ENERGY EFFICIENCY AND RENEWABLES SOURCES: A PRIMER

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ENERGY EFFICIENCY AND RENEWABLE ENERGY PROGRAM PRIMER

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Foreword

The production and use of energy causes most of America's air pollution. Providing incentives to modify the amount and patterns of consumers' energy usage and to convert the mix of fuels consumed to produce it can yield profound air quality improvements. These improvements are especially valuable in areas presently not achieving our nation's ambient air quality standards.

Air quality and energy officials within government have long recognized the links between energy production and use and air quality. Unfortunately, they have rarely institutionalized that relationship by explicitly integrating their program objectives and guidelines to reinforce the values they share. As a result, producers and consumers who make energy efficiency improvements or select renewable sources of supply that reduce overall air emissions typically receive no tangible reward for their contributions to improved air quality. At the same time, traditional approaches to controlling air emissions, adding scrubbers or other controls to powerplants and tailpipes, sometimes frustrate our efforts to improve energy efficiency because they create new demands for it.

Historically, air quality officials have addressed themselves strictly to what leaves America's smokestacks and tailpipes. They have ignored the demands for energy that cause fuels to be burned in the first place. Energy officials, on the other hand, have promoted energy efficiency and renewable energy supply technologies because they are economical to consumers and reduce the nation's economic vulnerability to foreign suppliers. Energy officials have treated the associated air quality improvements as incidental. Today we must both do better; we must formally join forces with one another to maximize our respective impact.

This primer, as well as its companion primer, is a start. It gives state air quality officials a basic understanding of state energy efficiency and renewable resource programs. This information should help state officials create tangible rewards for the air quality improvements energy consumers and producers make when they increase energy efficiency and develop renewable resources within their state.

Without these added rewards, overall energy efficiency and renewable energy investments could decline as utilities eliminate the programs they were previously ordered to operate and emerging electricity markets drive prices down. Energy officials will not be able to rely on their traditional economic justifications to support the same level of energy efficiency and renewable energy development they are promoting today. They will need to learn how to incorporate environmental values into all of their transactions to avoid being forced to do less.

INTRODUCTION

A New Paradigm

Why are so may state legislators and Governors, conservatives, independents and liberals, interested in energy efficiency and renewable energy? Economic development opportunities, environmental (air quality) improvement, and a more reliable power supply...it's that simple. Like the dedicated state energy office and air quality officials who have recently begun to work together to advance these programs, they realize that from the supply or demand — side, there is nothing better a public servant can do for their economic and environmental future than to invest in energy efficiency and renewable energy programs.

Energy efficiency and renewable energy technologies help our industries prevent pollution. American industries spend at least $45 billion a year to meet pollution control requirements-and U.S. industries produce enough wastes to fill a train stretching to the moon and back, two times every year. Fortunately, politicians are learning that it is often much cheaper to prevent pollution through energy efficiency and renewable energy applications than it is to control it. A conservative 10 percent reduction in energy demand would reduce pollution control costs by a greater amount.

The numbers are in, and they look impressive. With 25 years of research, development, demonstration and valuable practical experience behind them, states have discovered that 25 to 30 percent returns on efficiency investments are common: There is more to the story. Energy efficiency advances are matched by renewable energy success stories. Over this same time period, the cost of electricity produced from renewable energy has declined by more than 400 percent for some technologies. Renewable energy produced by biomass, wind and solar is competing with natural gas.

Thanks to the states, there are hundreds of well-documented, commercialization success stories, case studies, and related state-led examples proving that energy efficiency and renewable energy are available, affordable and practical. However, this important data is only “icing on the cake.”

The real reasons these technologies are advancing at both the state and federal levels is because they keep jobs at home, lower costs to constituent businesses and homeowners and they clean the air at the same time. In political terms, they are a politicians' dream. It is a classic “win-win-win.”

