the highly industrialized northwestern portion of Indiana. Large amounts of ozone precursors are emitted from these areas, and transported ozone and ozone precursors can contribute to ozone violations in western Michigan. The four Lake Michigan states, Illinois, Indiana, Michigan, and Wisconsin, joined together in 1989 to address the ozone problem in these areas, which is known as the Lake Michigan Ozone Study (LMOS) area. This was not an easy task.

First, an immense amount of data had to be gathered. The states commissioned a groundbreaking project to amass a comprehensive database of ozone precursor emissions, meteorological data, and ambient air quality measurements. This detailed information, used in the Urban Airshed Model, would help account for the effects of Lake Michigan on ozone formation and transport. Air quality data was gathered from an extensive network of ground level ozone monitors in the four states. Boats were sent out onto Lake Michigan to take ozone measurements, and aircraft was used to collect data both over the Lake and along the boundaries of the LMOS modeling domain. An emissions inventory was developed for the entire area to account for the emission of many different ozone precursors. The emissions of sources from large power plants, steel mills, paint and coating operations to numerous small sources such as dry cleaners and automobiles were assessed.

Once all the data was collected, the Urban Airshed Model had to be validated in order for the final attainment demonstration to be approved by USEPA. Basically, this means that the Lake Michigan states had to show that the model could replicate actual measured ozone concentrations in the area. Numerous model runs were evaluated so that the model inputs could be properly calibrated. The Lake Michigan states have recently submitted documentation to USEPA showing that the model meets USEPA's validation criteria for the LMOS domain.

Currently, several different control scenarios for the LMOS area are being tested using the Urban Airshed Model. It is apparent that the mandatory federal ozone control measures will not be quite enough to bring the entire LMOS area into attainment, and the states are considering further measures.

Earlier, I spoke of the way the reduction of NO_X emissions can sometimes complicate ozone control efforts for large urban areas. Modeling has shown that across-the-board NO_X controls will have a detrimental effect on the most densely populated areas in the Lake Michigan area. This negative effect seems to outweigh the benefits that NO_X control would have in the downwind areas. The Lake Michigan states have requested that USEPA waive the federal requirement for NO_X controls (NO_X RACT) in these nonattainment areas. Because NO_X control is beneficial to downwind areas, it may still be necessary, however, to impose some individual NO_X control measures.

The Lake Michigan states have not simply been waiting for the results of the Urban Airshed modeling effort, though. Many of the Clean Air Act-mandated control measures such as Stage II gasoline vapor controls have already gone into effect in the nonattainment areas of these states, and the consequences seem to be showing up in the monitored data. In the Chicago area, the design value, which generally represents a worst-case ozone concentration, has been declining in the years since the Clean Air Act was amended in 1990.

CONCLUSION

As a whole, the Midwest region is making great strides to eliminate its ozone problems. Many of the mandatory federal requirements are already in place. New measures will take effect in time to help decrease ozone formation next summer. The Reid Vapor Pressure of gasoline has been lowered, which means less gasoline evaporates and escapes into the air. Stage II controls have been implemented to capture the gasoline fumes normally released when refueling automobiles. You can already see these control measures in the Chicago area. More stringent inspection and maintenance programs are being implemented to ensure that automobiles are emitting the lowest possible amounts of pollutants. Stricter VOC emission controls on stationary sources are being put into place, and stricter emission control requirements will be placed on smaller new sources. The effects of these controls can already be seen in many areas. As ozone precursor controls continue to come into effect across the nation, we can expect to achieve even better air quality.

We still have a long way to go, partly because ozone is such a difficult pollutant to control. Every summer we continue to exceed the ozone standard all over the Midwest. Some areas will face difficult decisions in the future as they try to determine how best to reduce their ozone concentrations. A great deal of work remains to be done, but it is clear that with cooperation between USEPA, the states, and industry, we have made and will continue to make substantial progress in urban ground level ozone control.

CASE STUDY OF McCORMICK PLACE COGENERATION PROJECT

E. Louis Overstreet
General Manager
Trigen-Peoples District Energy Company

The cow and the flood are not excuses. Let's save Chicago. It's worth it.

What is it going to take? It is going to take at least four things:

- Providing a climate for competition in the marketplace,
- Working to clean up the environment,
- Stopping business plight to the suburbs,
- Promoting economic development activities.

In our business of providing district energy services, competition is the key to our being able to have a positive impact on the environment, business stability, and economic activity.

In the district energy industry, the competitive options are for property owners to continue to self generate energy to meet their needs, purchase energy from a company that utilizes electricity during off-peak hours to produce chilled water or take advantage of a *total solution* of purchasing tri-generation energy from Trigen-Peoples District Energy Company (Trigen-Peoples).

Tri-generation is an innovative technology which involves the simultaneous production of steam, chilled water, and electricity. See Figure 1 for a schematic illustration of the process. (All figures and tables appear at the end of this paper). Our McCormick Place cogeneration project calls for producing steam and chilled water (co-) for use by the Metropolitan Pier and Exposition Authority (MPEA). Our plant will also produce electricity (tri-) to run our production equipment.

This project is being developed under the difficult constraints of time, the need to maintain ongoing operations and provide guaranteed savings to MPEA.

The contract to develop the project was signed in December of 1992. Milestone dates in the contract were very tight, as was the method in which the work had to be prosecuted. Heating had to be available by November 1, 1993, and cooling service from a storage tank by May 1, 1994. Further, service for existing equipment had to be maintained on a continuous basis.

In December 1992, the McCormick Place complex consisted of Donnelley, North, and East Halls. Heating and cooling service for the North Hall was supplied by the Donnelley Hall plant. The East Hall contains its own power plant. To allow for the construction of the new South Hall, the McCormick Place Hotel and Donnelley Hall had to be demolished. This resulted in the need to be able to supply heating and cooling from an alternate location to the North Hall for the fall of 1993 and cooling in spring of 1994.

To meet these contractual requirements, Trigen-Peoples had to relocate some of the production equipment from Donnelley Hall to the East Hall and bore a tunnel under Lake Shore Drive in order to be able to install a distribution piping system to serve the North Hall with the East Hall. This was accomplished by starting the removal and relocation of equipment at the earliest possible date in spring of 1993, as well as the tunnel construction. These critical activities were completed in time to meet the heating needs of the North Hall by fall of 1993. Concurrently, work was proceeding on the construction of an 8.5 million gallon chilled water tank to store chilled water produced off-peak to cool the North and East Halls the next day. Along with a pumphouse, this work was completed in time to provide cooling in the spring of 1994.

Specifications have been completed for a power plant housing our tri-generation equipment to be on line by January 1, 1997; after which time, the power plant in the East Hall will be placed in standby status.

Our McCormick Place project is the latest addition to the Trigen family of district energy systems in other urban environments to include Boston, Philadelphia, and Baltimore (Table 1).

Trigen is serving the classifications of customers in eleven (11) cities in North America (Table 2).

Trigen-Peoples' ability to develop a district energy system in Chicago, similar to those in other cities, will be dependent on a climate that fosters competition. Such a climate is highly dependent on the regulatory and cost impacts of public policy.

Concluding, I submit to you that it is our collective responsibility to help save one of America's hallmark cities of cultural diversity. Our contribution to the collective effort will benefit Chicago as noted in Table 3.

TABLE 1

TRIGEN DISTRICT ENERGY SYSTEMS CUSTOMERS

Boston	Philadelphia	Baltimore
• John Hancock Tower • Marriott Hotel • Prudential Tower • Bank of Boston	• Independence Hall • Museum of Art • Thomas Jefferson University • Bell Atlantic Tower	• University of Maryland Medical Center • Columbus Center for Marine Research • Orioles Ballpark & Camden Yards

TABLE 2

TRIGEN CUSTOMERS BY CLASSIFICATION

15	Colleges / Universities
175	Civic Landmarks
93	Hotels
25	Hospitals
365	Commercial Buildings
16,351	Residential Units

TABLE 3

BENEFITS TO THE CITY OF CHICAGO BY UTILIZING DISTRICT HEATING & COOLING

- **Direct Cost Savings to the City**
  - Reduced cost of energy services.
  - Revenue can be derived from public/private initiatives.
  - No need to budget for capital expenditures to upgrade aging equipment.

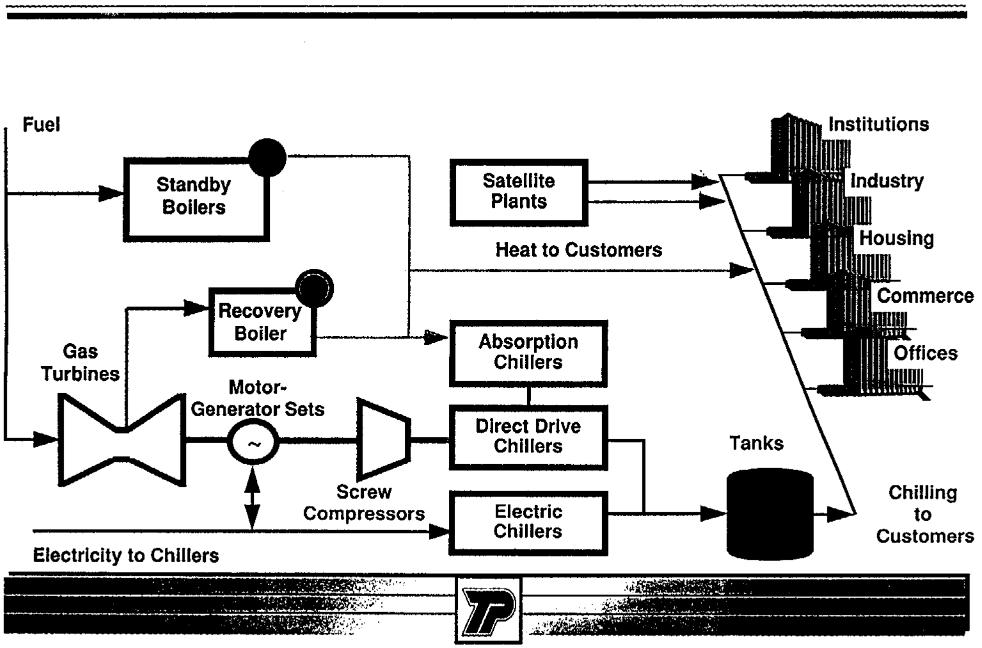
- **Promote Economic Development**
  - Energy alternatives promote competition.
  - Promotes local business opportunities during construction.
  - Vendor/purchasing opportunities.
  - Creates construction jobs.
  - Opportunity to promote equitable involvement of minorities and females in the development process.

- **Helps Chicago Retain and Attract Business**
  - Predictable and stable energy costs (planning consideration for developers).
  - Eliminates capital costs and reduces operating costs which will allow McCormick Place to structure more competitive bids for conferences.
  - Increased commercial/civic activities contributes to the vitality of the City.

- **Maintains and Increases Building Occupancy**
  - Lower energy operating costs can be used as a direct lease pass through to lessees.
  - Outsourcing energy management will allow for intra- and inter-building system integration; thus improving reliability through increased capacity.

- **Reduces Emissions/Eliminates Cooling Towers**
  - Aesthetics will be improved.
  - Pollutants are reduced.
  - CFC phaseout.

FIGURE 1


Fuel
Standby Boilers
Satellite Plants
Heat to Customers
Institutions
Industry
Housing
Commerce
Offices
Recovery Boiler
Gas Turbines
Absorption Chillers
Motor-Generator Sets
Direct Drive Chillers
Tanks
Screw Compressors
Electric Chillers
Chilling to Customers
Electricity to Chillers

SESSION IV: ENERGY AND ENVIRONMENT IN THE URBAN TRANSPORTATION SECTOR

IMPROVING ENERGY EFFICIENCY IN THE TRANSPORTATION SECTOR

Steven E. Plotkin
Project Director
Office of Technology Assessment

INTRODUCTION

A primary characteristic of transportation in the United States is its high per capita energy consumption. *The average U.S. citizen consumes nearly five times as much energy for transportation as the average Japanese and nearly three times as much as the average citizen of France, Britain, or West Germany.*[1] The energy efficiency of U.S. transportation has improved substantially over the past two decades (both absolutely and in comparison to Europe), and U.S. travel volume has grown more slowly than in most of the developed world. However, the United States still consumes more than one-third of the world's transport energy.[2] Also, 96 percent of U.S. transport energy is in the form of oil products.[3] This is more oil than the United States produces,[4] despite its position as one of the world's largest oil producers.

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[1]L. Schipper et al., "Energy Use in Passenger Transport in OECD Countries: Changes Between 1970 and 1987," *Transportation, The International Journal*, April 1992.

[2]U.S. Congress, Office of Technology Assessment, *Changing by Degrees: Steps to Reduce Greenhouse Gases*, OTA-0-482 (Washington, DC: U.S. Government Printing Office, February 1991), table 5-1.

[3]S.C. Davis and S.G. Strang, *Transportation Energy Data Book*, ed. 13, ORNL-6743 (Oak Ridge, TN: Oak Ridge National Laboratory, March 1993), table 2.8.

[4]Total 1990 transportation oil products consumption was 21.81 quadrillion British thermal units (Btus), versus domestic liquid production (crude oil, lease condensate, and natural gas plant liquids) of 17.91 quadrillion Btus. Energy Information Administration, *Annual Energy Outlook 1993*, DOE/EIA-1383(93) (Washington, DC: January 1993), tables G1 and G2.

In 1990, the U.S. transportation sector accounted for nearly 65 percent of all U.S. oil consumption.[5] The oil consumed by U.S. transportation creates problems in terms of: 1) air pollution — about 100 urban areas violate the ozone air quality standard, and emissions from transportation sources, primarily highway vehicles, contribute 30 percent of the volatile organic compound and 39 percent of the nitrogen oxide precursors of ozone; 2) national security and balance of trade, because so much of our oil is imported; and 3) greenhouse warming, because large quantities of carbon dioxide (the primary greenhouse gas) are emitted with oil combustion.

The intensity and magnitude of U.S. travel create other problems as well. Growing congestion, especially in urban areas, leads to expensive delays in passenger and freight transport, and increases fuel use and pollution. U.S. reliance on automobiles has resulted in a high percentage of land being devoted to highways, parking facilities, and other auto uses; the loss of wetlands and other ecologically sensitive lands to highways and the diffuse land use that highways support; and a range of other environmental impacts.

Energy use in U.S. transportation is expected to increase despite continued improvements in efficiency. The Energy Information Administration's (EIA) *Annual Energy Outlook 1993* projects steady but moderate growth in transportation energy use across all scenarios. EIA projects a 19 to 38 percent increase over the 20 year period of the forecast. Thus, by 2010, transport energy use would be 26.8 to 31.0 quadrillion British thermal units (10^{15} Btus = 1 quad),[6] about 12.9 to 14.9 million barrels of oil per day (mmbd), compared with its 1990 level of 22.5 quads, or 10.5 mmbd. And, as discussed later, the Office of Technology Assessment (OTA) believes these forecasted levels are likely to underestimate future transportation energy use, because they rely on optimistic assumptions about improvement in vehicle efficiency and growth in personal travel.

With current problems and expectations of continued growth in travel and energy use, Congress has increasingly turned to transportation energy conservation — in the form of improvements in the technical efficiency of travel, increases in load factors, reductions in travel demand, shifting to alternative fuels, and shifts to more efficient travel modes — as an important policy goal. For example, the Clean Air Amendments of 1990 incorporate transportation demand management as a critical tool

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[5]Ibid., table A-8.

[6]A "quad" of energy, aside from being one quadrillion (10^{15}) Btus, is equivalent to about one trillion cubic feet of natural gas, or about 1/20 of current annual U.S. natural gas consumption; about 170 million barrels of oil, or a bit more than 1/30 of current U.S. yearly oil consumption; about 40 million short tons of coal (coal energy content is variable, so this is a rough approximation), or about 1/20 of U.S. yearly coal consumption. In 1990, U.S. energy consumption was about 85 quads.

in reducing urban air pollution.[7] ISTEA — the Intermodal Surface Transportation Efficiency Act of 1991 — allows states to shift highway funds to transit, promotes new high-speed ground transportation systems, and generally establishes energy efficiency as a major goal of new transportation investment. EPACT — the Energy Policy Act of 1992 — establishes fleet requirements and a series of economic incentives to promote the use of nonpetroleum alternative fuels. Legislation proposed (but not passed) in the 102d Congress sought rigorous new automobile and light truck fuel economy standards. With continued increases in U.S. oil imports, urban traffic congestion, and greenhouse gas emissions, and the failure of many urban areas to meet air quality standards, strong congressional interest in new energy conservation initiatives is likely to continue.

Varying Perspectives on the Nature of the Problem and on Potential Solutions

Although policymakers and the transportation community may agree that transportation energy conservation is a worthwhile goal *in the abstract*, severe disagreements exist about the urgency of the problems that conservation measures can serve to address and the efficacy of conservation alternatives.

Disagreement begins with two very different perspectives about transportation itself:

1. *Transportation, and especially automobile-dominated transport, is a primary source of social and environmental ills such as air pollution, loss of ecosystems, greenhouse emissions, loss of life and limb, and noise pollution.*

2. *Transportation is a key to economic progress and to social, cultural, and recreational opportunity.*

Since both perspectives are valid, both should be considered in seeking a balanced approach to policymaking. Many transportation stakeholders, however, lean heavily toward one perspective or the other. Those leaning toward the first tend to focus on the need to reduce and restrict travel, shift travelers to less harmful modes, and enact strong environmental safeguards; those leaning toward the second focus on the need to increase access to travel and to make traveling easier and more efficient. Thus, in terms of these two perspectives, some of the key features of U.S. transportation — the highest level of personal travel in the world (13,500 miles per person per year) and the most vehicles per person in the world (nearly six autos or light trucks for every 10 persons, and two vehicles per household) — appear as signs either of the profligacy of the U.S. system or of its superiority. Such varying perspectives about the success of the American system in turn lead to very different perspectives about

[7] Transportation demand management (TDM) measures seek to reduce traffic volumes (or shift some traffic to less congested times or routes), especially during peak travel hours, by increasing vehicle occupancy, encouraging modal shifts, and other means.

the need for changing that system, with one tending toward substantive change and the other toward fine-tuning.

That transportation is not an end in itself, but a means to attain access to economic and personal opportunity, may aggravate the differences in perspective. The concept of access to a variety of opportunities is easy to grasp but difficult to measure, so transportation services are generally measured simply in miles traveled or trips made. Thus, there is a danger that a traveler who must commute several hours to work will be judged in some analyses to have obtained more value from transportation services than another who walks 20 minutes to work. Also, those judging proposed changes in transportation policy must distinguish carefully between changes that reduce travel *and* access to opportunity, and those that reduce travel but bring opportunity closer.

Three major problems are driving most transportation energy conservation initiatives — air pollution (especially urban), energy security, and greenhouse warming. Different views about the urgency of these problems in turn lead to different perspectives about the types of tradeoffs worth making to achieve lower energy use. There appears to be a consensus that urban air pollution is a critical national problem, and clear support exists for strong corrective measures. There is a modest level of agreement about the importance of rising oil imports as a national security and balance-of-trade problem, with levels of concern ranging from moderate to substantial and limited support for corrective measures. Agreement is lacking about the urgency of reducing greenhouse emissions to slow down potential warming: environmental groups urge strong action, whereas much of the business community urges that no action be taken until more is known.