About This Primer

Over the last two decades, states have poured billions of dollars into energy efficiency and renewable energy research, development and demonstration programs. Where are the results? If one were to look across all states and U.S. territories, where would one find the “winners?” What kind of programs have survived and risen to the top? What types of energy programs exist across the industrial, transportation, building, and utilities sectors? Which programs are surviving

and thriving? What kind of energy programs are most states involved in currently? What is the future of these programs given the restructuring of the electricity sector? This primer attempts to answer these questions and to give the reader a basic understanding of what kinds of energy efficiency and renewable energy programs exist at the state level now.

What do we mean by "energy efficiency" and "renewable energy?"

To appreciate how energy efficiency and renewable energy relate to air quality, it's important to understand what we mean by these terms. In the 1970's the Federal government promoted "energy conservation." Today, we encourage energy EFFICIENCY, and it has a far different meaning than energy conservation. We can have the same or better levels of comfort, prosperity, health and safety, but with less resource consumption. We want more bang for the BTU. More bang for the BTU generally means cleaner air, higher profits and greater economic productivity.

Not many people realize that the annual national energy bill is almost as much as the Federal income tax bill — more than $500 billion per year. Federal, state and local officials spend a lot of time in this country worrying about the impact income taxes has on the economy, but they virtually ignore the economic and environmental impacts of inefficient energy consumption. A number of notable economists have recently agreed that we can increase energy efficiency and "grow the economy" without losing jobs by investing in and using more efficient technologies — technologies that are available in the marketplace now such as lights, windows, appliances, cars, building systems, industrial processes, and so on. Many of these experts agree that energy demand could be reduced by as much as 30 percent through more efficient technologies.

By renewable energy, we mean solar, wind and other energy sources, where supply is virtually endless. Technology advances in recent years have made solar and other forms of renewable energy more cost-effective and reliable. A lot has happened since the 1970's when most of the research began. After a great deal of research and testing, wind technology has been dramatically improved, and wind turbines are among the most reliable of all electric generation equipment. Today, wind machines are churning out competitively priced electric energy--between 4 and 5 cents a kilowatt hour--around the country. Wind machines are operating in California, Minnesota, Iowa and Wisconsin. Other wind projects are now underway in Maine, New York, Wyoming, Oregon and Washington State. Soon, with a little more effort, wind turbines will be producing commercial power from New England to Hawaii.

Today, photovoltaic cells that turn sunlight into electricity are powering everything from spacecraft missions to Mars, to watches, telecommunications relay towers, water pumps for agricultural and ranching needs, highway signs and emergency telephones.

We should quickly review a few examples. Near Boston, Massachusetts, a Sealtest plant was producing almost as much red ink as ice cream a few years ago. It was one of the oldest and least-efficient plants in the Kraft Foods system, and Kraft considered closing it down. Two hundred jobs were going to be lost. The Massachusetts Office of Energy Resources conducted an

extensive energy audit at the plant and recommended $3.6 million in energy-saving projects. Boston Edison, the local utility, helped finance several of these improvements. The result? The plant experienced a 10 percent increase in productivity; the energy costs of producing a gallon of ice cream dropped from 7.5 cents to 5.5 cents, the plant remained open and 200 jobs were saved. Importantly, fewer emission were spewed into the air and more jobs have been added since.

Renewable energy programs provide similar benefits. The remote and/or rural applications of solar energy are well-documented. Most energy and air quality professionals know that if you need a water pump for livestock or need electricity supply for some other application and you are more than ¼ mile from a electric distribution line, solar energy is much more cost effective than running a new electric distribution line to meet your needs. Solar energy avoids the obvious emissions and environmental damage that accompanies building new electricity generation sources and extending any lines. It's also a more cost-effective, less polluting (and less noisy) alternative to diesel-power.

The photovoltaic demonstration project run by the Nevada State Energy Office helped avoid air emissions in the agricultural sector. (Again, photovoltaic technology converts sunlight directly to electricity.) Nevada's rural, arid nature presents a unique challenge to farmers and ranchers. Nevada's State Energy Office used photovoltaic-powered remote weather stations connected to phone lines, which allowed the stations to “talk” with and relay important climatic conditions via voice synthesizers to farmers. Since farmers often live distant miles from their farms, this application allowed the farmers to save transportation costs and emissions (saved gasoline) associated with their normal, numerous crop-checking trips. It also helped the farmers optimize their fertilizer and pesticide applications and crop rotations. This program is a wonderful example of a typical “pollution prevention” program run by the states.