Another potential disagreement about the nature of problems facing the transportation system could further polarize policymaking. The Federal Highway Administration (FHWA) projects large increases in urban and suburban traffic congestion, which implies that strong policy measures — including severe demand management and large shifts to alternate modes — will be needed to maintain acceptable levels of urban mobility. A small group of critics, however, claims that the FHWA projections are grossly in error, and that growth in congestion will be kept in check by changes in travel behavior and land use. These views, of course, yield a very different set of transportation policy priorities.

Another disagreement about the need for changes in transportation policy focuses on the extent to which prices for U.S. travel accurately reflect the true marginal costs to society of such travel. Many analysts believe that a combination of "externalities" (consequences such as air pollution that travelers do not pay for or take into account in their decisions) and inefficiently priced inputs (services such as parking, with hidden, subsidized, or inaccurate prices) yields an overall cost of travel that is too low and thus results in excessive travel. Other analysts conclude that the value of externalities and unpriced inputs is small compared with the prices paid openly by travelers, so that "correcting" prices would not result in large changes in travel behavior. These analysts hold that there is not much excess travel in the United States.

Finally, not surprisingly, there are major disagreements about the efficacy of virtually all conservation measures. For example:

- Proponents of *increased mass transit* foresee it as playing a major role in energy conservation and the revitalization of U.S. cities. Skeptics view it as basically irrelevant to most travel, having only a small role to play (mobility of disadvantaged populations, a major general role in a few of America's older, high-density urban cores) given the auto-oriented U.S. land use patterns and offering little if any benefits in energy efficiency.

- Proponents of *stronger fuel economy standards* believe that there are inexpensive ways to achieve large improvements in auto fuel economy, and view standard setting as a proven success in forcing these improvements. Opponents see little opportunity for more than slow, incremental growth in fuel economy, and view standards as an antimarket, inefficient method of achieving the small improvements that are available.

- Proponents of *higher gasoline taxes* view them as proven revenue raisers, which offer improved economic efficiency by capturing "externalities" and inefficiently priced transportation inputs, and allow significant energy savings. Opponents view them as harmful to the U.S. economy, and as offering no economic efficiency benefits and limited energy savings benefits, given the unresponsiveness of travel demand and technical efficiency to gasoline price.

A unifying feature of these policy arguments is a difference of views about the importance of policy-dependent factors versus policy-independent factors in shaping travel patterns. If history (including the history of technology), geography, income, and demographics are the primary determinants of travel patterns, policy may play only a minor role in changing energy use; but if fuel taxes, urban planning, parking policies, and other instruments of public policy are primary travel determinants, there is a large potential for policy to reduce U.S. energy use.

Although much of the disagreement about transportation policy stems from differences in values and philosophy, including different views about the role of government in markets, a significant portion stems from the lack of adequate research and data in several crucial areas.[8] These include:

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[8]A recent report by the Transportation Research Board (TRB) identifies critical research needs in transportation, land use, and air quality; TRB, *Transportation Research Circular 389: Environmental Research Needs in Transportation* (Washington, DC: National Research Council, March 1992).

- The relationship among travel behavior and demographics, urban design, and transportation system characteristics (e.g., the extent to which new transportation facilities can be used as part of an integrated effort to shift land use patterns and travel behavior);

- The magnitude of transportation "externalities," or costs that are not accounted for or borne by transport users;

- Identification and quantification of transport benefits; and

- The measurement of "accessibility," which is the primary goal that personal transportation attempts to satisfy.

SNAPSHOT OF THE U.S. TRANSPORTATION SYSTEM AND ENERGY USE

Passenger Travel

The transportation system in the United States provides U.S. residents with the highest level of personal mobility — in terms of trips made and miles traveled — in the world. The United States has the greatest number of automobiles per capita — 0.575 in 1989 — in the world,[9] *1.07 vehicles per licensed driver and 1.92 vehicles per household.*[10] The average adult with a driver's license travels 30 miles per day of local, personal travel, and even adults without licenses manage to travel 10 miles per day.[11] In 1990, the average U.S. resident traveled well over 13,000 miles.[12]

U.S. passenger travel is dominated by the automobile and the highway system. In 1990, about 86 percent of passenger miles were auto (and personal light truck) miles, and over 10 of the remaining 14 percent were air miles; buses and trains provided only 4 percent of passenger miles.[13]

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[9]S.C. Davis and M.D. Morris, *Transportation Energy Data Book*, ed. 12, ORNL-6710 (Oak Ridge, TN: Oak Ridge National Laboratory, March 1992), table 1-3.

[10]Ibid., table 4-1. Note that "vehicles" includes trucks and buses.

[11]A.T. Reno, "Personal Mobility in the United States," *A Look Ahead—Year 2020*, Transportation Research Board Special Report 220 (Washington, DC: Transportation Research Board, 1988).

[12]Data obtained from L. Schipper and N. Kiang, International Energy Studies, Lawrence Berkeley Laboratory, in advance of publication in the *Transportation Energy Data Book*, ed. 14 (Oak Ridge, TN: Oak Ridge National Laboratory, forthcoming).

[13]Ibid.

The U.S. highway system consists of about 3.8 million miles of roadway, including 44,000 miles in the Interstate System.[14] [15] The system also includes nearly 577,000 bridges.[16] Much of this infrastructure — more than 10 percent of the nation's roads and nearly 42 percent of its bridges — is considered deficient.[17]

The U.S. mass transit system consists of a wide array of regional and municipal systems, including buses, light rail, commuter rail, trolleys, and subways, as well as an array of vehicles providing "paratransit" services — dial-a-ride, van pools, subsidized taxis, and shared rides in minibuses or vans. Most cities of 20,000 or higher population have bus systems, and buses on established routes with set schedules account for more than half of all public transit passenger trips. However, about 70 percent of all such trips were in the 10 cities with rapid rail systems, with 35 percent of transit passengers and 41 percent of transit passenger miles in New York City and its suburbs.[18]

The highway and public transportation systems in U.S. cities are shaped largely by the need to offer capacity to satisfy peak traffic periods. These peaks now are no longer dominated by work trips, although these trips still account for 37 percent of peak person trips.[19] And although the pattern of workers living in surrounding areas and commuting to the central business district (CBD) may once have been dominant, in 1980 the CBDs employed only 9 percent of the workers in their total urban areas and only 3 percent of workers living outside the central city.[20] In other words, peak trips in general, and work trips in particular, are now quite diffuse in origin and destination and thus not easily served by transit. One reason for this travel pattern

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[14]U.S. Congress, Office of Technology Assessment, *Delivering the Goods: Public Works Technologies, Management, and Finance*, OTA-SET-477 (Washington, DC: U.S. Government Printing Office, April 1991), based on Department of Transportation data.

[15]Routes that connect principal metropolitan areas, serve the national defense, or connect with routes of continental importance in Mexico or Canada.

[16]Office of Technology Assessment, op. cit., footnote 14.

[17]Ibid.

[18]Ibid.

[19]H.W. Richardson and P. Gordon, University of Southern California, "New Data and Old Models in Urban Economics," preliminary draft, December 1992, table 3. Peak periods are from 6 to 9 a.m. and 4 to 7 p.m. The precise character of changes in trip purposes is made uncertain by the manner in which trip purpose data are collected. A work trip interrupted by a stop to run an errand would be counted as a shorter work trip and another trip. Because trip "chaining" of this sort has increased, some of the shift away from work trips may be an artifact of the data rather than an actual shift.

[20]I.S. Lowry, "Planning for Urban Sprawl," in *A Look Ahead—Year 2020*, op.cit., footnote 11.

is that urban development in the United States is characterized by an "undifferentiated mixture of land users and a broad plateau of population density . . . other central places, scattered over the urban landscape challenge the primacy of the historic CBD."[21]

Although the automobile continues to dominate U.S. travel, autos face strong competition from commercial aircraft for trips of a few hundred miles or longer. As noted above, air transportation has now captured about 10 percent of the total passenger miles traveled and is the most rapidly growing segment of the U.S. transportation system, with passenger miles growing more than 7 percent a year in the 1980s.[22]

The U.S. air travel system is quite centralized. There are more than 17,000 airports in the United States, but the top 100 handle 95 percent of all passenger trips, and the 10 largest serve 40 percent of all passenger trips. This is due primarily to widespread use by the major air carriers of "hub-and-spoke" routes.[23] The major airports experience substantial capacity problems and resulting delays — conditions that waste significant amounts of fuel by idling aircraft on runways and keeping arriving planes in holding patterns. Of the 25 airports with the most delays, Chicago's O'Hare ranks first, with total delays exceeding 100,000 airplane-hours per year; two airports have annual delays between 75,000 and 100,000 hours; two more have annual delays between 50,000 and 75,000 hours; and the remainder are between 20,000 and 50,000 hours.[24]

Freight Movement

The U.S. freight system moves about 3.2 trillion ton-miles of freight per year.[25] Trains and trucks each carry about 30 percent of this, barges about 25 percent, oil pipelines 16 percent, and air less than 1 percent. Trucks are the dominant transport mode for nonbulk cargo, such as mail, processed foods, and consumer goods. Truck types and cargo are extremely varied, with light trucks used primarily for short-distance urban and suburban delivery and for carrying craftsman's equipment, and heavy trucks hauling mixed cargo, processed foods, and building materials. Trains, on the other hand, carry primarily bulk products, which the United States ships in large quantities over very long distances. Key products moved by train include coal,

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[21]Ibid.

[22]Ibid.

[23]J.F. Hornbeck, *Transportation Infrastructure: Economic and Policy Issues*, 92-158E (Washington, DC: Congressional Research Service, Feb. 11, 1992).

[24]Office of Technology Assessment, op.cit., footnote 14.

[25]Davis and Strang, op. cit., footnote 3, p. 2-25.

farm products, and chemicals. An increasing fraction of train movement — now more than one-quarter — is in the form of trailers or containers (i.e., intermodal shipments involving both train and another freight mode, e.g., truck or barge), typically carrying manufactured or intermediate goods.

TRANSPORTATION ENERGY USE AND CONSERVATION POTENTIAL

Figure 1 (all figures appear at the end of this paper) provides a broad overview of where energy is being used in the U.S. transport system. The figure illustrates that light-duty vehicles — automobiles, pickup trucks, utility vehicles, and vans — account for more than half of all U.S. transportation energy consumption. These vehicles are used predominantly for passenger travel. Airplanes, also used predominantly for passenger travel, account for 14 percent of U.S. transportation energy use. These two components of passenger travel thus represent a tempting target for energy conservation measures.

Freight trucks are the second largest consumer of transportation energy, accounting for nearly 23 percent of the total U.S. use. Freight truck energy use is expected to grow substantially during the next two decades and thus should also be an important focus for energy conservation. Other freight modes — pipelines, shipping, and rail (most rail energy is freight energy) — are all important, and rail may represent an opportunity to attract freight from trucking, with subsequent energy savings, but they are clearly of lesser significance than trucks for national energy savings.

U.S. TRANSPORTATION ENERGY CONSUMPTION: WHERE IS IT HEADING?

EIA's *Annual Energy Outlook 1993* (AE093) provides a detailed picture of future U.S. energy supply and demand, and transportation energy consumption in particular. The forecasts of transportation energy consumption depend on a number of critical factors and assumptions including:

- Assumptions about future oil prices;
- Assumptions about important demographic and socioeconomic trends, for example, the nature of women's evolving role in the workplace and how this will affect their driving patterns, and future rates of immigration;
- Future progress in automobile and light-truck fuel economy;
- Overall and sectoral growth rate of the economy.

EIA's baseline forecast accepts mainstream ideas about oil prices and economic growth: that a combination of plentiful oil supply, gradually increasing world demand, and Saudi restraint will maintain prices in the $20 per barrel (bbl) range for a few years and then gradually push prices upward, to $29/bbl (1991 dollars) by 2010; and that slower growth in the U.S. labor force for the next few decades (a projected rate of about 1 percent per year versus 2.1 percent annually in 1970-90) will restrain the growth in real output of goods and services, but that the U.S. economy will remain sufficiently competitive in world markets to keep growing at the moderate rate of 2.0 percent per year.[26]

The forecast projects steady but moderate growth in transportation energy use: 1.26 percent per year, yielding a 28.5 percent increase from 1990 to 2010 — the 1990 level of 22.5 quads (10.8 mmbd) increases to 28.93 quads (13.9 mmbd) by 2010 (Figure 2).

EIA has formulated alternative forecasts based primarily on different economic assumptions. Alternative price scenarios reflect, on the low side, a combination of more conservation than expected, significant competition among Organization of Petroleum Exporting Countries (OPEC) members to expand production capacity, and high non-OPEC production and on the high side, more global economic growth and less conservation than expected, which boosts world oil demand, as well as a decreasing supply. Alternative economic growth scenarios reflect differing assumptions about the rate of labor force growth and productivity. As noted earlier, these scenarios introduce a range of transportation energy projections for year 2010 of 26.86 to 31.00 quads (12.9 to 14.9 mmbd) versus the 28.93 quads/13.9 mmbd baseline.

The uneven history of energy forecasting demands that EIA forecasts, and all others, be viewed with some skepticism. Over the past few decades, sharp changes in both energy demand and supply characteristics — especially the former — have caused actual national energy trends to diverge sharply from widely accepted forecasts. For example, during the 1970s, forecasts of future electricity demand were revised downward so often that a simultaneous plotting of forecasts made in consecutive years described a wide fan, with the top of the fan representing the earliest forecast and the bottom, the latest.

Absent important new federal policy measures — many of which are the province of Congress — several factors may increase the likelihood that actual transportation energy use in 2010 will diverge substantially from EIA forecasts. *Potential* sources of divergence include: sharp changes in urban travel behavior (e.g., more car-pooling and telecommuting), initiated by Transportation Control Measures under the Clean Air Act; major success of alternative fuels spurred by fleet purchases mandated

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[26]Energy Information Administration, 1993, op. cit., footnote 4.

by the Energy Policy Act, California's low-emission and zero-emission vehicle requirements, and technological breakthroughs; large increases in mass transit usage courtesy of state initiatives supported by ISTEA; breakthroughs in automotive technology, together with large shifts in market conditions; and continuation of recent trends in vehicle miles traveled (i.e., high rates of growth) and energy efficiency (i.e., stagnation, in contrast to EIA's more optimistic assumptions).

Some potential sources of divergence (e.g., unforeseen success of Transportation Control Measures) imply that the EIA forecasts of transportation energy growth could be too high. The most likely sources, however, imply the opposite. *The most likely sources of forecasting error are assumptions about growth rates of travel and efficiency.* EIA has consistently chosen growth rates of travel that are lower, and efficiency increases that are higher, than recent historic rates. For example:

- Light-duty vehicle miles traveled (vmt) grew at rates well over 3 percent per year during the 1980s, compared with EIA's assumed 1990-2010 rate of 1.7 percent annually. The history of light-duty vmt growth during the past four or five decades has been one of seemingly inexorable growth, despite expectations to the contrary.

- New car fuel economy has fallen since 1987, compared with EIA's assumed 1990-2010 increase of 1.1 percent per year. Low oil prices and consumer preferences for luxury, performance, and size are pushing the market away from fuel economy gains.

- Air travel grew at a better than 7 percent per year pace in the 1980s, compared with EIA's assumed 1990-2010 pace of 3.9 percent per year.

- All categories of freight trucks had mileage increases well above 3 percent per year (combination trucks' mileage grew at 4.7 percent per year from 1982 to 1990), compared with EIA's assumed 1990-2010 annual rate of 1.9 percent per year.

In OTA's view, without substantial policy intervention (excluded in the projections), *future rates of travel are quite likely to be higher*[27] *and efficiency lower than EIA projects, with a resulting greater increase in transportation energy use than the projected levels.* There is room for technological breakthroughs in engines and other aspects of vehicle design to make some difference (e.g., in energy savings) in the 2010 time frame, but this is less probable than the potential for significant diversions from the forecasts in travel and efficiency growth rates, toward higher energy use. There appears little likelihood (again, without substantial policy intervention) that

[27]OTA agrees, however, that growth rates for light-duty vmt will fall somewhat below recent rates, primarily because of the likely slower growth in the number of adults of driving age.

shifts to mass transit, other important changes in travel behavior, or market breakthroughs in alternative fuels will cause major changes (beyond those already included in the forecasts) in transportation energy use by 2010.

IS THE U.S. TRANSPORTATION SYSTEM ENERGY-EFFICIENT? A COMPARISON WITH EUROPE

Decisions to initiate pro-conservation policies would be served by a determination about whether the current U.S. transportation system is particularly inefficient in terms of energy use, as suggested by some, or whether it is relatively efficient. Some analysts and policymakers have compared U.S. energy use in general, and that used for transportation, with energy use in other developed nations, particularly Japan and Western Europe. Typically, these comparisons are described as demonstrations of U.S. energy inefficiency, because Japan and Western Europe use considerably less energy per capita in most sectors. As noted above, the average U.S. citizen uses about five times as much transportation energy as the average Japanese, and about three times as much as citizens of Great Britain, West Germany, and France. An examination of comparative energy use in the U.S. and Western Europe demonstrates that the disparity in per capita consumption is caused by a variety of factors, some of which clearly are related to differences in efficiency, but some of which have little to do with efficiency or are only vaguely connected to it. The discussion here does not address the critical question of comparative access to recreational, social, cultural, and employment opportunities, nor can the relative roles of government policies and other influences in shaping transportation energy use be separated definitively.

The major reason for the difference between U.S. and European transportation energy use is a difference in travel volume: on average, Europeans travel only about half as much (in miles per capita per year) as Americans.[28] This one factor accounts for half of the total difference in energy use. The causes of the difference are multiple and difficult to unscramble: higher cost of travel; *much* denser land use in Europe — in urban areas, in suburbs, and overall (which may be due in part to higher travel costs, but also is the result of different cultural histories, lower availability of land, stricter land use controls); differences in socioeconomic factors affecting travel (e.g., women's participation in the workforce, household size, willingness of workers to relocate far from their families); differences in lifestyle; and so forth. Another reason may be timing: Europe began its shift to "automobility" later than the United States and, despite now having per capita incomes equal to or greater than U.S. levels, is still catching up in auto ownership. Part of the difference in travel may translate into greater accessibility to economic, cultural, and recreational opportunities for U.S. citizens, but OTA is not aware of

[28]Schipper and Kiang, op. cit., footnote 12.

any evidence to support this; the existence of such a difference in accessibility, especially in urban areas, is debatable because European population densities and prevalence of mixed-use development made access to work, recreation, and other destinations closer at hand; because much European urban travel is by walking and bicycling (which tend to be overlooked in statistical analyses); and because accessibility is a subjective, culture-laden term. European land use patterns will be described as "more efficient" than U.S. patterns by some, but this too is highly subjective.

The other half of the energy difference is accounted for by differences in the proportions of various travel modes used (modal shares), load factors, and vehicle efficiency. As a fraction of their total travel, Americans travel somewhat more in private autos, and far more in energy-intensive airplanes, than do Europeans, who made far greater use of buses and trains. Mass transit has about 15 percent modal share — measured as a percentage of *passenger miles* — in Europe versus about 3 percent in the United States.[29] And European automobile fleets are more efficient than the U.S. fleet, partly because Americans purchase large numbers of light trucks for personal travel use, and partly because American automobiles are larger than their European counterparts. These differences are lessening, however, as are the differences in per capita travel: the rates of growth of travel and auto ownership are much higher in Europe than in the United States; U.S. auto fleet efficiency is catching up to most European fleets; and mass transit modal shares — although not absolute levels of ridership — are shrinking in most of Europe.

Unlike personal travel, European freight transportation is not more energy efficient than its U.S. counterpart, though its volume in ton-miles in proportion to total economic activity is much lower than in the United States. The types of goods transported and the physical conditions differ sufficiently from those in the U.S. that there seem to be few lessons easily extracted from a comparison of the two systems.

The available statistical comparisons between Europe and the United States allow only tentative conclusions. They do demonstrate clearly that *the substantial differences between European and U.S. transportation energy use patterns are associated largely with different levels of travel; about half of the difference in per capita energy use is due to differences in energy efficiency, at least in terms of common perceptions of what efficiency is*. On the other hand, Europe's faster rates of growth in travel demand should not be interpreted as meaning that European transportation is simply at an earlier stage of automobile dominance than the United States and destined to "catch up" to U.S. energy consumption levels. Although there will be some continued convergence between the two, *European levels of per capita travel and energy consumption should continue significantly below those of the United*

[29]L. Schipper et al., *Energy Efficiency and Human Activity: Past Trends, Future Prospects* (Cambridge, England: Cambridge University Press, 1992).

States because of a combination of different geography and urban histories; European gasoline prices that are three to four times higher than prices in the United States; different policies regarding land use controls, parking availability, automobile restrictions, and other factors that affect travel; Europe's reasonably robust mass transit systems; and cultural and socioeconomic differences.

Could the United States, if it chose, match European levels of transportation energy use? Fuel price and other policy differences between the United States and Europe can be made to disappear by legislative will, and future U.S. moves to raise fuel prices, enact land use controls that increase urban densities, restrict parking, and so forth *would* move U.S. transportation energy use in the direction of European levels. However, some or all of these policy changes may not be politically acceptable; they would not affect all of the factors that make European energy use lower than U.S. levels; and some resulting changes in energy use, especially those associated with land use, would come quite slowly, over many decades. The remainder of this discussion examines the incentives for and potential of U.S. government intervention in transportation.

WHY INTERVENE IN THE TRANSPORTATION SYSTEM?

As noted above, a variety of problems and issues are driving U.S. transportation policymaking, and perceptions of the importance of these problems and issues will be a key determinant of future policy decisions.

Economic Efficiency, Externalities, and Unpriced Inputs

To the extent that travelers do no pay for, or do not account for, the full costs of their travel, they will overuse it. Travelers do not pay the full price of the air pollution and congestion they cause, the impacts on national security of the oil they consume, (a portion of) the costs of the injuries and fatalities they cause in auto accidents, and so forth. They indirectly pay for, but do not account for in their travel decisions, the costs of parking in the shopping malls they patronize (these costs are embedded in the price of the goods being sold). Similarly, they may indirectly pay (in the form of lower salaries) but not account for most parking costs at workplaces. They pay and/or take into account only a portion of the costs of building and maintaining roads, because some of this cost is met from general funds, not user fees. And they pay and account for some services inefficiently: gasoline taxes that pay for road building are only indirectly related to actual road requirements.

In this study, OTA asked Mark DeLuchi of the University of California at Davis to prepare estimates of the social costs of motor vehicle travel, separating private, efficiently paid costs from external costs, hidden private costs, and inefficiently priced costs.[30] **These estimates indicate that approximately two-thirds to four-fifths of the total monetary costs of motor vehicle use[31] are efficiently priced, that is, paid for entirely by motor vehicle users, considered in their travel decisions, and priced at marginal costs to society. Based on some preliminary estimates of the dollar value of external costs, motor vehicle users efficiently paid for about one-half to two-thirds of the social (public plus private) costs of motor vehicle use, both monetary and nonmonetary, excluding the value of time.**

These estimates represent a long-term view of costs and their effects on behavior; that is, they make no distinction between costs that must be paid only occasionally (e.g., vehicle purchase price, insurance premiums) and those that are incurred frequently (e.g., fuel costs, air pollution damages). Some analysts prefer to focus on frequently incurred costs because they believe that these have a more powerful impact on travel behavior. Because many of the private, efficiently paid costs are paid infrequently, and most externalities and hidden or inefficiently priced costs are incurred daily or at least frequently, an analysis of frequently incurred costs would yield a lower ratio of efficiently priced costs to total societal costs. Which perspective — a focus on total costs or only on those costs incurred frequently — is more "correct," however, is not a settled issue.

These conclusions imply that there is some significant opportunity for improving the economic efficiency of motor vehicle travel by incorporating external costs, hidden private costs, and inefficiently priced private costs into the price paid by travelers. However, there are four important caveats:

1. Considerable uncertainty remains about both the magnitude and the appropriate monetary value of several external costs.

2. Measures to incorporate these costs must carefully match the pricing mechanism (gas tax, road pricing, etc.) to the patterns with which the costs are incurred and should avoid high implementation costs. If this cannot be done, it may sometimes be better to leave the costs unpaid by users.

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[30]M.A. DeLuchi, University of California at Davis, "The Annualized Social Costs of Motor Vehicle Use Based on 1990-1991 Data," OTA contractor report, April 1994. Other studies of motor vehicle use are discussed in M.E. Hanson, *Results of Literature Survey and Summary of Findings: The Nature and Magnitude of Social Costs of Urban Roadway Use*, for Federal Highway Administration, U.S. Department of Transportation, 1992. OTA will soon publish a study reviewing different estimates of the environmental externalities of electricity generation.

[31]Including the cost of free parking and the monopsony cost of importing oil (the portion of oil consumption costs attributable to the effect that U.S. oil imports have on world oil prices), but excluding the costs of air pollution, travel time, and other nonmonetary costs.

3. Attempting to charge full social costs *only* in the motor vehicle sector ignores the reality that *all* economic activities have hidden, inefficiently priced, and external costs. Although there are reasons to believe that these represent a higher percentage of motor vehicle costs than of the costs for other activities, failure to apply full social cost accounting to other activities may reduce the economic efficiency benefits that would otherwise result from correcting transport pricing.

4. There may be external benefits as well as costs associated with motor vehicle travel that, ideally, would be incorporated in a "full social cost" accounting. Little research has been done on external benefits, but this does not mean that they are negligible.

Congestion

As noted, FHWA and others have projected large increases in traffic congestion for the coming decades, with delay costs soaring to tens of billions of dollars and average vehicle speeds dropping calamitously in many urban areas. For example, FHWA has projected a 450 percent increase in annual delay times from 1984 to 2005, from slightly more than 1 billion hours to nearly 7 billion hours. And local studies project that Los Angeles freeway speeds will drop to 11 miles per hour (mph) by 2010, from their present 31 mph. Skeptics of these estimates have attacked them at least in part on the basis of survey results showing that average U.S. commuting times remained essentially unchanged during the 1980s, a seemingly odd result if congestion has grown as much as estimated. Increases in reported average freeway speeds also appear at odds with estimated increases in congestion.

OTA's evaluation of the available data indicates that it is possible that both the estimates of growing congestion and some of the apparently contradictory travel and highway speed data may both be right.[32] However, there is another reason to be concerned about the accuracy of the congestion estimates — they are based on traffic counts rather than on measurements of actual speed declines and travel delays, an indirect method that invites inaccuracy. And the dire projections of future congestion costs also invite skepticism because they take no account of shifts in job and residential locations or of changes in travel behavior (although these have been important factors in the past), and they assume that rising travel time costs will have no negative effect on the growth in traffic volume. In other words, these projections appear to be worst-case extrapolations rather than "most likely case" estimates.

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[32] This is primarily because congestion delays still represent a relatively small portion of total highway travel. Consequently, adverse effects of congestion on highway speeds and travel times could be offset by factors such as increased highway speeds during uncongested periods and shifts in commuting patterns.

OPTIONS FOR REDUCING TRANSPORTATION ENERGY USE

The options available to policymakers to pursue transportation energy conservation activities include:

1. *Economic Incentives* — direct taxes, granting or eliminating tax breaks, subsidies, granting of regulatory exemptions, making pricing more efficient;

2. *Public Investment* — in new infrastructure (including new types of systems and services, e.g., mass transit), maintenance and rehabilitation of old transportation infrastructure, expansion of service, urban development, research and development; and

3. *Regulatory Incentives* — efficiency standards, zoning, fuel use requirements, speed limits, inspection and maintenance requirements, and travel restrictions.

Some of the main thrusts of transportation energy conservation policy are discussed here, from raising gasoline taxes to increasing the use of mass transit.

Gasoline Taxes

Raising taxes on gasoline is often viewed as both a means to raise revenue and an energy conservation measure. Higher gasoline prices serve an incentive to purchase more efficient cars and light trucks and to change travel behavior — toward car-pooling, transit, and reduced tripmaking.

For every 1 percent increase in the price of gasoline, the number of vehicle miles traveled is expected to decline of 0.1 to 0.25 percent;[33] new car fuel economy may also respond by increasing a small amount,[34] unless fuel economy standards are already forcing fleet miles per gallon higher than the market would drive it. Current corporate average fuel economy (CAFE) standards do seem to be propping up fuel economy against a market-induced drop. Consequently, small increases in gasoline taxes may be more likely to allow some automakers to stop subsidizing sales of small cars (which they do to comply with the standards) than to actually raise their CAFE levels.

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[33]See C.A. Dahl, "Gasoline Demand Survey," *The Energy Journal*, vol. 7, No. 1, 1986, pp. 67-82.

[34]The elasticity of fuel economy with respect to gasoline price is highly uncertain, because the large changes in fuel economy during the 1970s and early 1980s, which provide the best opportunity to obtain data for computing elasticities, occurred during a period when factors other than current gasoline price probably played an important role in boosting fuel economy. In particular, CAFE standards had been passed and available forecasts predicted astronomical oil prices. Also, U.S. new car fuel economy had declined to very low levels, so that the initial improvements were easy to achieve.

Although there is a substantial range of views about the effect of gasoline taxes on gasoline demand and vehicle efficiency, the primary source of controversy about such taxes is disagreement about their impact on the deficit and on the economy. This disagreement stems from three major sources: failure to account for differences in the actual scenarios being analyzed; analytical uncertainty introduced by the use of different models, parameter choices, and baseline assumptions; and differences in beliefs about the extent to which gasoline is "underpriced" because of externalities and unpriced economic inputs associated with driving.

Any discussion of the impacts of a gasoline tax must recognize that such a tax, *like any tax*, acting alone, will in the short term depress the overall economy, increase unemployment, and reduce gross national product (GNP); after several years, these effects die out. Although there are multiple pathways for these effects, the primary paths include the reduction in gasoline demand and demand for new cars, which cuts jobs and income, and the reduction in aftertax income for people who must buy gasoline, which reduces their demand for most goods and services. These impacts then reverberate throughout the economy.

Gasoline taxes provide revenue, however, and the use to which this revenue is put makes a critical difference in the overall economic impacts of the taxes. This is why evaluation of gasoline tax impacts must be linked to scenarios of how tax revenues are used (e.g., reductions in other taxes, additional expenditures, or deficit reduction; in addition, the Federal Reserve System may accommodate tax changes with changes in monetary policy, and these changes will strongly influence overall economic impacts). For example, if revenues from an increase in gasoline taxes were used to reduce the tax rate on capital investments, the net macroeconomic effect would likely be positive because taxes on investment are particularly distorting to the economy. On the other hand, coupling the tax to a reduction in personal income taxes would likely yield a net negative impact because income taxes do not have large distortionary effects on the economy.

Analytical uncertainty is introduced to estimates of gasoline tax impacts by the use of alternative models. The Energy Modeling Forum at Stanford University has conducted carefully controlled evaluations of alternative model runs that examine the same tax scenario. These evaluations have uncovered large differences in predicted outcomes among the alternative models.

The above factors influence evaluations of the effects of a gasoline tax on quantifiable measures of the health of the U.S. economy. Another indicator of the health of the economy, one that cannot be directly measured, is economic efficiency, which is a theoretical concept of the "goodness" of resource allocation in the economy. As discussed earlier, the presence of externalities and unpriced economic inputs associated with driving leads to an underpricing of driving costs, and thus to more driving and more gasoline use than would be economically efficient. To the extent that a new gasoline tax reduces this underpricing, it will add to the efficiency of the economy; any further increase beyond the point at which gasoline price matches the marginal cost to society would reduce economic efficiency.

A gasoline tax is limited in its ability to compensate efficiently for externalities and unpriced inputs. It tracks well only with greenhouse warming and energy security costs, but quantification of monetary equivalents for these two externalities is extremely uncertain. Other externalities and unpriced inputs, such as congestion delays and unpriced road services, can be addressed more efficiently by means other than fuel taxes, for example, variable congestion charges on roads. According to the social cost estimates prepared for this study, inclusion of greenhouse warming[35] and energy security costs into the cost of gasoline would add approximately $0.15 to $0.80 per gallon to current prices. Thus, if these estimates are correct, additional gasoline taxes of up to $0.15/gallon and perhaps higher would improve overall economic efficiency.

Full Cost Accounting

Although gasoline taxes should be considered a primary option for transportation energy conservation, they are also one component of a broader option, full cost accounting of all transportation modes. As discussed above, full cost accounting attempts to maximize economic efficiency by repricing transportation services so that travelers pay and account for the full marginal cost to society of the transport services they select. Such a system would force travelers to take account of the air pollution (and other environmental effects, and negative impacts on society) that a trip would cause; would force payment for all transport services received (e.g., law enforcement); and would move hidden payments, such as parking costs, into the open so that travelers would account for them.

There is little argument about the clear value of full cost accounting in the abstract, but extensive controversy about the practical aspects of such accounting — the magnitude of externalities and unpriced inputs; the monetary values that should be placed on various externalities; the appropriate methods for implementing required price changes; and the likely impacts of price changes on travel behavior.

As noted, gasoline taxes could serve well to "internalize" the external costs associated with energy security and greenhouse warming because these effects vary with gasoline consumed, and thus with gasoline taxes collected. A variety of options exist to incorporate other externalities, unpriced inputs, and other ignored costs into the transportation price structure. For example, congestion pricing with electronic scanning of vehicles can be used to internalize the externalities associated with highway congestion. Parking costs can be "charged" to commuters by requiring

[35]Global warming cost estimates should be considered particularly speculative.

firms to offer a cash option as an alternative to free parking. The costs of currently subsidized services — police and fire protection, for example, and a portion of local road building — can be translated into travel charges, although matching the nature of the services to an appropriate collection mechanism will be difficult. And the external costs of accidents can be added to driving charges by stricter requirements for insurance coverage or by incorporating a portion of insurance costs into fuel prices, vehicle registration fees, or other charges, thereby decreasing the incidence of uncompensated accident victims.

Automobile and Light-Truck Fuel Economy Standards[36]

Because light-duty vehicles — automobiles and light trucks — consume more than 50 percent of all transportation energy and 70 percent of energy from all motor vehicles, raising fuel economy standards for new light-duty vehicles is an obvious candidate for part of a national conservation strategy. The earlier legislative debate on new standards focused on a number of critical issues: the effectiveness of a regulatory approach to increasing fuel economy; achievable fuel economy levels; the most effective format for a new standard; timing of implementation; potential adverse effects on auto safety; effects on employment; and the likely fuel use reductions that would occur if standards are implemented. Each of these issues has generated substantial controversy.

Arguments about the effectiveness of new standards tend to revolve around perceptions about the actual impact of the 27.5 mpg standard (for automobiles only) set in 1975. Claims and counterclaims have been made about whether the large gains in U.S. fleet fuel economy in the 1970s and early 1980s[37] were a response to the standard or to changed market conditions. "Proof" of either side of the argument is elusive, but the sharply different fuel economy trends of companies that were either constrained or not constrained by the standards are persuasive that the past standard was a critical factor in the fleet's improvement.

The range of estimates for an "achievable" level of fuel economy over the next decade or so has been very wide, with domestic automakers arguing that future gains will at best be small and incremental, and conservation groups arguing that gains of 40 to 50 percent over current levels are readily achievable soon after the turn of the century. OTA concluded in 1991 that U.S. new car fleet fuel economy levels of about 33 mpg could likely be achieved soon after the turn of the century, with

[36]For more details, see U.S. Congress, Office of Technology Assessment, *Improving Automobile Fuel Economy: New Standards, New Approaches*, OTA-E-504 (Washington, DC: U.S. Government Printing Office, October 1991).

[37]U.S. new car fleet fuel economy rose from 17.2 mpg in 1976 to 27.9 mpg in 1986.

additional vehicle costs balanced by oil savings[38] and few measurable safety consequences (no downsizing would be necessary), but (probably) some limits on performance. Fleet levels of about 35 or 36 mpg were projected to be achievable in the same time frame with little technical risk and no forced early retirement of model lines but with costs that would not be recouped by fuel savings alone. During the nearly 3 years since these estimates were made, U.S. new car fleet fuel economy has not improved, and average vehicle weight has risen. Taking this into account, an updated estimate would likely project potential attainment of 33 mpg (at full cost recovery) or 35 to 36 mpg (cost recovery at $2 per gallon gasoline) by 2004 or 2005.[39]

The potential for light trucks is somewhat less than for automobiles. Recent analysis of light-truck fuel economy projects that the domestic light-truck fleet could achieve about 23 mpg by 2005 with additional vehicle costs balanced by oil savings, and about 26 mpg by the same date with application of all available fuel economy technologies but no forced early retirements.[40]

Justification for the higher targets for both automobiles and light trucks would presumably be based on a belief that further fuel savings will yield added societal benefits in the form of lower greenhouse emissions, national security benefits from reduced oil imports (for the United States), and environmental benefits from lower oil production that are not incorporated in the price of oil.

The above increases in fleet fuel economy are based on application of well-known technologies and designs. New technologies, not yet introduced commercially into the fleet, could begin to play a significant role within the same time frame. The potential for these technologies is discussed below.

If more stringent standards are to be imposed on new automobiles and light trucks, lawmakers will have to give serious consideration to the appropriate format for new standards. The current uniform 27.5 mpg standard for automobiles, applied separately to domestic and imported fleets for each company, has created large marketplace distortions by ignoring differences in the mix of vehicles manufactured

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[38]If gasoline prices in year 2001 were $1.50 per gallon (1991 dollars). Office of Technology, op.cit., footnote 6.

[39]Full cost recovery would occur if gasoline prices rose to $2 per gallon by 2001. In comparison, the National Research Council (NRC) projected a "practically achievable level" of 31 to 33 mpg for 2001 using similar assumptions; the most appropriate value for comparison to OTA's projection appears to be the lower value, NRC's "high confidence" level.

[40]Energy and Environmental Analysis, Inc., "Domestic Manufacturers Light Duty Truck Fuel Economy Potential to 2005," paper prepared for Oak Ridge National Laboratory, July 1993.

by each automaker and by allowing gaming between domestic and imported fleets.[41] In particular, the uniform standard offers substantial market advantages to makers who have focused on smaller cars (e.g., the Japanese automakers), by leaving these makers relatively unconstrained. Lawmakers might consider standards that vary with the average attributes of each automaker's fleet, so that each company's fuel economy target bears some relationship to the true technical potential of the vehicles it manufactures. Attributes such as interior volume, "footprint" (wheelbase x track width), or even combinations of weight, engine torque, and interior volume might be appropriate candidates for such a standard. New standards for light trucks might deal with different categories of trucks individually — for example, basing standards for passenger vans on interior volume and standards for pickup trucks on load carrying capacity. Design of appropriate standards for the light-truck fleet will be a special challenge for regulators.