Many people are unaware that new photovoltaic applications are used closer to home and abroad. Chances are, the (urban) station that relays your cell phone signal is also photovoltaic-powered. If you are one of the 23 states that allows “net-metering”, someone near you probably uses a roof-top photovoltaic module that allows them to power their own home and sell the “excess” electricity back to their local utility.

When you combine energy efficiency and renewable energy building practices, the results can even be more impressive. For example, a major company, Lockheed moved 2,700 of it's workers into a new building that made heavy use of energy efficiency and daylighting-- the practice of allowing more sunlight into building interiors. Lockheed is now saving $500,000 a year on energy bills, and is experiencing a 15 percent increase in productivity. This is typical.

From small agricultural photovoltaic programs to multimillion-dollar energy efficiency retrofits for major corporations, there are hundreds more examples like these in the U.S. economy today...thanks to state energy offices and their partners. Businesses and consumers are discovering that energy efficiency and renewable energy mean not just energy savings and improved national security (less oil imported), but also cleaner air, pollution prevention, more disposable income and profitable increases in productivity. This primer will help you learn about

these state energy efficiency and renewable energy programs and their link to America's economic and environmental future.

The primer is organized as follows: an overview of energy efficiency and renewable energy resources; Chapter I — a brief review of the history of energy efficiency and renewable energy development; Chapter II — a discussion of state energy offices; chapter III — a description of numerous state energy efficiency activities; Chapter IV — a description of state renewable energy resource activities; Chapter V — a discussion of the environmental benefits of energy efficiency and renewable sources activities; Chapter VI —- a description of verification methods and Chapter VII — a brief conclusion.

ENERGY EFFICIENCY AND RENEWABLE ENERGY PROGRAM PRIMER
OVERVIEW ENERGY EFFICIENCY

Energy efficiency refers to actions that are aimed at reducing the energy used by specific end-use devices and systems, typically without affecting the services provided. The goal of energy efficiency activities is to increase the end use efficiency of converting energy to useful energy products (e.g. heat, lighting, refrigeration, etc.).

Energy efficiency is not lowering comfort standards such as temperature or lighting levels to reduced energy use. Nor is energy efficiency managing the customer's electricity use pattern to optimize the operation of the electricity system. Energy efficiency is reducing kilowatt hours, not shifting kilowatt hours from a peak period to an off-peak period as would be achieved through a utility load management measure.

Energy efficiency can be one element of a utility demand-side management (DSM) program. Other DSM elements typically are load management programs to shift peak demand to off peak periods, and build off peak demand. Few current DSM programs are targeted to reducing kilowatt hours; rather they tend to be targeted to shifting peak demand to off peak periods.

Increased energy efficiency is in the public interest for environmental, economic and national security reasons. The production and use of energy causes most of the nation's air pollution. Fossil fuel combustion and the resulting emissions are harmful to public health in a variety of ways; harmful to ecological systems, especially by increasing the acidity of rainfall and water bodies; and a major source of greenhouse gases causing climate change. A reduction in energy consumption through greater efficiency of energy use is a means to reduce all emissions from burning fossil fuels including NO_x SO_2, and CO_2.

The environmental public interest is served by energy efficiency actions that are usually cost-effective to the user. Hence, long-term environmental and health benefits can be achieved by actions that have monetary benefits to the user and the economy.

Cost-effective energy efficiency actions are beneficial to individual users by reducing consumer costs, and to the economy by increasing discretionary income. Since energy efficiency actions usually reduce cash flow out of a region, such actions tend to improve the local, state, regional, and even national balance of payments. The national net import bill for energy (primarily petroleum) constituted $105 billion of the total national trade deficit of $370 billion in 2000.

National security and energy use are linked as long as a significant share of oil is produced in politically unstable regions of the world. Energy efficiency is one means of reducing growing dependence upon petroleum imports. The national bill for protecting our petroleum supplies is a huge economic burden that is not included in the price of energy. The Washington, D.C. based nonprofit entity, Sustainable New Wealth Industries, estimated the annual cost for protecting U.S. petroleum supplies to be $55 billion in 1999. It is predicted that U.S. reliance on imported oil will

increase to 61% of total national consumption and OPEC's portion of the world supply will be up to 56% in 2015. If we are no longer dependent on fossil fuels, we are less closely tied to instability in oil-producing countries.

Energy efficiency advocates are constantly asked, “If energy efficiency is that great, why isn't more happening?” There are several reasons why cost-effective energy efficiency is not occurring to a greater extent. They include: high consumer discount rates, inadequate information, lack of consumer awareness, technology transfer barriers, perceived risks, real and perceived insignificance of many energy efficiency investments, high transaction costs, lack of adequate financing arrangements and institutional constraints. A residential consumer may have a personal discount rate of 50 percent to 100 percent (i.e., 1-2 year simple payback) while being able to borrow at 10 percent; thus, many measures that would reduce energy and save money over the long-term are ignored. Business internal rates of return required for investment often are 25 percent to 40 percent; thus, eliminating many cost-effective energy efficiency investments.

Business firms and individuals lack information about energy efficiency measures, especially the financial options and implementation experiences of others. Normally they are unlikely to pursue such information due to the perceived insignificance of many energy efficient investments. While they may yield sound financial returns, the value of the savings achieved typically is only a small percentage of business operating costs. Generally, business managers are more interested in core activities such as expanding production. Furthermore, if there is some perceived risk of the technology not working and/or interrupting the firms day-to-day business, firm managers are reluctant to make new energy efficiency investments.

Energy efficiency investments, especially with technologies that are relatively new and unfamiliar to business, often carry high costs. Each step can add to the total cost — obtaining and verifying information, planning and design, arranging either internal or external financing, implementation scheduling, monitoring initial performance and implementing necessary adjustments. These steps are often perceived not to be worth the trouble for such a small benefit. Also, in some cases, the financing is difficult to obtain at attractive rates.

Institutional constraints can also limit energy efficiency investments. A building owner may not be responsible for the heating, cooling and electricity bills. Such an owner may not be interested in high-efficiency design and equipment in new building construction or retrofitting of an old building. On the other hand, if the building owner pays for the utilities, the occupant may not be very interested in energy efficient equipment. Government and government-assisted agencies tend to have a difficult time gaining funding in capital budgets and are given a baseline budget for operating costs. Typically, when a state agency reduces their energy consumption and saves operating costs, their budget is reduced by that amount the next year. Therefore, there is no incentive to implement energy efficiency measures. This budgeting reality leads to higher energy use than what would be cost-effective.

The public role in educating, promoting, encouraging, demonstrating, mandating, and delivering energy efficiency has been an important factor more that two decades. These public activities

have been carried out by all levels of government. The primary Federal involvement has come from DOE and EPA; the primary state involvement has been through the state energy offices (SEOs).

If energy efficiency activities are to continue to be important, a very strong public policy and education effort is necessary to transform the market for energy efficiency into one compatible with the competitive procurement of natural gas and electricity. Efficiency activities focused on the customer must replace the activities focused upon the utility due to the restructuring of the electricity industry. The energy efficiency industry must be expanded and encouraged to work in new sectors and to work with new delivery mechanisms for energy and other services.

Renewable Energy Resources

The term renewable energy resources refers to resources that are sustainable by their nature (e.g., solar, wind, geothermal, hydropower) or by replacement cycles (e.g., bio-mass). Renewable resources can provide energy directly (e.g., solar hot water heating); electricity directly (e.g., photovoltaics - "PV"); or electricity through generation (hydro, geothermal, solar thermal electric, or wind). The line between energy efficiency and renewable resources can be blurred. A passive solar design and/or system reduces energy demand. A customer's solar hot water system affects the electricity system by reducing demand, as does a customer's PV system. Renewable energy sources are available in the transportation sector as well. For example, a hybrid electric vehicle powered by a hydrogen fuel cell can be a totally renewable fueled vehicle if bio-gas or ethanol is the source of the hydrogen.