A centerpiece of recent congressional debates about new fuel economy standards has been concern about effects on vehicle safety, with the chief concern being the potential for forced downsizing of vehicles and an accompanying increase in injuries and fatalities from higher incidence of vehicle rollover or other causes. The potential for adverse safety consequences from either downsizing or downweighting is a legitimate concern. Although 10 year fleet fuel economy gains of 30 percent or so are feasible *without* downsizing, and market forces would appear likely to weigh against downsizing, there are no guarantees that automakers would not choose this course; further, moderate reductions in weight (a few hundred pounds would be likely) might have some adverse safety consequences. Also, requiring gains greater than 30 percent in this time frame, or a shorter schedule for required gains, could create severe pressure to downsize the fleet, with likely adverse safety consequences. On the other hand, measures are available to mitigate safety problems, including small increases in track width to reduce rollover risks, universal application of antilock brakes, and enhancement of interior padding to prevent head injuries.

Another strong concern of lawmakers has been the potential employment consequences of new standards. Clearly, standards that can be achieved only by severely compromising consumer amenities could adversely affect sales and have an unfavorable impact on industry employment. However, there is no indication that standards at the levels discussed would hurt domestic automakers' competitive position or strongly affect their sales.

Analyses by both the industry and the conservation community have concluded that new standards would have strong employment impacts. However, competing analyses drew sharply different conclusions: the industry's analysis projected large

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[41]For example, by shifting the manufacturing location of a few parts, automakers have changed vehicle designations from "import" to "domestic" or vice versa when this would ease their compliance requirements.

job losses, and the conservation community's analysis projected large job gains. OTA found that both projections were driven more by their starting *assumptions* than by objective analysis.[42] The only defensible conclusion is that oil savings from new standards, like oil savings from any source, will tend to have positive impacts on national employment because the oil backed out of the economy will likely be imported oil, which generates fewer jobs per dollar spent than most other expenditures.[43] However, this is only one of several sources of employment impacts from new standards. Depending on the cost of required changes in auto design and the gasoline savings achieved, consumers may have more or less to spend on other goods and services, which would affect nonindustry employment; and net auto sales as well as auto manufacturing productivity rates might change, which would affect industry employment. These impacts could be negative or positive.

Finally, there has been considerable debate about the likely fuel savings associated with new standards. Most of the debate has been centered around Senate Bill S. 279, which required each company's fleet to improve by 20 percent for 1996 and 40 percent by 2001. Most differences in estimates occurred because of differences in assumptions about the likely values of fuel economy that would occur *without* new standards; the likely use of alternative fuel credits by automakers; the magnitude of any increase in driving because of reduced "per mile" fuel costs associated with higher efficiency autos; and the likely magnitude of future growth of vehicle miles traveled. Two estimates that can serve as "outliers" are the Department of Energy's estimate of 1 mmbd saved by 2010, and the American Council for an Energy-Efficient Economy's estimate of 2.5 mmbd saved by 2005. OTA estimates that the most likely savings from compliance with S. 279 would be about 1.5 to 2.2 mmbd by 2010, *if compliance does not significantly hurt new car sales.*

"Feebates": An Alternative or Complement to Fuel Economy Standards

"Feebate" plans offer a market substitute for, or supplement to, new fuel economy standards. Feebate plans involve charging fees to purchasers of new cars that have low fuel economy[44] and awarding rebates to purchasers of new cars with high fuel economy. The plans can be designed to be revenue neutral or revenue generating, but their general purpose is to provide an incentive for consumers to purchase efficient vehicles and for manufacturers to produce them. Feebates avoid the danger inherent in CAFE standards: that the estimated costs and fuel economy benefits of available technologies are too optimistic, so that complying with the standards will

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[42]Although the conservation community's analysis, conducted by the American Council for an Energy-Efficient Economy, made much more use of economic analysis in its projection.

[43]In other words, a dollar *not* spent on imported oil costs fewer jobs than are added by spending that dollar elsewhere in the economy.

[44]Measured against the average for all cars, or for cars in that class, or some other value.

end up costing much more than expected. Also, unlike CAFE standards, feebates provide continuing incentives to improve fuel economy beyond the level initially desired by rewarding the deployment of new, unforeseen technologies. On the other hand, leaving fuel economy results entirely to the market runs the risk that the actual improvements obtained may be considerably less than hoped for. In OTA's view, the potential for error in projecting the costs and benefits of feebates is quite high. Attempting to predict the actions of auto manufacturers in a free market adds considerable uncertainty to an analysis of fuel economy potential — beyond the important uncertainties in technology costs and benefits inherent in OTA's analysis of CAFE standards.[45]

Recent analyses by Lawrence Berkeley Laboratory (LBL) conclude that feebates large enough to award a $500 differential between a 20 mpg and a 25 mpg car can achieve a significant new car fleet fuel economy increase — 15 percent over expected levels by 2010.[46] Virtually all of this improvement is expected to come from manufacturer responses to feebates, with changes in consumer behavior contributing little. If this analysis is correct, feebates will have an impact similar to CAFE standards aimed at the same 15 percent improvement, although with more flexibility for manufacturers but less certainty of attaining the desired improvements in fuel economy. The dominance of the manufacturer response implies, however, that small-scale programs (e.g., programs conducted by one or a few small states) are unlikely to have much effect because they would be unlikely to affect manufacturer decisions.

An important concern of feebates is the possibility that they would provide an advantage to foreign automakers, because foreign companies, especially the Japanese, tend to have higher CAFE levels than U.S. automakers. The LBL analysis concludes that foreign automakers will gain more rebates than U.S. manufacturers, although this effect would diminish over time. Basing the feebate system on car size would diminish the adverse impact on U.S. companies, because much of the difference between the U.S. fleets and the Japanese fleets is due to the larger average size of U.S. cars. However, LBL concludes that this type of feebate yields considerably less improvement in fuel economy than a feebate that allocates fees and rebates based only on fuel economy.

Transportation Demand Management Measures

Both the Clean Air Act Amendments of 1990 and ISTEA include requirements for programs that improve transportation efficiency by reducing traffic volume, especially during peak travel times. These transportation demand management measures

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[45]Office of Technology Assessment, op. cit., footnote 2.

[46]Using the same estimates of technology costs and fuel economy improvements that OTA used to evaluate CAFE standards.

(TDMs),[47] including parking charges, high-occupancy vehicle (HOV) lanes, and intelligent vehicle highway systems (IVHS), could play an important role in a national conservation strategy. (In essence, many TDM measures are similar or identical to measures that would form the basis for full cost accounting). Although few analysts expect any particular TDM to make great inroads in fuel use, especially because of likely political limitations on the severity of incentives considered, fuel savings of several percent may be possible from an intensive program combining a variety of such measures. Unfortunately, the limited number of trials of TDM measures and the diversity and complexity of travelers' reactions to them imply that policymakers must accept considerable uncertainty in gauging their likely impacts. Some promising or prominent measures include:

1. *Pricing Parking*: Parking charges would be one of the largest and most visible costs of commuting and other local travel if most travelers paid them, but 90 percent of commuters receive free parking. Asking employers to offer workers a cash alternative to free parking (i.e., either parking or cash, at their choice) or otherwise providing a market incentive not to park appears to have substantial potential to reduce vehicle work trips.

2. *Congestion Pricing*: Placing electronic tolls on heavily traveled roads during peak periods should both reduce total trips and displace trips out of peak periods, when congestion makes them inefficient. Although congestion pricing is economically efficient because it asks travelers to pay for costs they impose on others, the substantial magnitude of the per mile charges needed to make significant inroads on traffic volumes (estimated to be as high as $0.65 per mile in California's urban areas) represents a powerful roadblock to implementation.

3. *Telecommuting*: The growth of information-oriented service industries and simultaneous radical improvements in telecommunications capabilities may allow growing numbers of workers to "telecommute" from home or satellite offices, thereby avoiding long commutes. Currently, between 2 million and 8 million workers telecommute,[48] and the Department of Transportation projects that as many as 15 million workers could telecommute by 2002. Although all such estimates are highly uncertain, the potential clearly is large, with accompanying energy savings of more than 1 billion gallons of gasoline per year at the upper end.

4. *High-Occupancy Vehicle Lanes*: HOV lanes are freeway lanes restricted during peak hours to vehicles containing two or more passengers. They provide an encouragement to car-pooling, as well as providing some potential congestion

[47]Or transportation control measures (TCMs).

[48]The range reflects the severe lack of data.

relief — and increased efficiency — to the remainder of the roadway (unless they are conversions from previously unrestricted lanes, in which case their effects on congestion depend on circumstances). There is controversy about the ability of new HOV lanes to reduce overall vehicle miles of travel and energy use, because the added roadway capacity and reduced congestion will stimulate additional travel, canceling some of the benefits from increased ride sharing.

5. *Intelligent Vehicle Highway Systems*: IVHS encompasses a range of systems that can provide services from timely information to drivers about congestion and alternative routes to fully automated control of vehicles on limited access roads. ISTEA authorizes several hundred million dollars for IVHS development. These systems should have substantial potential to relieve congestion in crucial corridors. The ability of IVHS to reduce overall energy use is more problematic, however, because the energy saved by reducing congested (and inefficient) traffic flow must be balanced against any increased energy use from additional travel stimulated by increased road capacity.

Public Transportation

Whether public transportation is a key to revitalizing U.S. central cities and substantially reducing automobile use or has only minor relevance to future transportation policy is an ongoing argument in the transportation community. This is largely an argument between the hoped-for potential of public transportation and the disappointing record of its actual performance in the United States; it is also an argument about unpaid for costs and unaccounted for benefits.

There may be many local success stories of U.S. public transportation, and the central business districts of many American cities could not survive in their present forms without mass transit; yet for the past several decades, transit has shown a disturbing trend toward increasing costs and declining market share despite heavy subsidies. Labor productivity, for example, fell sharply during 1960-85, although it has rebounded a bit during the past few years. Similarly, per mile labor costs rose by 80 percent *after inflation* from 1965 to 1983, with relative stability since then. With higher operating costs and reluctance to raise fares because of declining patronage, transit subsidies have risen. Local, state, and federal governments now pay about 57 percent of transit operating costs and almost 100 percent of capital costs. This means that on capital-intensive systems (e.g., heavy rail systems such as Atlanta, Washington, DC, Buffalo), ticket prices may be paying for only 10 or 20 percent of total costs, with governments picking up the rest.

Aside from high costs, it also is not clear that most U.S. transit systems *in their present form* are saving much energy. From 1970 to 1989, both bus and rail transit energy intensity (fuel use per passenger mile) increased substantially: buses by 70 percent, primarily because of lower load factors, growing urban congestion, and greater orientation to suburban services that require more nonrevenue backhauls; and rail systems by 38 percent, at least in part because a number of new systems were added that are faster and tend to operate at lower load factors than earlier ones. Right now, *on average* there is little difference between auto efficiency and public transportation efficiency in Btus per passenger mile.[49] Unfortunately, obtaining a fair comparison between auto and transit energy intensity is quite difficult, requiring an accounting of trip circuity;[50] energy built into capital structures; trips used to access mass transit; appropriate auto load factors, given not only the type of trip but the characteristics of those auto users who are potential transit users; travel conditions (e.g., congestion); and transit system characteristics. Automobiles may in some instances be more energy efficient than mass transit.[51] This does not imply, of course, that transit systems cannot save considerable amounts of energy under the right circumstances: high load factors for the transit system; private vehicles operating in congested conditions, often with single occupancy; transit operating on its own right of way or lane, or sharing an HOV lane.

Urban Planning

The potential of public transportation cannot be discussed properly without simultaneously discussing the role of urban form in shaping transportation patterns and energy use. It is clear from evaluation of urban areas worldwide and within the U.S. that residential density, as well as other urban characteristics such as centralization and mix of land uses, plays a crucial role in both the amount of per capita travel and the mode chosen. Cities with high residential densities (greater than 12 persons per acre), a strong central focus, and an intertwining of residential and commercial land uses tend to have both low overall per capita travel and relatively high use of public modes of transportation, as well as walking and bicycling, compared with cities with lower densities, lack of centralization, and separated land uses. Other urban characteristics that are strong indicators of both travel and mode choice are the relative volume of roadway and the volume of parking spaces per 1,000 vehicles. Given these relationships, many in the environmental community wish to consciously reshape American cities to make them more compatible with transit, bicycling, and walking, and to greatly reduce the travel necessary for access to employment, recreational, and cultural opportunities.

The urban characteristics discussed above are the result of both immutable factors — the cities' wealth and its distribution, their history (especially when they experienced their major growth), and their geography — as well as factors that are controlled by

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[49]Davis and Strang, op. cit., footnote 3, table 2-13.

[50]Trip circuity is the degree to which a trip between origin and destination diverges from the shortest path between the two.

[51]For example, in car pools, or more generally, when transit load factors are low.

governments, such as road building policies, housing policies (including tax breaks afforded private dwellings), parking requirements, and land use planning controls. The precise role of the various forces is still the subject of considerable debate, with environmental groups stressing the role of policy and pro-development groups stressing the role of factors not controllable by policy. In reality, however, even those factors theoretically controllable by policy have become embedded in the American political system and are difficult to change. A few U.S. cities have made serious attempts to change some of these factors, however — Portland, Oregon being one of the most widely known[52] — but the results are not yet evident. And even these cities can change only some factors; other important matters, such as mortgage interest exemption and a tax policy that treats free employee parking as exempt from taxation, are controlled by the federal government. What this implies is that a serious effort to shift land use patterns into forms more compatible with reduced travel and greater use of transit, bicycling, and walking will require strong efforts at all levels of government, that changing the necessary policies will be politically difficult, and that the results, in terms of actual changes in land use, are uncertain. Without a coordinated effort of this sort and a successful shift to denser land use patterns, however, it is difficult to imagine any kind of revitalization of public transportation in this country, regardless of the investment capital poured into new systems.

A corollary to the idea of changing land use to revitalize transit and reduce travel demand is that of installing transit systems to shape land use. Unfortunately, although it is clear that introduction of rapid transit systems can have large effects in the immediate locality around stations, there is little indication that such systems have had much effect on urban structure, at least over the past few decades. This lack of a strong, measurable impact implies that access to a transit system, although certainly a factor in determining locational decisions for new development, is only one of many such factors. Building a transit system can be part of a multifaceted strategy to affect land use, but it is unlikely to do much in relative isolation.

This conclusion is disputed by some environmental organizations, which maintain that comparisons of travel behavior and land use density across areas with different levels of transit service show clearly that such service creates higher densities of land use and reduces per capita levels of travel. Were such an effect to occur, transit evaluations should properly count the induced reductions in travel — as a direct benefit of transit. OTA's evaluation of the available studies indicates, however, that

[52]Portland has established an Urban Growth Boundary to direct development into the city rather than its suburbs; prohibited automobiles in a key downtown corridor served by bus transit; restricted parking spaces incorporated into new office development; and developed a light rail system. The city has thus far obtained good results regarding traffic volume and transit share for a small downtown area but, as a whole, has seen both a loss in transit share and a large increase in single occupancy vehicles from 1980 to 1990.

they are not adequate to demonstrate such an effect: they generally do not show changes over time, do not account sufficiently for demographic differences between areas with differing land use, fail to distinguish among different trip purposes, and cannot prove cause and effect. However, the positive relationship between good transit service and dense land use, on the one hand, and lower levels of travel, on the other, does lend weight to the argument that policies aimed at *both* increasing transit service and increasing land use density, if successful, would likely reduce travel and should be credited with this reduction in a cost-benefit analysis. Further study is needed to define the likely magnitude of such an effect, however.

High-Speed Intercity Public Transportation

Only 1.2 percent of all person trips are at least 75 miles in length, but these trips represent more than one-quarter of all person miles of travel. For trips from 100 miles (below which autos can be expected to continue their dominance) to about 500 miles in length (beyond which air travel should continue dominance), investments in high-speed ground transportation (HSGT) systems capable of speed around 200 mph or faster — rail or maglev[53] — represent an option to relieve congestion in both auto and air modes and possibly (depending on system characteristics) to save energy (and reduce oil use). In fact, proposals have been made to install such systems in a number of U.S. inter-city corridors, including Miami-Orlando-Tampa, Cleveland-Columbus, San Diego-Los Angeles-San Francisco-Sacramento-Reno-Las Vegas, Atlanta-Columbus/Macon-Savannah, and the Northeast Corridor (Boston-New York City-Washington, DC). The Transportation Research Board has found that further testing and development are necessary for maglev systems to prove they can operate safely and reliably in revenue service; European high-speed rail systems operating at speeds approaching 200 mph are firmly established.[54]

Although high-speed rail systems have been successful in Europe and Japan, this does not automatically demonstrate their applicability to U.S. conditions. The United States has some key disadvantages — less densely populated intercity corridors, with major cities farther apart; lack of preexisting heavily traveled rail links; lack of well-established intracity trains in most destinations; and availability of competitively priced air shuttle services. Further, much of the current and projected airport congestion is due to airline management decisions favoring hub-and-spoke operations, and is not entirely a function of physical capacity. Thus, the extent of future airport congestion, which is a key argument in favor of intercity high-speed rail, is somewhat in question.

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[53]Maglev systems are trains that operate suspended in air on fixed, dedicated guideways, held up by magnetic forces and propelled by linear electric motors.

[54]Transportation Research Board, *In Pursuit of Speed: New Options for Intercity Passenger Transport*, Transportation Research Board Special Report 233 (Washington, DC: National Research Council, 1991).

Available analyses indicate that new HSGT systems would likely require strong government capital subsidies to maintain financial viability. With full capital subsidies (which new urban rail transit systems have received), operating and maintenance costs for new systems should be low enough to allow them to compete well with air and low-occupancy auto travel. Without such subsidies, annual ridership levels would have to be at least 2 million, and most likely about 6 million passengers (high estimate: 17 million passengers per year), for the systems to break even. By 2010, only four city pairs are expected to have total air ridership exceeding this mark — Los Angeles-San Francisco, Boston-New York, Washington, DC-New York, and Los Angels-Phoenix. Although maglev costs are quite uncertain because full-scale systems have not been built, early analyses imply that they would have a more difficult time breaking even without subsidies; OTA has found that the infrastructure costs of a maglev system for the Northeast Corridor would be approximately double those of a high-speed rail system.[55]

The keys to the future success of HSGT systems, if they are built, will be the extent of congestion growth in both road and air modes (available forecasts for both modes have large uncertainties), the level of subsidies federal and state governments are willing to extend (which depend, in turn, on the value society places on the oil displacement, congestion relief, and other societal costs reduced by use of the systems), and the response of competing modes.

Improving Auto Fuel Economy: Moving Beyond Current Technology

Recent congressional deliberations about fuel economy standards have focused on relatively evolutionary improvements in automobile design, on moving available fuel efficiency technologies widely into the fleet, and on a short-term (10 to 15 years) time horizon. Another potential direction for fuel economy improvements is a radical shift in technology and design, possibly including a change in basic powerplant. Such a direction is embodied in calls for the introduction of "supercars," extraordinarily light-weight, electric-hybrid-powered vehicles, by the conservation community[56] and in a recent announcement by the Administration and the three domestic automakers of a partnership to develop a new passenger car with up to three times the fuel efficiency of current autos.

The basic features of an advanced automobile, one that went well beyond current technology, might include:

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[55]U.S. Congress, Office of Technology Assessment, *New Ways: Tiltrotor Aircraft and Magnetically Levitated Vehicles*, OTA-SET-507 (Washington, DC: U.S. Government Printing Office, October 1991).