The increased use of renewable resources is beneficial to the public for national security, environmental and fuel diversity reasons. Renewable resources are local and not dependent upon vulnerable fuel delivery systems and/or price swings due to external factors, ranging from weather to war. A significant share of renewable resources in the electricity generation fuel mix can dampen potential electricity price swings caused by natural gas price volatility. Also, renewable resources can offset the potential disruption of other generation sources.

Renewable resources are environmentally benign, especially compared to fossil fuels. The air quality benefits of using renewable energy are remarkably significant. The zero carbon nature of wind, solar, hydro, geothermal and closed loop renewable biomass make these resources ideal for greenhouse gas reduction programs. Reduced fossil fuel use reduces both NO_2 and SO_2 emission as well as associated particulates.

The primary barrier to renewable energy resources development is the relatively high up front capital costs compared with existing fossil fuel systems. The competitive market's generation system of choice is a natural gas-fired combined cycle unit (gas combustion turbines linked through a heat recovery boiler to a steam turbine) capable of converting natural gas into electricity at an efficiency of over 50 percent. Such units are capable of turning $2.00/mmbtu gas into 3.5¢/kwhr electricity with a relatively low capital cost ($500/kw). While renewable resources

usually have low operation and maintenance costs, their higher capital costs place them at a disadvantage. In a competitive generation market with limited long term contracts, high capital costs are not valued. Also, dispatchability of generation is of increasing importance in a competitive generation market. Renewable resource generation with limited dispatchability has a lower value in such a market.

Public policy and programs have been major factors in the prior development of renewable resources through research and development, technology demonstrations to prove concepts, Federal and/or state tax credits, and Federal and state incentives/requirements for utility procurement of renewable resources. While some renewable energy technologies have reached cost competitiveness, if renewable resources are to continue to be developed, continued well-targeted assistance from public policy is needed.

Public Policy

A variety of policy approaches are used to increase use of energy efficient technologies and practices and stimulate renewable energy market expansion:

- renewable portfolio standard (RPS) - a requirement that a portion of all electricity sold be generated from renewable sources

- systems benefits charge —a charge on the distribution of electricity that is used to provide public benefits usually in the form of investments in energy efficiency, renewable energy technologies, and low income assistance

- tax credits/incentives — Federal and/or state investment tax credit to reduce renewable source development costs; reduce cost of energy efficient technologies

- net metering — an on-site renewable sources generation owner would be able to move electricity into the grid and receive the "net" of the price exchange

- disclosure — requirement that electricity providers disclose to the customer the environmental emissions profile of <u>all</u> electricity offered for sale

- certification/labeling — establishing a "green" label for electricity certified to be from renewable sources (whole or in part)

- codes and standards — establishing a minimum level of energy efficiency in buildings, equipment and appliances

- efficiency labeling — determining the relative energy consumption and its likely cost and placing this information on equipment and appliances

- efficiency certificate — establishing a high efficiency standard and certifying buildings,

equipment or appliances that meet this standard

- preferential financing — establishing a link between high efficiency buildings and mortgage lending practices

CHAPTER I
BRIEF HISTORY OF ENERGY EFFICIENCY AND RENEWABLE ENERGY DEVELOPMENT

Prior to the Arab Oil Embargo of 1973, interest in energy efficiency was virtually non-existent due to low energy prices and declining electricity prices. Greater electrification of the economy and more low cost petroleum imports were public policy objectives. The first oil price shock which dramatically effected all energy prices changed the public's perception of energy, availability, importance and price. Federal, state and local governments began to respond with policies and programs to encourage energy efficiency and to switch from petroleum to other fuels, including renewable resources.