[56]See A.B. Lovins et al., Rocky Mountain Institute, "Supercars: The Coming Light-Vehicle Revolution," unpublished report, Mar. 31, 1993.

- A shift in body materials, probably to carbon-fiber or other composite materials, with higher materials costs counteracted by greatly reduced assembly costs;

- A total dedication to streamlining, bringing the vehicle's drag coefficient down to the range of 0.2 or lower, compared with the current commercial state of the art of about 0.3;

- High-pressure, low-rolling resistance tires, perhaps similar to those in General Motors' Impact electric vehicle;

- An advanced engine, probably either a super-efficient four-stroke design with four or more valves per cylinder, adjustable valve lift and timing, and other low-friction measures or a two-stroke design; and

- Extensive use of aluminum and other light-weight materials in suspension and other components (e.g., brake rotors and calipers, sway bars, wheels).

Rather than an advanced internal combustion engine, a radically redesigned automobile might use electric motors powered by batteries or fuel cells, or a hybrid combination including batteries and a motor/generator (or one of a variety of other combinations of power sources, including flywheels).

Recent strong technical advances have placed such an automobile closer to reality, although still a considerable way from commercialization. Some important advances are small, light-weight direct-current inverters that allow use of highly efficient, light-weight alternating current motors; and a 40-fold reduction in the amount of platinum required in proton-exchange membrane fuel cells, moving platinum availability and costs into the "realistic" range. Not surprisingly, there remain a number of crucial technical hurdles: improving the manufacturability and reducing the cost of advanced materials; designing adequate safety systems for a vehicle in the 1,000 pound range; achieving major improvements in fuel cell and battery technology; and so forth.

Thus far, the major "driver" for the development of advanced light-duty vehicles has been California's zero emission vehicle (ZEV) requirements, which require automakers to achieve at least 2 percent of their in-state sales with vehicles emitting no criteria pollutants by 1998, and 10 percent by 2003 (some northeastern states have adopted identical requirements). These vehicles will almost certainly be electric. The ZEV requirements have succeeded in stimulating a major research effort to develop electric cars; the eventual success of the requirements in bringing commercially acceptable electric cars to the marketplace remains an open question, however.

On September 29, 1993, the President announced a "Clean Car Initiative" with the three domestic auto manufacturers. The initiative has as a primary goal the development of a manufacturable prototype automobile within 10 years that achieves a threefold increase in fuel efficiency while maintaining the affordability, safety standards, performance, and comfort of today's cars. This joint government-industry research program may add to the impetus for a large improvement in light-duty vehicle efficiency.

Shifting to Alternative Fuels[57]

The use of alternative, nonpetroleum-based fuels in vehicles, though generally viewed as a fuel substitution measure, also offers opportunities to reduce overall energy use and greenhouse emissions; in other words, alternative fuels can play a role in energy conservation. Energy savings may be gained from changes across the entire fuel cycle, ranging from changes in fuel efficiency at the vehicle[58] to changes in the energy required to find, collect, and transport fuel feedstock materials. Greenhouse gas emission reductions may be obtained directly from the energy savings and also from differences (from gasoline) in the alternative fuels' carbon content and general chemical makeup, which yield different fuel cycle emissions of carbon dioxide and the other greenhouse gases (carbon monoxide, nitrogen oxides, nitrous oxide, methane, etc.).[59]

The primary alternative fuels under consideration for use in light-duty vehicles are the alcohols methanol and ethanol, natural gas, liquefied petroleum gas (LPG), hydrogen, and electricity. Except for electricity, all the fuels can be used in internal combustion engines. Hydrogen also can be used in fuel cells.[60] Methanol and natural gas, which are hydrogen-rich, can act as hydrogen carriers for fuel cells.[61]

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[57]For more details, see U.S. Congress, Office of Technology Assessment, *Replacing Gasoline: Alternative Fuels for Light-Duty Vehicles*, OTA-E-364 (Washington, DC: U.S. Government Printing Office, September 1990).

[58]Because the alternative fuels have different combustion characteristics (e.g., methanol's octane rating is 101.5 and natural gas' is 120 to 130 versus 87 to 93 for typical gasolines; this allows methanol and natural gas engines to use higher compression ratios, raising thermal efficiency) and may require basic shifts in the drive train and fuel storage systems (e.g., electricity demands the use of electric drive motors and battery of ultracapacitor storage).

[59]See M.A. DuLuchi, *Emissions of Greenhouse Gases From the Use of Transportation Fuels and Electricity*, ANL/EDS-TM/22 (Argonne, IL: Argonne National Laboratory, 1991). This report presents detailed estimates of the greenhouse emissions for each portion of the fuel cycle for a variety of alternative fuel/vehicle/supply source combinations.

[60]Fuel cells are electro-chemical devices that convert hydrogen into electricity without combustion and with water as their only byproduct, acting like batteries that have continual recharge of their chemical electrolyte.

[61]However, use in fuel cells of hydrogen carriers rather than pure hydrogen requires the addition of an onboard reformer to first release the hydrogen from these fuels. Although the fuel cell has no air emissions, the reformer does, so a fuel cell vehicle with a hydrogen-carrier fuel will not strictly be a zero emission vehicle.

Several factors inhibit the introduction of these fuels into the marketplace: the entrenchment of gasoline in the light-duty vehicle market; the lack of supply infrastructures and mature vehicle technologies for most of the alternative fuels; and various cost and range problems.[62] The Energy Information Administration expects, however, that a range of government incentives will help alternatively fueled light-duty vehicles capture from 1.9 to 2.4 percent of the light-duty vehicle fuel market by 2010.[63] These incentives include the 1990 Clean Air Act Amendments (CAAA), which establish a set of lean fuels requirements; the State of California's Low Emission Vehicle Program under CAAA, which requires minimum sales of vehicles in different emissions categories, including the 1998 2 percent ZEV sales mandate discussed earlier; and alternative fuel fleet requirements and tax incentives under the Energy Policy Act of 1992. Vehicle manufacturers can also get fuel economy credits toward meeting their CAFE requirements by manufacturing alternative fuel vehicles. Because most automakers can comply with current CAFE standards without a great deal of difficulty, the availability of the credits may have little effect unless CAFE requirements are raised.

Government incentives for alternative fuel use hinge on three potential benefits: energy security and economic benefits from reducing oil use and imports; air quality benefits, especially from reduced emissions of ozone precursors; and greenhouse benefits from reduced fuel cycle emissions of CO_2 and other greenhouse gases. The likelihood that these benefits will actually be obtained is mixed and uncertain, however. Take energy security, for example. Although all of the alternative fuels will substitute for oil, some raise their own security concerns because they may be imported (e.g., methanol if U.S. natural gas prices were to rise,[64] LPG in large quantities). These concerns may not be as severe as those associated with oil imports, however; feedstock resources, e.g., natural gas, tend to be less concentrated geographically. Security benefits also will depend on market penetration (which will affect fuel supply sources and costs) and other factors that are uncertain. And the existence of fuel economy credits adds uncertainty to security benefits. Were CAFE standards to be raised, automobile manufacturers might choose to use credits from sales of alternative fuel vehicles to avoid some of the fuel economy improvements otherwise required by the standards; the oil use reduction benefits of the alternative fuels might then be at least partially offset by the loss in efficiency gains.

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[62]All of the alternative fuels are less energy-dense than gasoline, and thus need a higher volume of fuel to achieve an equivalent range.

[63]U.S. Department of Energy, Energy Information Administration, *Assumptions for the Annual Energy Outlook 1993*, DOE/EIA-0527(93) (Washington, DC: January 1993).

[64]Methanol would likely be produced primarily in the U.S. and Canada at current gas prices; at higher prices, overseas production would be more likely, though some analysts believe there would still be potential for domestic methanol production as a byproduct of steel production, assuming shifts in steel production technology to allow co-production of pig iron and methanol.

Air quality benefits depend on the nature of emission standards promulgated for alternative fuel vehicles and on the tradeoffs vehicle designers make among factors such as emissions, vehicle performance, and fuel economy. Where regulators try to adjust standards so as to weight emissions according to their potential to impact air quality, as California is doing, the emissions from vehicles using gasoline, methanol, natural gas, and other alternative fuels in internal combustion engine vehicles may be similar; only electricity and hydrogen, and methanol and natural gas in fuel cell vehicles, would then enjoy a clear emissions advantage.[65] Finally, greenhouse benefits depend on a variety of system design details, including choice of feedstocks, tradeoffs in conversion facility energy efficiency between capital and operating cost, and vehicle design decisions, as well as the uncertain progress of immature technologies. In the near term, any greenhouse benefits are likely to be small and easily lost (though early growth of alternative fuels use may lay the groundwork for later benefits); large greenhouse benefits will come when renewables provide the majority of the feedstocks or when design decisions are controlled by strong incentives to reduce greenhouse emissions from the entire fuel cycle.

Two important issues facing federal policymakers involve fuel taxation policy and the current federal policy of fuel neutrality. Currently, federal taxation of alternative fuels seems at odds with interest in promoting fuels such as methanol and in maintaining a "level playing field" among competing fuels. Electricity, for example, pays no federal highway tax, and natural gas pays very little, whereas LPG and methanol pay higher taxes than gasoline (on a $/Btu basis). Although it may make sense to tax different fuels at different rates based on their perceived benefits, current rates seem to bear no relation to federal goals. Congress might consider adjusting tax rates to establish either a uniform tax (per unit energy) among competing fuels or a differential tax weighted according to emissions benefits or other perceived benefits.

Current legislation (especially EPACT) provides large economic incentives (thousands of dollars per vehicle) to alternative fuels with little regard to any differences among the various fuels in their likelihood of satisfying environmental or other federal goals. Some types of alternatively fueled vehicles likely to enjoy success in the marketplace may, however, provide benefits that are significantly inferior to those provided by other vehicles.[66] At some point, perhaps when the environmental and energy security attributes of various vehicle/fuel combinations become clearer, Congress may want to reconsider the current policy of fuel neutrality (among the competing alternative fuels) in awarding incentives.

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[65]See D.E. Gushee, Congressional Research Service, "Alternative Fuels for Automobiles: Are They Cleaner than Gasoline?" report for Congress, 92-235 S, Feb. 27, 1992.

[66]For example, a flexibly fueled vehicle, fueled by gasoline, M85 (a mixture of 85 percent methanol and 15 percent gasoline), or any mix of the two will likely yield significantly smaller air quality benefits than a dedicated methanol vehicle.

FREIGHT POLICY

The future potential for energy conservation in the freight sector lies largely in reducing truck energy use, because trucks consume the major part of U.S. freight energy (more than 80 percent) and because truck mileage is expected to grow rapidly — about 2 percent per year in the EIA forecast, and, in OTA's opinion, probably somewhat faster. The technical measures available include improvement in truck fuel economy — both for new trucks and, with retrofit technology, for the fleet as a whole (including improvement in driver skills); shifting to alternative modes and intermodalism (linking with other modes); and changes in operations to reduce waste.

Tests of the most energy-efficient new trucks under optimal driving conditions for high efficiency have achieved fuel economies 50 to 70 percent above the current fleet average efficiency. Similar tests of prototype trucks have achieved fuel economies over twice the current fleet average. Although real-world operating conditions, including average rather than optimal driving skills, would yield reductions in these efficiency advantages, the test results do suggest that there is a considerable energy savings potential from using commercially available and new technologies. Thus, a key to improving the efficiency of the fleet is both to encourage purchase of the most efficient vehicles and to speed up turnover, which is slow. Policy options to raise new truck fuel economy include fuel taxes, fuel economy standards, feebate programs, and government purchase programs; measures to encourage turnover include fuel taxes, retirement programs, and tax code changes.

Both fuel economy standards and feebate programs will encounter difficult technical problems because the great variety of truck types and cargo confounds efforts to establish fair efficiency goals for trucks and to appropriately group trucks into classes. Combination trucks pose a special problem for regulation because they are sold as separate trailer and engine units, with the design of each being crucial to fuel economy.

It is sometimes argued that mode shifts from trucks to rail or to barges would save significant amounts of energy since rail and barge shipping appears to be much more energy efficient than trucks. In fact, shippers have found intermodal operations to be very attractive, and this form of shipment has been growing rapidly, with the common form being containers moving from truck to train to truck. Care must be taken not to exaggerate the energy benefits, however: national data suggest that rail movement is 11.5 times as efficient as truck, but not for the same types of cargo. Limited analysis of alternative modes of moving the same cargo over the same routes suggests that trucks use 1.3 to 5.1 times as much energy as do trains. And incorporating the energy embodied in equipment and in getting freight to and from the rail terminal may reduce rail's advantage further, although it still comes out ahead. With the limited portion of freight movement likely to be eligible for shifting to rail, however, total likely savings are in the range of one-or two-tenths of a quad, a few percent of total U.S. freight energy consumption.

POLICY OVERVIEW

Depending on their perception of the urgency of transportation problems and problems associated with urban air pollution, energy security, and greenhouse warming, federal policymakers have a number of choices to make regarding transportation that can be simplified into three basic options:

1. Retention of the status quo, with fine-tuning;

2. An activist approach that focuses primarily on improving technology; and

3. An approach that attempts to move U.S. Transportation gradually away from its dependence on the private vehicle.

A status quo approach might use some moderate regulatory and economic policies to ease transportation problems: new CAFE standards set at levels achievable with available technology; modest gasoline taxes, perhaps $0.25 to $0.50 per gallon but likely lower; encouragement of local transportation initiatives taken in response to Clean Air Act requirements; some increased investment in transit with funds shifted from highway allocations (allowed by ISTEA); and so forth. Under such a scenario, congestion would likely increase, but the marketplace would moderate the increase by forcing changes in business and housing locations and in travel behavior. Cars will become more comfortable and will offer more opportunity for entertainment and work. In particularly congested areas, businesses will establish more use of telecommuting, perhaps by establishing satellite work centers. There would likely be a diversity of solutions to local transportation problems, most of them modest, but some drastic as in Portland, Oregon, a city that seeks to remake itself. Given political realities, most jurisdictions will likely try to satisfy both majority auto-oriented drivers and the conservation-environmental community by improving highways *and* transit services, but the latter is likely to have limited success without more basic changes in the existing incentives for private travel and in urban form.

The "livability" of the results of such an approach is difficult to predict, because analyses that forecast disastrous results invariably ignore society's adjustments to emerging problems. In the absence of technological breakthroughs (e.g., an inexpensive, energy and power intensive battery that allows electric vehicles to compete successfully with gasoline cars), urban pollution levels may worsen or not improve, congestion will probably grow worse (but not by as much as current government analyses predict), most urban centers will likely continue to weaken, and transportation energy use is likely to grow and continue to depend primarily on oil. However, there may be some surprises. If local solutions work well and seem transferable to other areas, they will spread. Simple steps that fit well into this overall strategy might make some inroads into auto use. Two measures that could work are requiring employers to "cash out" parking costs to employees and congestion pricing using electronic sensors (although this measure might more comfortably fit into the next approach).

A "technological fix" approach could make some serious inroads into some important transportation problems, while not affecting others. Such an approach might focus on leapfrogging current automotive technology to achieve very high levels of fuel economy, perhaps twice as high as today's. Government-industry cooperative research programs could also move toward replacing internal combustion engines with electric drives powered by batteries or fuel cells, but strong economic incentives would probably be necessary to make the transition. Investment in IVHS could make moderate inroads in congestion, although probably not in urban centers. It is not clear that the congestion relief offered by such systems would yield better conditions than simply allowing marketplace adjustments, however, because the increased highway capacity such systems create could easily spur travel demand.

In predicting the eventual outcome of this approach, a key unknown is whether travel demand will keep on growing and overwhelm the effects of efficiency or will, instead, reach a plateau or period of very slow growth so that raising efficiency will reduce total energy use.

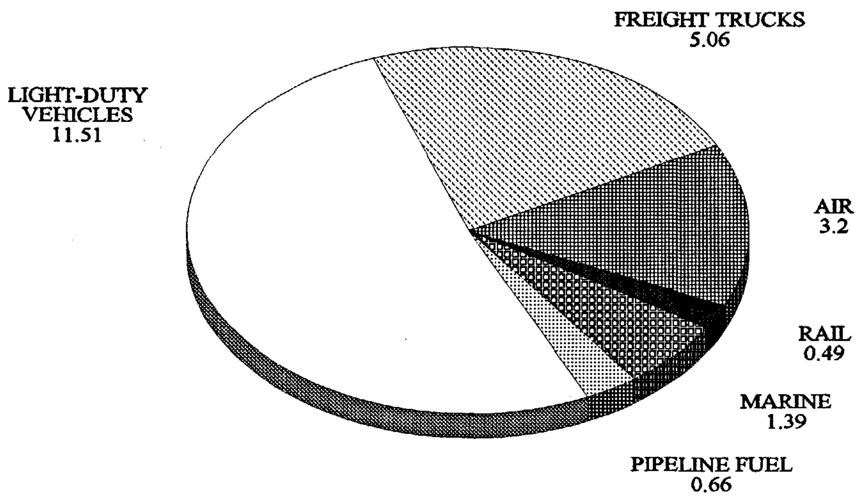
The third approach is to try to shift the U.S. transportation system substantially away from the private automobile, especially in urban areas and for intercity travel. Such an approach could have a chance of success *only* if it followed a multi-pronged strategy of drastically reducing highway building and accepting slower highway speeds; practicing "full societal cost accounting" on automobiles, probably with significant increases in driving costs; redirecting urban structure toward higher density, centralization, and corridor development, with strong limits on parking and limits on suburban/exurban development; and investing massively in existing and new public transportation systems, with high-density mixed-use development focused on station areas.

The goal of such an approach is not only to drastically reduce gasoline use and urban air pollution, but to revitalize American's urban centers, making them places where walking and bicycling to multiple activities are feasible and where urban life is far more vibrant than is possible in most of today's U.S. cities. Whether the measures necessary to follow this approach are politically and socially feasible, and whether the goal is achievable even if such measures are taken, are two critical uncertainties. Many of the measures that would be necessary for this strategy to have a chance for success — especially the strong controls on development and the increased costs of driving — are likely to draw severe opposition. Also the strategy seeks to reverse a process that appears to be going on worldwide, in a country that has a mature infrastructure designed around inexpensive automobile access. Ultimately, whether the goal is achievable even *with* successful implementation of the necessary policy measures depends on the answer to the question raised earlier. Has the past and continuing evolution of our city structures and travel behaviors depended primarily on policy or on technological change, rising income, and other immutable factors, and what will be the future relationships among these variables? Only prolonged experimentation with sharp changes in policy can answer this question.

FIGURE 1

TRANSPORTATION ENERGY USE IN 1990

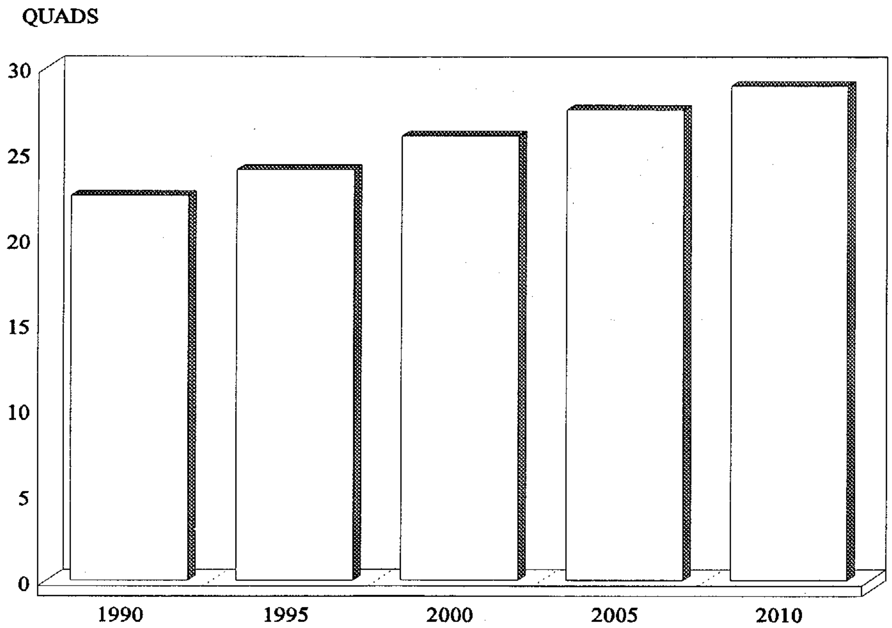
QUADS



Source: Energy Information Administration data

FIGURE 2

EXPECTED GROWTH IN U.S. TRANSPORT ENERGY



Source: U.S. Department of Energy, *Annual Energy Outlook 1993*

CHICAGO-ST. LOUIS HIGH SPEED RAIL PLAN

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The Illinois Department of Transportation (IDOT), in cooperation with Amtrak, undertook the Chicago-St. Louis High Speed Rail Financial and Implementation Plan study in order to develop a realistic and achievable blueprint for implementation of high speed rail in the Chicago-St. Louis corridor.

This report presents a summary of the Price Waterhouse Project Team's analysis and the Financial and Implementation Plan for implementing high speed rail service in the Chicago-St. Louis corridor.

OVERVIEW OF THE PLAN

Most of the proposals for high speed rail systems in the United States have been modelled after the European experience, offering top speeds of at least 150 miles per hour on dedicated right-of-way. These systems are very costly to develop because they require new rights-of-way, extensive new track construction, installation of overhead catenary lines for electric-powered trains, and complete elimination of at-grade road crossings. In Europe, where regional air and automobile travel is more expensive than in the U.S., gasoline is heavily taxed, and populations are more concentrated, the government-owned high speed rail companies have been able to recover much of these high costs through passenger fares.

In contrast to Europe, the United States has different travel patterns, travel costs, and population densities. As a result, the cost of constructing and operating European-type 150+ mph service in the United States is likely to be prohibitive until increased intercity congestion and travel costs begin to affect travel behavior. In fact, these high construction cost estimates have left overly ambitious plans unfunded in the several states that have embarked on high speed rail programs. For these reasons, in 1991 IDOT developed an initial Conceptual Plan of how the Chicago-St. Louis system might operate with less expensive technology and less dependence on government contributions.

The simple understanding in IDOT's vision of high speed rail is that customers are sensitive to *travel time*, not maximum top speed. Therefore, the strategy in Illinois focuses on those investments which would most reduce travel time for the lowest cost. The Conceptual Plan contained the following features:

- Use of existing rail infrastructure whenever possible (eliminating the need for all-new track and right-of-way);

- Beginning service with diesel-powered trains until traffic grows to the point where full electrification (using overhead catenary wires) is justified financially;

- Potential employment of sophisticated vehicle suspension technology allowing higher speed travel on existing alignments;

- Use of trains which cruise at speeds of 110-125 mph rather than 150 mph or more (eliminating the need to close or rebuild all grade crossings).

The Project Team was engaged to develop a more rigorous analysis of the options for pursuing the Conceptual Plan's strategy and to develop a Financial and Implementation Plan for project implementation. In developing the plan, the Project team conducted the following analyses:

- Examined the corridor grade crossings and recommended improvements;

- Estimated the capital costs, operating costs, and ridership potential of a high speed rail system;

- Examined current and projected usage and capacity of the corridor by freight, commuter, and intercity trains;

- Examined alternative institutional frameworks for implementing the system;

- Analyzed the legal issues related to system implementation;

- Performed a financial feasibility analysis and analyzed sources and uses of funds, including federal contributions;

- Examined the special needs of high speed rail with regard to concept marketing and public involvement; and

- Identified the specific steps that would be required to implement the system.

PROPOSED SYSTEM

The Proposed System describes the range of technology, configuration, and alignment options available to the Chicago-St. Louis high speed rail service. The Proposed System also describes the shared use of the track with freight trains, and the capital costs, operating costs, and ridership projections for high speed rail.

System Options

The Project Team considered a range of options to improve passenger service but focused on intermediate performance systems that would not require new right-of way and extensive new track. The technology options examined have top speeds of between 110 and 140 mph, and would provide Chicago-Joliet-St. Louis trip times ranging from 3 hours and 15 minutes to 3 hours and 35 minutes.

Higher performance systems, such as the French TGV or magnetically levitated systems, were not examined in depth due to prohibitively high capital costs. For example, a 1981 IDOT study estimated the capital cost of a Chicago-St. Louis 150 mph double-tracked system with a dedicated right-of-way at $2.2 billion (in 1993 dollars), compared to a cost for the preferred alternatives of under $400 million. At the other end of the spectrum, systems with tope speeds of less than 110 mph were also not considered because they would require capital costs similar to a 110 to 125 mph system, but would provide a much smaller service improvement.

For the 110 to 140 mph options, a variety of different types of rolling stock were evaluated in order to arrive at a system configuration that reflects the current state-of-the-art technology in this area. There are several options for motive power, including turbine-electric and diesel-electric locomotives. In the Summary Report, all of these fossil-fueled power units are included in the term "diesel."

The analysis also considered rail-car tilt suspension technology, as well as conventional non-tilt technology. Tilt technology allows trains to travel at higher speeds through curves than conventional non-tilting trains, however, tilt mechanisms cost approximately $150,000 per car and result in higher maintenance costs. The Proposed System includes tilt technology because it allows for shorter trip times, a more comfortable ride through curves, and potential economies associated with linkages to other high speed corridors on which it may be functional (e.g., Chicago-Detroit).

System Configuration

In assessing the range of intermediate system options, the Project Team analyzed the Chicago-Joliet-St. Louis alignment in detail, considering capital costs and operating costs, potential ridership, and the level of public funding required for system development. The estimated capital costs and Chicago-Joliet-St. Louis trip times for the systems under consideration are presented in Table 1. (All tables and figures appear at the end of this paper).

The system offering the best combination of performance and cost was based on a 125 mph diesel-powered train with tilt suspension. The 110 mph system would cost as much as the 125 mph system but offer longer travel times. The 140 mph system would allow for shorter travel times, but is estimated to cost $335.3 million more than the 125 mph diesel system, largely because of the costs associated with electrifying the corridor. The elimination of all grade crossings in areas where train speeds exceed 125 mph, as required by the Federal Railroad Administration (FRA), would also add to the cost of the 140 mph system. The ridership and financial analyses indicate that the added revenues associated with the six minute Chicago to St. Louis time savings would not initially be sufficient to support the additional costs of an electrified system, although an electrified system may be feasible after the corridor has experienced significant ridership growth. Based on the system configuration analysis on the Joliet corridor, the Project Team focused on the 125 mph diesel/tilt technology for the remainder of the analysis. The 140 mph scenario was dropped from further consideration because of the high cost of electrification and elimination of all grade crossings.

The proposed rail service would provide eight round trips daily — twice the service frequency of current rail service — with a trip time more than two hours shorter. This configuration would provide a downtown to downtown travel time that is competitive with travel times for air trips, and would be less affected by adverse weather, airport congestion, and road congestion. Station renovations and the use of modern rail cars with high quality suspensions would provide passengers with a high level of comfort.

Alternative Alignments

The Proposed Systems allow for two alternative rail line alignments (see Figure 1). The first alignment, through Joliet, offers the lowest cost alternative for the high speed system. The second alignment, through Peotone, would allow the high speed system to serve the proposed new South Suburban Airport. The proposed airport is currently in the preliminary engineering phase and is scheduled to open in 2001. The Peotone alignment could join with the Joliet alignment on one of three routes: (1) through construction of a new rail corridor from Peotone to Wilmington; (2) on the Conrail track from Kankakee to Dwight; (3) on the Toledo, Peoria & Western (TP&W) track from Gilman to Chenoa.

After a thorough analysis of all three Peotone options, the Project Team focused on the Conrail option because of environmental factors and advantages in cost. The TP&W route is approximately 10 percent longer with many grade crossings, increasing both trip time and capital cost. The new rail corridor may face greater environmental barriers, although it allows the shortest travel times of all potential alignments. Unless otherwise noted, the Peotone alignment refers to the high speed rail alignment through Peotone on the Conrail track from Kankakee to Dwight.

Service Under Alternative Alignments

On either the Joliet or Peotone alignment, the proposed 125 mph diesel system would offer eight round trips per day between Chicago and St. Louis. The trip time between Chicago and St. Louis would be approximately 3 hours and 21 minutes through Joliet or 3 hours and 13 minutes through Peotone (faster than the 140 mph service through Joliet). The three principal stops (after Joliet or Peotone/Kankakee) would be Bloomington/Normal, Springfield, and Alton. Other communities along the corridor could be served by running selected trains that make additional stops. In addition, several of Amtrak's currently scheduled trains may continue to provide service on the corridor.

Selection of a Final Alignment

The choice between the Joliet and Peotone alignments may depend on serving a new South Suburban Airport. The Joliet alignment is less costly and would likely be preferred if the airport is not in service. However, with airport service, the Peotone option would be preferable due to the intermodal synergies of the high speed rail line and the airport. The airport would generate demand for the rail line while the rail line would improve access to the airport. Other factors, including environmental impacts, local preferences, and the undetermined location of a Chicago hub for high speed rail (to be examined this year in a new study by the City of Chicago) will also affect the alignment decision.

Shared Use with Freight Service

The track from Chicago to St. Louis is currently owned by freight rail companies which operate freight service on the corridor along with Amtrak's passenger services. The computerized operating simulations performed as part of this study indicate that the Proposed Systems' configuration will continue to support both passenger service and the current level of freight operation without difficulty under either of the potential alternative alignments. Joint use of the track has been successful in several rail corridors in Europe. Discussions with some of the freight carriers suggest that as long as the passenger and freight operations are operationally compatible, the freight carriers would prefer to continue operating on their current rail line for the following reasons:

- Local freight service will be required over significant portions of the Chicago-St. Louis line even after high speed passenger service is in place and it is more efficient for the freight operator if both local and through freight trains use the same rail line.

- The current carriers can better control their own commercial and operating schedules if they are the principal freight operator on the passenger line rather than tenants on track owned by other freight companies. Tenant carriers perceive joint freight operations on anther carrier's lines as a disadvantage because the tenant does not control dispatching. A freight operator will also probably prefer to co-exist with passenger service because passenger trains are predictable and would not use the line at night.

- Sharing the line with the proposed passenger service may be less expensive than paying fees for use of another freight company's track.

With eight trains in each direction, the high speed passenger service will likely be the principal user of the upgraded Chicago to St. Louis line. The passenger rail developer will therefore want to control the track, rather than leasing trackage rights from the current owners, in order to ensure that the passenger service maintains scheduling priority on the corridor. The plan assumes that the passenger rail developer or the state purchases the track from the freight companies that currently own it and leases back trackage rights to the freight operators. The trackage fees charged to the freight operators will allow the passenger rail project to defray a portion of the costs of track maintenance. In addition, the freight operators' exposure to tort liability would be greatly reduced by the change in ownership.

An additional advantage of shared use of the corridor between passenger and freight service is that it would not adversely impact freight rail employment on the corridor. Instead, there would be an increase in rail-related jobs for construction, operation, and maintenance of the new passenger service.

There are conditions under which continued shared use of the proposed passenger corridor may not be feasible. These conditions include:

- Passenger train speeds evolving to such high levels that Federal Railroad Administration rules will mandate a separation for safety reasons (these rules are still being developed).

- Time between passenger trains reduced to the point where freight operation is restricted to intolerably narrow periods of operation during nigh-time hours.

- Total traffic densities rising to the point where insufficient time remains to maintain the track.

None of these circumstances is expected to occur under the proposed service during the 20 year planning horizon of this study. If any of these circumstances occur in the more distant future, it may be necessary to add substantial trackage, essentially restoring the double main tracks that previous existed.

System Capital Costs

The cost of upgrading the corridor and purchasing the rolling stock for the Proposed System ranges from $310.5 million for the Joliet alignment to $355.1 million for the Peotone alignment. The costs of the airport-related infrastructure, which would be constructed shortly before airport opening are estimated at $129.6 million. The track, fencing, and signalling costs were estimated by Envirodyne Engineers while the rolling stock and maintenance facility costs were estimated by Raul V. Bravo & Associates. Table 2 summarizes the allocation of costs for the Proposed System under each of the alternative alignments.

- Rolling Stock

  Rolling stock costs include seven train sets, each with one high speed diesel locomotive and five train cars with tilt suspension. Rolling stock costs also include an initial supply of spare parts for rolling stock maintenance estimated at $2.5 million. At any point in time, five train sets would be in service, while two train sets would be receiving periodic maintenance and downtime, or held in reserve. The airport service would require additional locomotives and cars.

- Maintenance Facility

  Maintenance facility costs include the cost of facilities and equipment necessary to maintain system rolling stock.

- Trackwork and Acquisition

  Trackwork costs include upgrading the track to permit high speed passenger operations, the construction of additional track sidings and double-main tracks to minimize potential facility usage conflicts with freight, and corridor acquisition costs. Acquisition of corridor rights-of-way is recommended to ensure that routing priority is given to passenger operations. The cost of corridor acquisition has been estimated by the Project Team and IDOT and may change significantly once negotiations are opened with the freight railroad owners. The airport-related trackwork costs include a major bridge at Kensington.

- Signalling

  Signalling costs include installation of an entirely new signal system to meet the demands of high speed passenger operation and to facilitate continued freight operations; costs to equip freight locomotives for cab signal operation so that they can operate on the high speed track; and construction of a central dispatch facility to control the Chicago-St. Louis rail corridor.

- Fencing

  Fencing costs are for installing IDOT standard four-foot woven wire fence where necessary to restrict access to the rail corridor.

Grade Crossing Costs

In addition to the costs described above, an estimated $77.4 million would be required for treating the 327 grade crossings on the Joliet corridor. This is based on providing approximately one-half of the existing crossings with enhanced warning devises or, in certain cases, with grade separation structures and closing the remaining crossings. Candidates for possible closure have been identified in a preliminary study released in January 1994. IDOT will work with affected communities and will undertake additional engineering studies. There will be massive changes and IDOT anticipates discussing the new grade crossing plan with affected communities in 1995.

On the Peotone corridor, the cost of grade crossing improvements is estimated at $79.1 million. The proposed crossing protection treatments were developed considering train and vehicular traffic volumes and speed, accident history, and the availability of alternative crossings. Systems with train speeds about 125 mph would require the elimination of all crossings in areas where train speeds exceed 125 mph, estimated at a total of $162.0 million (1993 dollars) on the Joliet alignment. The cost of grade crossing improvements was estimated by Envirodyne Engineers based on a preliminary analysis of crossings.

The cost of grade crossing improvements would be funded through existing federal and state programs (with minor exceptions) and is therefore not included in the project costs that must be funded with new sources of financing. IDOT considers crossing protection, improved warning devices, and crossing elimination a public cost. Therefore, changes in grade crossing improvement costs would not affect the financial plan.

Furthermore, the project cost does not include station renovations or additional station development which will also be funded outside of the project. The six largest cities along the Chicago-St. Louis corridor already have new or recently renovated rail passenger stations, with the exception of St. Louis which is in the design phase of constructing a new $35 million transportation center.

Development Timetable

It is estimated that, with a three year lead time, the high speed passenger service could be operational by the turn of the century. Orders for rolling stock would be placed as soon as financing could be arranged and would take 30 to 40 months for delivery. Construction would be spread over the three year period and should be planned to minimize disruption to the existing rail service in order to provide a demand base for high speed passenger service.

Costs of Airport Service

The initial capital costs of the Peotone alignment do not include the cost of additional infrastructure to serve airport passengers because it is anticipated that the airport would not become operational until after the high speed rail line. The airport-related improvements would be financed and implemented shortly before the airport opens.

Preparing the high speed system to serve the proposed airport and its approximately 500,000 rail passengers will require the purchase of additional train sets, the construction of a loop track from the main track into the airport station, and the construction of double-tracking from the downtown terminal to the airport. The cost of these upgrades is estimated at $18.0 million for the train sets (IDOT estimate), $20.5 million for the loop track, and $91.1 million for the double-tracking (including a major bridge near Kensington). The revenues generated by the service are estimated at $20.4 million. (All estimates are in 1993 dollars). In fact, the existence of a high speed shuttle train to downtown Chicago from Peotone could greatly enhance the attractiveness of the airport.

Potential for Future Expansion

After ridership and revenues have grown sufficiently to support additional costs, the corridor could be upgraded, principally through additional double-tracking, electrification, full grade separation, and realignments, to an electric system achieving speeds in excess of 140 mph. However, the difficulties in eliminating all grade crossings in areas where train speeds would exceed 125 mph may prove substantial.

System Operating Costs

The year 2000 operating costs for the Proposed System were estimated by Raul V. Bravo Associates at approximately $32 million in 1993 dollars. Operating costs for the alternative alignments are summarized in Table 3.

- Track and Signal Maintenance

  Track and signal maintenance includes the labor cost to maintain the track and new signal system.

- Staffing

  Staffing costs include the staffing costs for approximately 40 operational personnel. With the airport service, additional staff would be needed.

- Equipment Maintenance

  Equipment maintenance includes the labor cost to maintain the train sets. Because the Peotone alignment is slightly longer, it incurs higher equipment maintenance costs.

- Energy

  The energy cost covers the estimated cost of diesel fuel for the train system. The differences in energy cost are caused by the Peotone alignment's greater length.

- Administration

  The administrative cost covers the estimated cost of system administration and includes security costs and executive compensation.

- Sales and Marketing

  Sales and marketing costs are estimated at 8.5 percent of sales revenue and cover the cost of promotions, marketing, and commissions.

- Purchased Services

  Purchased services covers the costs of outside services purchased for the system and include station cleaning, fueling, and toilets.

- Leases

  Leasing costs include the cost of ticketing machines and other leased equipment.

- Insurance

  Insurance covers the cost of insuring the operator and may vary depending on the owner and operator of the facility. The financial plan assumes public ownership and private operation of the high speed system.

- Materials

  Materials includes the spare parts and other materials required for track, signal, and equipment maintenance. The figure in Table 3 does not include an additional $500,000 in spare parts that would be required beginning in 2002 since these costs would be covered by warranty during the first four years of operation.

- Track Usage Fees

  Track usage fees are for use of the 3.5 miles of track in St. Louis and East St. Louis that are owned by the Terminal Road Association of St. Louis.

Ridership and Revenue

The Project Team included Wilbur Smith Associates (WSA), a transportation planning firm. WSA developed and calibrated ridership forecasting models based on surveys of potential system users, economic and transportation data for the Chicago-St. Louis corridor, 1991 base rail ridership, and other factors. The ridership surveys, conducted by Resource Systems Group, questioned potential system users regarding their preferences for rail, auto, and air travel and the importance they place on the time and cost of travel.