The Energy Policy and Conservation Act of 1975 (EPCA) was a watershed event in energy efficiency policy and program development. EPCA established fuel efficiency standards for the automobile industry (a doubling of average automobile fuel efficiency over a 10 year period), established the State Energy Conservation Programs (SECP), and established the conservation program for schools and hospitals. Energy research, authorized by the Energy Research Development Act of 1974, ensured continued development of new more efficient products. The Energy Conservation and Production Act of 1976 established the State Low-Income Weatherization Assistance Program.

The Carter Administration, and especially Energy Secretary James Schlesinger initiated an energy policy with a major energy conservation component. Since 1972 Schlesinger had been arguing that energy conservation should be promoted on grounds of national security, foreign economic policy and environmental improvement. In administering EPCA and ECPA under Schlesinger, the Department of Energy greatly encouraged energy efficiency.

The Public Utilities Regulatory Policies Act of 1978 (PURPA) began opening the electricity generation market to competition and greatly encouraged renewable resources and cogeneration development. PURPA required independent generators to either use renewable resources or cogeneration in order to be considered qualifying facilities (QFs). QFs were guaranteed a market with the nearest utility at that utility's long run avoided costs. The fate of PURPA is uncertain given restructuring of the electricity industry.

The Carter Administration advanced energy efficiency activities and renewable resource development through a series of demonstrations, commercialization and marketing projects, tax credits, loans, grants, research and development of energy efficient and renewable energy technologies, efficiency standards, and consumer education. A significant portion of these efforts, especially in energy efficiency, was delivered through the states.

The fall of the Shah of Iran in early 1979 and the resulting second oil price shock further increased interest in energy conservation activities. The Three Mile Island accident in the spring of 1979 raised serious doubts about the future development of nuclear power and its role in reducing oil dependence. Rising energy prices and growing doubts about nuclear options increased interest in

greater energy efficiency and development of renewable energy resources. Increased energy efficiency often was used by opponents of nuclear units as an alternative to developing such units in the 1970's and 1980's.

The schools and hospitals programs, managed by the State Energy Offices, launched the concept of performance contracts for energy savings in the latest 1970's and early 1980's. Energy service companies (ESCOs) were born as a result of this program, according to an early ESCO pioneer.

The Reagan Administration significantly reduced Federal expenditures for energy efficiency and renewable resources. However, a new source of funding for such programs became available in 1982. Petroleum was under price and allocation controls from 1973 until 1981. Petroleum companies violated these controls. Eventually, the violations were discovered, disposed, prosecuted or settled. The overcharges in petroleum products by the oil companies was huge. The Federal Courts established energy conservation and low income assistance programs as a distribution vehicle for the overcharge funds to be returned to the public. To date about $4.5 billion have been distributed through the state energy efficiency and low income programs. Every state received these funds based on their petroleum usage, population, and other factors. These funds have been the major source of state energy efficiency programs. However, these funds are now nearly depleted.

The third oil price shock occurred in 1986 when the price of oil fell from $30/bbl to $10/bbl; a brief rebound in oil prices occurred during the 1990 Gulf War. The general trend in oil, gas and electricity prices has been downward in real terms since 1985. The decline in energy prices has been a significant factor in reducing the public's interest in greater energy efficiency and renewable energy.

In the 1980's some states (including California, New York, Wisconsin, Washington and Iowa) implemented the least cost concept in utility generation planning. The least cost concept, or integrated resource planning (IRP) as it was often labeled stressed saving kilowatts and kilowatt hours instead of generating them. The logic of the concept is that all energy efficiency up to the marginal cost of generation should be developed prior to any new generation facilities. “Why pay 6¢/kwhr when you can develop enough “negawatt hours” at 3¢/kwhr?” was the message. Utilities whose marginal generation costs were significantly above their retail prices or whose state public utility commission (PUC) granted a recovery of the “lost revenues” and a return of and on the energy efficiency investment became supporters of this concept. Until the early 90's, the concept and the related energy efficiency and load management activities grew in states where the PUCs supported the concept. The prospects of competitive markets and a restructured market lead to the death of most IRPs and the quick decline of utility energy efficiency activities (see Restructuring Primer).