Although ridership forecasts represent the greatest source of uncertainty in rail planning, the results of the ridership analysis are encouraging. Under the baseline assumptions used by WSA, improved service on the Joliet alignment would attract 1,113,703 riders in the year 2000 and generate an estimated $57.4 million in revenues. Based on the same baseline assumptions, high speed rail service through Peotone would attract 1,110,056 riders in 2000 and generate an estimated $57.9 million in revenues; see Table 4. (All estimates are in 1993 dollars).

The Wilbur Smith baseline forecasts are based on the following principal assumptions:

- Intermediate station stops at Joliet or Peotone/Kankakee, Bloomington, Springfield, and Alton;

- Eight trips per day in each direction;

- A fare structure based on a Chicago-St. Louis one-way ticket price of $65 for business passengers and $47 for non-business passengers;

- 1991 base annual ridership on the corridor or 341,601 passengers.

Sensitivity Analysis on the Joliet Alignment

Using the Joliet alignment as a base, Wilbur Smith analyzed the sensitivity of these results to changes in key assumptions. In particular, Wilbur Smith examined the effect of increasing the assumed 1991 base ridership level from 341,601 to 400,000 passengers; see Table 4. This analysis was conducted because of the variability in ridership on the corridor in recent years. Ridership grew to 305,661 in 1987 and was expected to continue to grow in the future; however, deteriorated service caused corridor ridership to drop to 259,657 in 1991. Had service quality not been disrupted from 1988 to 1991, ridership would have been expected to grow to at least 341,601 and possibly as high as 400,000 by 1991. In fact, improved service since 1991 caused ridership to increase to 313,827 for the period July 1992 to June 1993. IDOT believes the completion of the four year, $40 million rehabilitation of the corridor between Joliet and St. Louis, with a concomitant reduction in travel times and increase in on-time performance, will further contribute to increased ridership on the corridor.

The Project Team also included Transportation Economics & Management Systems (TEMS) as an oversight consultant to offer a "second opinion" on the methodologies and results used by Wilber Smith. TEMS utilized much of the same data used by WSA, but tested the impact of alternative model specifications and assumptions on projected rail travel demand. The principal differences between Wilbur Smith's and TEMS' assumptions are:

- Wilbur Smith assumes 1991 base year ridership of 341,601 and 400,000 in its forecasts while TEMS assumes 1991 base year ridership of 389,998 (based on increased ridership in the first half of 1992);

- TEMS estimated induced demand (i.e., new demand generated in the corridor as a result of high speed rail service) at approximately eight percent of demand whereas WSA estimated induced demand of approximately four percent;

- TEMS used a more aggregated origin/destination zone structure to model travel patterns;

- TEMS tested assumptions which characterize high speed rail service as a genuinely new mode of travel as attractive to potential customers as air travel (new mode bias).

The TEMS approach yields significantly higher estimates of future demand, as summarized in Table 5.

TEMS projections are discussed in this report as an alternative estimate of ridership potential in the corridor; however, the WSA baseline results are used as the proposed ridership and revenue assumption. Unless otherwise noted, the WSA baseline is used for the financial plan and other analyses included in this report.

Ridership and Revenue on the Peotone Alignment

Having performed these sensitivity analyses on the Joliet alignment, WSA developed additional ridership and revenue forecasts for the Peotone alignment using only the baseline assumptions. The baseline assumptions allow for a direct comparison of the Joliet and Peotone alignments, as summarized in Table 6.

The Peotone alignment generates fewer riders but more revenue than the Joliet alignment because of its different mix of business and non-business ridership and differences in distances traveled. Airport riders are not included in the later year estimates of Peotone ridership and revenue, but they are estimated to add approximately one million passengers and over $20 million in revenues.

It is important to understand that projecting future ridership for a new type of transportation alternative is a challenging and somewhat uncertain exercise, requiring the forecasting consultant to make and test a variety of assumptions and model specifications. This variability is confirmed by the differences in WSA's results from those of TEMS.

THE DEVELOPMENT MODEL

The public-private development approach determines the allocation of responsibilities in the financial plan. The development approach also describes future upgrades to serve the proposed South Suburban Airport or, potentially, to use faster technology.

The Public-Private Development Approach

Passenger rail services in the United States and abroad have generally been developed by the public sector with public funds. However, as the public sector's financial resources have been constrained and public managers seek private sector efficiencies in railroad development and operation, governments are increasingly turning to the private sector as a partner in the financing, operation, and maintenance of passenger rail systems.

A public-private partnership for high speed rail can be created by dividing the rail system into several physical and financial components and allocating responsibilities for each component to the partner, public or private, who is best able to execute the required duties. There are numerous models for forging the public-private relationship in transportation development, each with unique characteristics. For each project, the structure of the public-private partnership depends on which party (or parties) is responsible for the following:

- Obtaining funding for each component of the system;
- Supporting financing for the project;
- Directing the design, planning, and construction of the project;
- Holding legal ownership of each component of the system;
- Operating the system and collecting fares;
- Marketing the service;
- Ensuring the safe design and operation of the service.

In identifying appropriate public-private development options for the Chicago-St. Louis project, the Project Team considered the following legal and institutional issues.

- Rapid and Efficient Development

  IDOT recognized early in the planning that it was neither practical nor desirable for the Department to manage all aspects of system development and operation. From the outset, IDOT sought the involvement of a private sector partner to act as developer of the system, believing that such an independent entity could (with IDOT's assistance) more efficiently and aggressively bring together the physical and financial components of the system.

- Eligibility for Tax-Exempt Debt

  The costs of financing certain components of the system may be somewhat lower if tax-exempt debt can be used. Tax-exempt debt carriers a lower interest rate because investors in these bonds are exempt from paying income taxes on the interest earnings. For the project to be eligible for tax-exempt debt, however, a private party cannot own or lease the portions of the system that are funded with tax-exempt debt, nor can an operating contract be granted of more than three to five years duration.

- Tort Liability

  Liability for passenger rail accidents is a potential obstacle to providing high speed passenger rail service in the United States. The state and other public entities in Illinois have the advantage of certain procedural requirements and immunities in tort law that are not available to private firms. Thus, the magnitude of potential tort claims may be reduced by allowing a public entity to retain ownership and control of some components of the system, such as the tracks and signals.

- Amtrak Operating Rights

  The Rail Passenger Services Act of 1970 gives Amtrak the first right to operate intercity rail passenger service on most rail corridors in the United States, including Chicago-St. Louis. Amtrak's statutory operating rights expire in 1996 at which point the Congress may or may not renew the rights. In the interest of minimizing costs and maximizing service for the state, the Implementation Plan assumes that operation of the high speed rail system would be offered on a competitive basis to qualified bidders, including Amtrak.

- Developer's Responsibilities

  The project developer (either a public or private entity) will need broad authority to implement the project, including the ability to issue bonds secured by future revenues, to enter into agreements with private parties to design, build, and operate the system, and to procure goods and services without having to adhere to traditional government procurement regulations. New legislation will be required to grant these powers to IDOT, a public authority, or a private partner to develop the facility.

After considering the issues above and the experience of other public-private transportation projects worldwide, the Project Team identified two development options for further study: Private Franchise and Turnkey Development.

Private Franchise

Under a private franchise agreement, a private developer would:

- Obtain a franchise from IDOT to design, develop, and operate the system;

- Receive public funding for selected portions of the system, including grade crossings;

- Arrange private financing for the remaining project costs;

- Acquire the right-of-way or lease it from the state;
- Make necessary track, signalling, and fencing improvements;
- Operate the system or issue a long-term contract to a separate operator.

A private franchise would benefit from the efficiencies associated with substantial private sector involvement. A private developer may invest its own capital in the project and develop the facility more rapidly and cost effectively than the public sector. In addition, a long-term operating concessionaire would have a strong financial interest in the success of the project and is therefore likely to pursue system riders aggressively, price the service efficiently, and minimize operating costs.

Turnkey Development

Under turnkey development, a new independent public authority would be established to:

- Obtain public funding for selected portions of the system, including grade crossings;
- Issue tax-exempt bonds for the remaining project costs;
- Acquire the right-of-way or lease it from the state;
- Enter into a fixed-price "turnkey" contract with a private consortium to design and build the necessary track, signalling, and fencing improvements;
- Contract to a separate operator for no more than three to five years at a time.

Turnkey development allows the project to benefit from the time and cost efficiencies of private design/build techniques. In addition, the private turnkey developer may assume the risk of cost overruns through a fixed price contract. If the operating contract is limited to three to five years, the project would also be eligible for lower cost tax-exempt debt. Finally, public ownership and control of the project may result in a lower exposure to tort liability than under a private franchise.

The principal disadvantage of the turnkey development model is that it does not allow for the private capital contributions or the full time and cost efficiencies associated with private development and operation. Regulations governing tax-exempt debt limit private sector participation and impose contracting and procurement requirements which restrict developer flexibility. A private contractor would not have as strong an incentive to invest capital, develop the project efficiently, and optimize system operation under turnkey development as under a private franchise. Because of this, project costs may be higher under turnkey development than under a private franchise.

Financial Plan

A detailed financial plan was developed based on the proposed system costs, revenues, and development structure. The financial plan uses non-recourse financing supported only by project revenues, meaning that the state would be under no obligation to repay the bonds or other financial instruments if revenue shortfalls occurred.

The objective of the financial plan is to maximize the portion of project costs funded by project revenues and minimize the public contribution to the project, while maintaining financial feasibility. Although the share of costs covered by fare revenues is greater than for any other planned high speed rail system in the United States, the cost coverage is not 10 percent (under the baseline ridership estimates and financial assumptions). This means that implementation of the system is dependent in some measure upon federal capital grant funding. Some of the federal funding is already available from current U.S. DOT programs while the remainder depends on additional sources of public funding, such as a federal high speed rail program.

The proposed financial plan calls for using revenue-backed financing for the rolling stock, maintenance facility, and a portion of the track improvements, signalling, and fencing costs. The remaining portion of these costs is assumed to be funded through new federal programs or innovative finance mechanisms. The costs of grade crossing safety improvements and track acquisition are assumed to be public responsibilities.

A financial plan was developed for the two alternative alignments and each of the two development options under consideration. The turnkey development option is assumed to use a combination of tax-exempt bonds and public grants (for grade crossing improvements, right-of-way acquisition, and some track improvements). The private franchise option would use a combination of *taxable* debt, a lease arrangement for the rolling stock, and public grants. The Project Team used Wilbur Smith's baseline demand forecasts in developing the financial plans. Under these assumptions, the most financeable option (turnkey, via Joliet) covers 78 percent of project costs. The analysis was performed in current dollars; the results of the analysis are presented in 1993 dollars (for ease of comparison) in Table 7.

Impact of the Proposed Airport

The completion of a major South Suburban Airport would increase ridership and revenues for the high speed rail line. In addition, high speed rail service may generate additional passengers and passenger revenues for the airport. The analyses prepared by WSA and TEMS, in conjunction with The al Chalabi Group, estimate that an additional \$20.4 million in fare revenues may be generated by rail travelers to and from the airport in 2001. The airport service would require approximately \$11.4 million in additional operating costs. Additional net revenues to support the future improvements in the system would therefore be \$9.0 million. Based on these additional net revenues, the high speed rail system could finance a substantial portion of the cost of the additional $129.6 million in train set acquisition and track, signal, and grade crossing improvements required to serve the airport. (All cost and revenue estimates are in 1993 dollars).

IMPLEMENTATION PLAN

The Implementation Plan describes the specific steps that the state and its private partners should undertake to successfully implement high speed rail service on the Chicago to St. Louis corridor. The plan establishes public involvement strategies, legislative requirements, institutional relationships, and financial responsibilities for implementing the proposed system and development model. The Implementation Plan is structured to maximize the amount of time before finalizing an alignment option, in order to resolve outstanding issues.

Begin Public Awareness Program

Research conducted by the Project Team on numerous high speed rail projects in the United States and abroad concludes that public opinion is frequently the pivotal factor in determining the success of the high speed rail project and that the public should be informed and involved as early in the project as possible. The results of this research were used to develop a three part public involvement plan for Illinois high speed rail. Two of the components of the plan are:

- *A public opinion and involvement program* with a goal of fostering widespread understanding of high speed rail and coalescing public support for the project in all sectors, including business, environmental, public, and private citizens. The Citizens Committee for High Speed Rail would play a major role in this program.

- *A media relations campaign program* with the goal of early and accurate distribution of information about the project and its potential benefits.

The public awareness program is designed to raise the profile of high speed rail in the minds of the public and to educate the public regarding the proposed system. It will also facilitate public and local government involvement in and understanding of decisions to close grade crossings and modify the corridor.

Develop and Enact Enabling Legislation

New legislation will be required to authorize IDOT or a separate public entity to implement the steps required to develop high speed rail service. The enabling legislation should grant the public sponsor of the project the power to:

- Acquire the Chicago to St. Louis right-of-way from the current owners;

- Make capital improvements of the corridor and purchase rolling stock;

- Collect farebox revenues and other corridor revenues;

- Issue bonds secured by future revenues;

- Solicit public grants and private investment;

- Enter into agreements with private partners to undertake the responsibilities listed above;

- Procure goods and services without having to adhere to all traditional government procurement regulations;

- Regulate the activities of private partners with regard to safety, quality of service, and profits.

In addition, during this stage of the project, the state may determine the Development Model and the type of credit support, if any, to be used to support high speed rail system implementation.

Develop Detailed Master Plan

The Financial and Implementation Plan will be expanded and refined by the state in cooperation with potential private partners that will be considered for the project. Each of the following elements of the plan will be addressed:

- The Proposed System, including the precise alignment and capital improvements, rolling stock technology, ridership and revenue projections, specifications for grade crossing modifications, and station improvements;

- The Development Model, including the public and private responsibilities for financing, developing, and operating the system;

- The Implementation Plan, including the specific steps required to implement the revised system and Development Model.

Select Developer and Operator

The state will issue an RFP to select a private partner for the project. The RFP will allow the private operator the flexibility to propose an appropriate development structure. The state and the developer (under the franchise option) will then select a private operator for the project under a long-term operating contract.

Negotiate with Private Freight Carriers

The public sponsor will negotiate an agreement with the private freight carriers that currently own the right-of-way and that will continue to operate freight service on the corridor. The principal issues for negotiation include:

- The terms by which the developer will acquire use of the right-of-way;
- The terms for continued sharing of track between the freight and passenger service, including trackage fees and tort liability management;
- Alternative arrangements in the event that the freight rail service levels increase.

Obtain Funding Commitments from Other Agencies

The public sponsor will obtain governmental funding commitments for grade crossing improvements, track acquisition, and other costs that will be funded outside of the project's own revenues. A commitment of public credit support for the revenue-backed financing may also be desirable. Funding commitments will likely be required at the federal level, and in the case of grade crossings, also at the state level.

Order Train Sets and Signal Equipment

The train sets will be selected and ordered immediately after funding is secured for the system in order to ensure that the train sets will be available prior to the completion of the corridor improvements. The train sets are expected to be owned by a separate company and leased to the project in order to take advantage of the tax depreciation on the equipment.

Carry Out Grade Crossing and Track Improvements

The grade crossing treatments and track improvements will be undertaken while minimizing disruption to the current passenger and freight service. A preliminary analysis of grade crossing treatments was released in January 1994. IDOT will work with affected communities and will undertake additional engineering studies. There will be massive changes and IDOT anticipates discussing the new grade crossing plan with affected communities in 1995. The construction period is expected to be approximately three years.

Develop Supporting System Components

The supporting plans and facilities for the system will be developed including:

- Maintenance and storage facilities;
- Station improvements;

- Shared use agreements with freight operators;

- High speed rail service marketing campaigns;

Initiate High Speed Service

High speed passenger rail service will commence approximately three years after the beginning of construction.

Oversee Operation of the System

The state, through IDOT, will monitor operation of the system and regulate the private operator with respect to safety and quality of service.

Phase-In Future Improvements as Financing becomes Available

The feasibility of electrifying the system and increasing top speeds above 125 mph to significantly reduce trip times will be studied once system revenues have grown sufficiently to cover the cost of the initial revenue-backed financing and the costs of additional improvements. It is unlikely that the Proposed System would change dramatically before 2010. Further improvements to the system may include the following:

- Installation of an overhead catenary system to allow the use of electric powered locomotives;

- Replacement of diesel locomotives with higher performance electric locomotives;

- Construction of additional sections of double track to accommodate higher speeds and greater frequency of service;

- Closure or separation of grade crossings along the corridor where train speeds exceed 125 mph;

- Further improvement of corridor stations;

- Purchase of train sets and construction of track loop and double tracking (including a major bridge at Kensington) to serve the new airport.

In addition, connections to other cities and regional systems will be considered, including Chicago-Detroit and Chicago-Milwaukee.

TABLE 1

COMPARISON OF SYSTEM OPTIONS
CHICAGO-JOLIET-ST. LOUIS ALIGNMENT

Configuration	Trip Time	Capital Cost* (1993 Dollars)
110 mph Diesel/Tilt	3 hours 35 minutes	$310.5 million
125 mph Diesel/Tilt	3 hours 21 minutes	$310.5 million
140 mph Electric/Tilt	3 hours 15 minutes	$645.8 million

* Capital cost includes train sets, trackwork, track acquisition, catenary (in the electric configuration), signaling, fencing and maintenance facility.

TABLE 2

ESTIMATED SYSTEM CAPITAL COSTS
BY ALIGNMENT ALTERNATIVES
(Millions of 1993 Dollars)

Cost Category	Chicago Joliet St. Louis	Chicago Peotone St. Louis	Airport Related Capital Costs
Rolling Stock	93.5	93.5	18.0
Maintenance Facility	13.0	13.0	0.0
Trackwork & Acquisition	139.6	169.2	104.6
Signalling	53.8	67.9	6.8
Fencing	10.6	11.5	0.2
Total	**310.5***	**355.1***	**129.6**

* These amounts do not include loan forgiveness or grade crossing improvements.

TABLE 3

SYSTEM OPERATING COSTS BY ALTERNATIVE ALIGNMENT (Millions of 1993 Dollars)

Operating Cost Category	Chicago Joliet St. Louis	Chicago Peotone St. Louis	Airport Service
Track/Signal Maintenance	5.2	5.2	1.7
Staffing	4.2	4.5	2.9
Equipment Maintenance	5.9	6.6	3.5
Energy	1.5	1.7	0.7
Administration	2.5	2.5	0.0
Sales and Marketing	4.9	4.9	0.5
Purchased Services	1.0	1.0	0.2
Leases	0.1	0.1	0.0
Insurance	3.1	3.1	1.8
Materials	2.1	2.3	0.0
Track Usage Fees	0.8	0.8	0.0
Total	**31.4***	**32.6***	**11.4***

* Components may not sum to total because of rounding.

TABLE 4

SUMMARY OF WSA RIDERSHIP FORECAST RESULTS (Revenues in Millions of 1993 Dollars)

WSA Ridership Forecast	2000		2010		2020	
	Ridership	Revenue	Ridership	Revenue	Ridership	Revenue
Baseline	1,113,703	57.4	1,295,723	67.2	1,509,913	78.8
400,000 Base	1,266,998	65.3	1,474,149	71.2	1,717,912	89.7

TABLE 5

SUMMARY OF TEMS RIDERSHIP FORECAST RESULTS
(Revenues in Millions of 1993 Dollars)

TEMS Ridership Forecast	2000		2010		2020	
	Ridership	Revenue	Ridership	Revenue	Ridership	Revenue
Baseline	1,316,001	63.5	1,536,108	74.0	1,829,305	87.9
New Mode Bias	1,696,497	88.7	1,982,096	103.6	2,360,514	123.2

TABLE 6

SUMMARY OF PEOTONE AND JOLIET BASELINE FORECASTS
(Revenues in Millions of 1993 Dollars)

Ridership Forecast	2000		2010		2020	
	Ridership	Revenue	Ridership	Revenue	Ridership	Revenue
Joliet Baseline	1,113,703	57.4	1,295,723	67.2	1,509,913	78.8
Peotone Baseline	1,110,056	57.9	1,291,741	67.8	1,505,373	79.5

TABLE 7

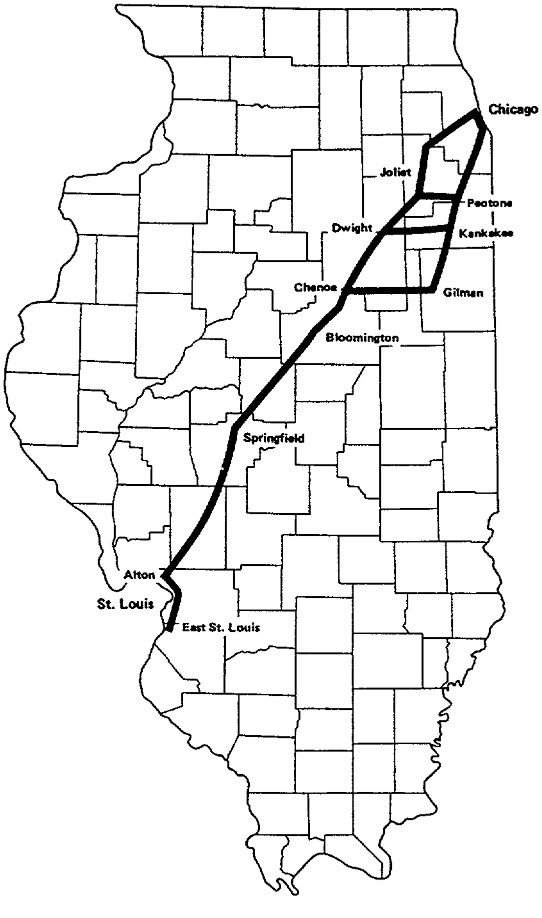
SOURCES OF PROJECT FINANCING (WITHOUT CREDIT SUPPORT)
Based on WSA Baseline Ridership Forecasts
(Millions of 1993 Dollars)

Alignment Alternative	Financing	Revenue-Backed Financing	Public Contribution*	Capital Cost
Joliet	Turnkey	241.8	68.7	310.5
	Franchise	197.8	112.7	310.5
Peotone	Turnkey	232.2	122.8	355.1
	Franchise	192.4	162.7	355.1

* Public contribution does not include grade crossing costs or the loan forgiveness portion of the corridor acquisition. No state tax dollars are anticipated.

FIGURE 1

ALTERNATE HIGH SPEED RAIL ALIGNMENTS



ALTERNATIVE FUELS IN URBAN FLEETS

Tony Lindsay
Director
Natural Gas Vehicle Marketing
Northern Illinois Gas Company

TABLE 1

OBJECTIVES

- Programs that are driving the introduction of alternative fuels into fleet operations in urban areas around the country.
- Define alternative fuels.
- Quantify the present use and future projections on alternative fuel vehicles (AVFs) in the Chicago metropolitan statistical area.
- Benefits to increased use of alternative fuels in urban areas.

TABLE 2

PETROLEUM DEPENDENCE TRENDS

- Take a look at our "current situation."
- The transportation sector is 97 percent dependent on petroleum.
- The transportation sector accounts for 63 percent of all U.S. petroleum use.
- I.C. engines have become more energy efficient, but we continue to use more.
- Escalating petroleum use continues to contribute to the nation's negative balance of payments.
- In fact, transportation fuel use by itself exceeds domestic oil production by 44 percent (1992 data).

TABLE 3

TRANSPORTATION SHARE OF EMISSIONS

- The transportation sector (as a whole) is responsible for a large percentage of total U.S. pollutants emissions.
- About 112 million people in the U.S. reside in areas that are out of compliance for air quality standards as specified in the Clean Air Act Amendments (CAAA).
- Concern is still growing over the adverse health effects of many of these pollutants.

TABLE 4

POLICY DRIVERS FOR AFVs

- Steps to encourage the use of alternative fuels began back in 1988 with the Alternative Motor Fuels Act to provide information and demonstrations of AFVs.
- Next, a major step towards improving air quality concerns took place with the CAAA-90 which affects fleet operations in 21 urban areas classified as either extreme or severe nonattainment areas.
- Then, an executive order was signed in 1991 that sought to ensure federal purchases of the maximum number of AFVs as practical.
- Then, the Energy Policy Act of 1992 required federal, state, and alternative fuel providers to begin purchasing AFVs.
- In 1992, another Presidential order was given to increase by 50 percent the number of AFV purchases mandated by the EPA over the next three years.

TABLE 5

SUMMARY OF CLEAN AIR ACT MAJOR PROVISIONS

- Tighter emission standards
- Fuel composition requirements for gasoline and diesel
  - Reformulated gasoline
  - Oxygenated fuels
  - Lower sulfur diesel
- Clean fuel program
  - Fleet program for 22 cities
  - California clean fuel pilot program
  - Urban bus program

TABLE 6

ANNUAL MANDATED VEHICLE PURCHASES

- CAAA legislation will result in the phase-in of AFVs on an annual basis.
- Over 15,000 in 1998, rising to over 30,000 per year in 2003.
- Some of the CAAA mandates may be satisfied with RFG and that is why it is important that the intentions of the EPA be enforced to ensure the utilization of "true" alternative fuels.

TABLE 7

POTENTIAL CUMULATIVE AFVs ON THE ROAD

- When we take into account the turnover rate in fleet vehicles and the resale and voluntary use of AFVs, it is projected that there could be as many as 82,000 in the year 2000, rising to over a quarter million by 2010.

TABLE 8

POTENTIAL ECONOMIC IMPACT ON ILLINOIS

- It is estimated that the fueling and service infrastructure as well as vehicle requirements projected will result in the creation of 27,000 jobs and capital investments of $2.1 billion in Illinois.

TABLE 9

CLEAN CITIES

- These may seem like ambitious numbers to attain, and they are, but I would like to take a few minutes to describe a prOgram that is helping get this accomplished — it is called "Clean Cities."
- This is a voluntary federal program designed to accelerate and expand the use of AFVs in urban communities and to provide maintenance and refueling facilities for their operations. It is open to any area willing to make the commitments involved. I am proud to say that Chicago received its designation as a "Clean City."

TABLE 10

CLEAN CITIES PROGRAM GOALS

- The AFV infrastructure includes expanding the availability of commercially available AFVs, AFV conversion and maintenance facilities, and refueling facilities.
- At the time of signing on, Chicagoland area had 1,700 AFVs in operation (almost 1,200 of which are natural gas vehicles) and some 69 public and private alternative fuel fueling stations.
- An example of the types of things that a united group can accomplish is the recent treatment of AFVs in Illinois' ECO program. As the result of the efforts of Clean Cities member organizations, AFVs are now an easy to use method of compliance since an AFV counts as at least one-half car pooler.

TABLE 11

BROADER NATIONAL GOALS

Key Players

- The strategy of the program is to bring together the key players and coordinate their agendas and work to remove barriers to the expanded use of AFVs; over 40 organizations signed the MOU and agreed to participate in the program. Key players include:
  - Fleet Owners and Operators
  - Alternative Fuel Suppliers
  - AFV Manufacturers
- Without this three-way balancing act of having fleet operators willing to use them, fueling facilities available to fuel them, and manufacturers and converters in place to provide them, there will be no market for AFVs.

Benefits through a Dramatic Increase in the Use of AFVs

- Air quality improvements leading to potential health benefits and reduced health care costs.
- Create new business and economic growth through establishing an alternative fuel infrastructure and all the jobs that go along with it.
- Compliance with federal legislation.
- Earn recognition and enhance our area's public image.

TABLE 12

POTENTIAL ECONOMIC IMPACT ON ILLINOIS 1994-2010

- 27,000 jobs
- $2.1 billion capital investment

TABLE 13

SUMMARY OF PRESENT SITUATION

The Transportation Section in the United States:

- Is 97 percent dependent on petroleum.
- Accounts for 63 percent of all U.S. petroleum use.
- Produces a significant share of U.S. pollutant releases.
- Has major impacts on consumers, the economy, and the national trade balance.
- Currently has no readily available alternative to petroleum.
- Has limited infrastructure to support alternative fuels.

TABLE 14

GOALS

- Broader National Goals:
  - Reduced dependence on imported oil
  - Improved environmental quality
  - Increased economic growth and competitiveness
- Program Goals:
  - Increase use of AFVs
  - Establish or expand the AFV infrastructure
  - Stimulate domestic fuels industry
  - Increase public awareness

TABLE 15

FEDERAL GOVERNMENT INVOLVEMENT IN NGVs

Federal Government

- Executive Order 12844
  - Directed that the federal government substantially increase their purchases of alternative fueled vehicles beyond the requirements of the Clean Air Act and the Energy Policy Act.
- Federal Fleet Task Force
  - Set up by the Clinton Administration to develop recommendations to carry out Executive Order 12844 which will also lead to the widespread use of alternative fuel vehicles.
  - Chicago metropolitan area listed as Tier I City. The task force will focus its efforts on developing the alternative fuel vehicle infrastructure in 1994 in Tier I cities.
- U.S. Postal Service
  - The United States Postal Service in Rockford has recently converted 50 of their vehicles to natural gas. Since 1970, the Post Office has tested every alternative fuel available, and to this date, they have nearly 3,000 NGVs operating in their fleet. They will have converted an additional 1,400 vehicles by the end of 1993, and they plan to convert 2,000 more vehicles in 1994. The Post Office has stated that their goal is to have ten percent of their fleet, which represents 20,000 vehicles, running on natural gas by the year 2000.
- U.S. GSA
  - Twenty NGVs in service currently with most using public refueling stations.
  - Seventy-five NGV purchases planned for 1994 for the Chicago metropolitan area.

TABLE 16

THE TOP METROPOLITAN STATISTICAL AREAS AS RANKED BY THE TOTAL NUMBER OF FLEETS

Rank	SMSA	No. of Fleets	No. of Vehicles
1	Chicago, IL	1,790	725,431
2	New York, NY-NJ	1,368	677,635
3	Washington, DC, MD-VA	528	525,611
4	San Francisco, Oakland, CA	885	452,603
5	Los Angeles, Long Beach, CA	1,711	436,154
6	Minneapolis, St. Paul, MN-WI	730	353,201
7	Detroit, MI	916	342,673
8	Philadelphia, PA-NJ	1,358	316,733
9	Newark, NJ	637	309,710
10	Atlanta, GA	561	260,588
11	Dallas, Ft. Worth, TX	676	237,768
12	Boston, Lowell, Lawrence, Haverhill, MA	1,092	186,151
13	Cleveland, OH	564	149,532
14	Houston, TX	634	137,432
15	Syracuse, NY	261	130,945
16	Miami, FL	312	118,776
17	Baltimore, MD	538	116,265
18	St. Louis, MO-IL	419	110,316
19	Memphis, TN-AR-MS	250	105,855
20	Nassau, Suffolk, NY	503	101,911

TABLE 17

ILLINOIS NATURAL GAS VEHICLE COALITION

- The Illinois National Gas Vehicle (INGV) Coalition was formed to gain recognition of natural gas as an efficient, cleaner-burning fuel for vehicles in Illinois. The coalition supports activities which promote the use of natural gas vehicles as a means of providing long-term environmental and economic benefits to Illinois.
- Members include: The Peoples Gas Company, Amoco Corporation, Central Illinois Light Company, Iowa-Illinois Electric and Gas, North Shore Gas Company, MidCon Development Corporation, Illinois Power, and Central Illinois Public Service Company.

TABLE 18

DEVELOPMENT OF REFUELING INFRASTRUCTURE IN ILLINOIS

- The INGV Coalition members and their customers have installed 23 existing private fueling stations in the State of Illinois.
- In addition, the public fueling infrastructure has also begun to develop. A natural gas dispenser has been installed at a Phillips 66 station in Peoria while Amoco has opened three natural gas fueling facilities in the Chicagoland area (Chicago, Warrenville, Elgin).
- Amoco plans to have seven additional natural gas refueling stations operating by 1995.

TABLE 19

CONVERSION FACILITIES

- One of the obstacles that the NGV industry here in Illinois has had to deal with up to now has been the lack of a conversion facility closer than three hours away.
- However, conversion facilities have emerged in the Chicagoland area as well as downstate. The companies who have opened facilities include: Diversified Fleet Service, Naperville; Illinois Industrial Equipment, Mokena; Kady Oil Company, Peoria; North Shore Auto Clinic, Evanston; and Patten Energy Systems, Elmhurst.

TABLE 20

ORIGINAL EQUIPMENT MANUFACTURING (OEM) INVOLVEMENT

General Motors

- Dedicated three-quarter ton Sierra pick-up truck
- GM conversion program for 1994 (OEM warranted conversions — eight vehicle platforms including the Caprice and Corisa)

Ford

- Dedicated Crown Victoria prototype program — Model year 1995 production

Chrysler

- Dedicated B250/B350 Ram Vans
- Dedicated Dodge Mini Van - 1994

Heavy-Duty Natural Gas Engines

- Navistar (school bus, delivery truck); Hercules (school bus, delivery truck); Mack Truck (refuse handler); Detroit Diesel (transit bus); Cummins (transit bus)

TABLE 21

ENERGY POLICY ACT OF 1992

Summary of Major Provisions

- Reduce dependency on foreign energy sources
- Mandates use of AFVs
- Provides incentives towards AFVs
  - Federal tax deductions
  - State incentives
  - Low interest loans
- Authorizes urban and school bus demonstrations

TABLE 22

ALTERNATIVE FUELS DEFINITION ENERGY POLICY ACT OF 1992

For purposes of legislation, "Alternative Fuels" means:

- Methanol, or mixtures containing 85 percent or more of methanol
- Ethanol, or mixtures containing 85 percent or more of ethanol
- Natural Gas
- Liquified Petroleum Gas
- Electricity
- Hydrogen
- Coal-Derived Liquids
- Fuels Derived from Biological Materials

TABLE 23

COVERED FLEETS/VEHICLES
ENERGY POLICY ACT OF 1992

- Federal, state, private and municipal
  - 50 or more vehicles (w/20 in one location)
  - Light duty vehicles
  - MSA 250,000 +
- Fuel providers

TABLE 24

GENERAL FLEET REQUIREMENTS
ENERGY POLICY ACT OF 1992

- 20 percent of new vehicle purchases in FY 1999, 2000, 2001
- 30 percent of new vehicle purchases in FY 2002
- 40 percent of new vehicle purchases in FY 2003
- 50 percent of new vehicle purchases in FY 2004
- 60 percent of new vehicle purchases in FY 2005
- 70 percent of new vehicle purchases in FY 2006 and thereafter

TABLE 25

INCENTIVES
ENERGY POLICY ACT OF 1992

- Provides tax deductions for alternate fueled vehicles (including converted or dedicated natural gas vehicles)
  - $2,000 for vehicles up to 10,000 lbs. GVW
  - $5,000 for vehicles between 10,000 and 26,000 lbs. GVW
  - $50,000 for vehicles above 26,000 lbs. GVW
- Provides tax deductions for alternate fuel refueling facilities up to $100,000
- Provides low-interest loans up to $25 million for each fiscal year between 1993-1995

FIGURE 1

MANDATED ALTERNATE FUEL VEHICLE PURCHASES

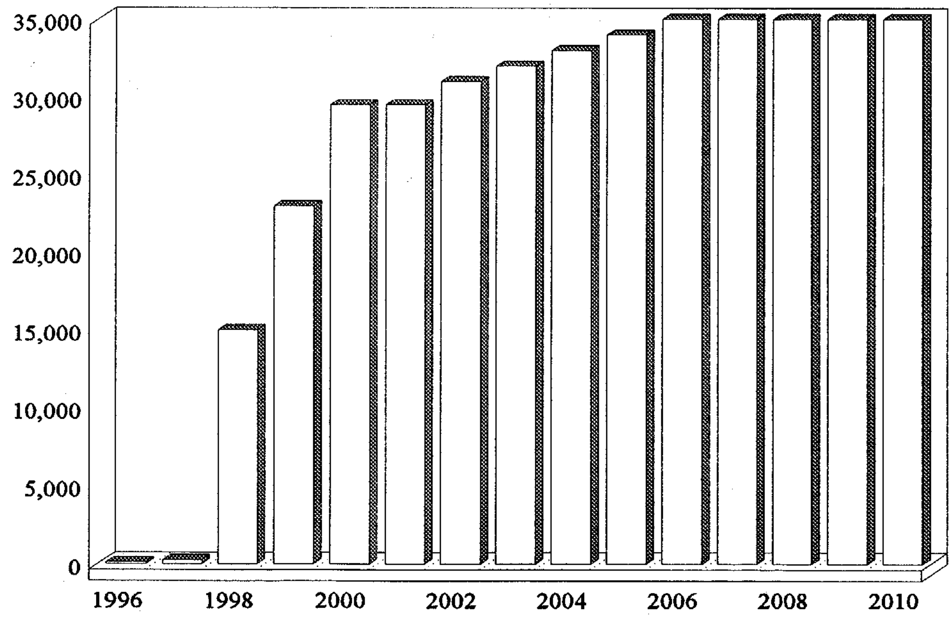
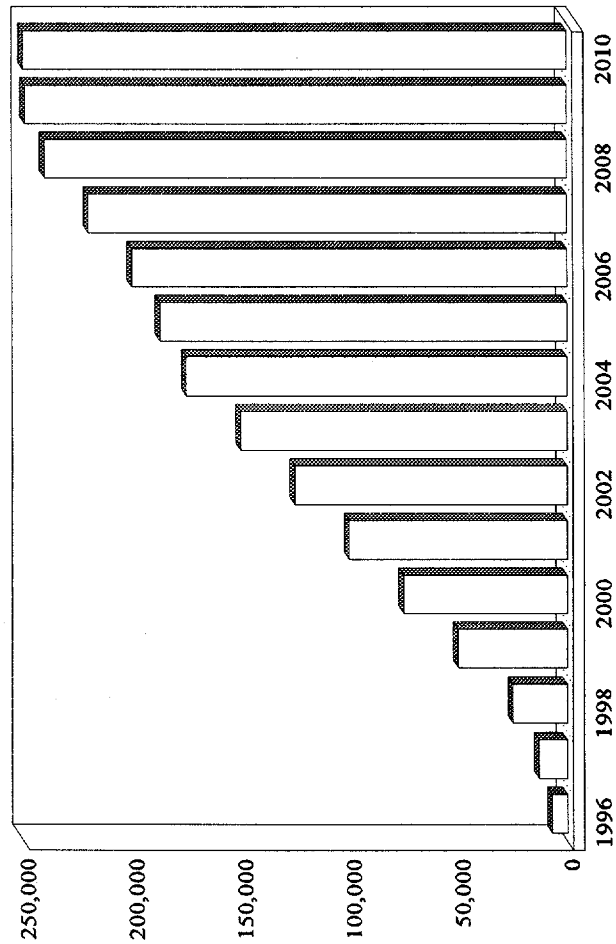


FIGURE 2

POTENTIAL CUMULATIVE NATURAL GAS VEHICLES ON THE ROAD



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