It was a bipartisan vote of Congress -- the Energy Policy Act of 1992 -- that set much of the energy efficiency and renewable energy agenda the DOE and EPA are implementing today. It was a Republican president, George H.W. Bush, who signed that legislation. It was under the first Bush Administration that the energy efficiency and renewable energy budget began to grow,

in real dollars, for the first time in a decade. This upward trend continued through the first two years of the Clinton Administration. In 1994, the federal budgets for renewable energy and energy efficiency were cut by Congress by 30 to 50 percent. Thereafter, the federal investment in renewable energy and energy efficiency research and development remained reasonably steady.

The Energy Policy Act of 1992 (EPACT), three years in the making, was a comprehensive national energy bill. It set new efficiency standards for homes and office buildings, mandated new efficiency standards for lighting, motors, utility transformer, heating and cooling equipment in commercial buildings and authorized DOE to set standards for showerheads, faucets and toilets. States were encouraged to upgrade the energy efficiency elements of state building codes, develop home rating systems for energy efficiency, and conduct various commercial and industrial efficiency programs. The Federal Energy Management Program (FEMP) was charged with reducing federal building energy use by 20 percent below 1985 levels by 2000.

EPACT also established a 1.5¢/kwhr production incentive to generation owners of new (1994 or later) renewable resources (wind, solar, closed loop biomass, and geothermal) for a maximum of 10 years. This provision, one subject to available appropriations, has resulted in an annual battle that to date has been mixed. As is the case with many of EPACT's major provisions, Congress has neglected to provide consistent funding for these programs. Also, EPACT provided for a permanent 10 percent investment tax credit for the purchase and installation of solar energy by a commercial entity.

The Department of Energy’s efficiency programs currently save consumers more than $25 billion each year. In total, the Department's energy efficiency programs are projected to save consumers and businesses over $30 billion per year by the year 2010. These programs focus on improving energy efficiency in buildings, transportation, and industrial processes, as well as how the federal government can save energy in its buildings and facilities. The US has spent approximately $12 billion since 1978 on energy-efficiency research, development, and deployment. A small group of selected, audited technological achievements by DOE - a fraction of the overall achievements -- in energy-efficiency have returned more than $100 billion to the U.S. economy during that period and facilitated large reductions in the emission of air pollution.

CHAPTER II
STATE ENERGY OFFICES

The State Energy Offices (SEOs) are the focal point in state government for both energy efficiency activities and the encouragement of renewable resource development. The SEOs are advocates for increased energy efficiency investments in the public and private sectors and the renewable resource development advocates within the state government.

Most state energy officials deal directly with energy efficiency and renewable energy industries more than any other state agency. Most SEOs actively provide economic development opportunities for state businesses. As such, they are not perceived as regulatory agencies. They enjoy a unique relationship with industry. Most SEOs maintain the energy efficiency component of their state building code and many SEOs are involved in the development of home energy rating systems. SEOs manage the Federal State Energy Program funds, the institutional buildings programs and maintain energy efficiency education and outreach programs.

Many SEOs are involved in various energy efficiency and/or renewable resource development projects, often in partnership with state industries. Many SEOs manage alternative transportation fuels and vehicle programs. Many have worked closely with the DOE, EPA and national laboratories, especially the National Renewable Energy Lab, (NREL) in demonstrating new technologies. SEOs, through the institutional buildings programs, have worked closely with ESCOs in the use of performance contracting. Some SEOs manage the state Weatherization programs.

Often SEOs provide Governors and Legislatures guidance on energy policy, especially in the areas of energy efficiency and renewable resource development. The initial round of appliance standards in the U.S. was developed by large states such as California, New York and Florida. These standards evolved into national standards. Recently, some SEOs have been very involved in the development of the new strengthened national appliance standards.

SEOs can be independent agencies such as the California Energy Commission and the New York State Energy Research and Development Authority. However, in most cases SEOs are divisions of a large agency such as Economic Development, Public Utility Commission, Natural Resources, Environmental Protection, Housing and Community Development or General Services. In some cases, the SEOs are attached to the Governor's Office.

SEOs are as diverse as the states themselves. The role and focus of an individual SEO are influenced by unique characteristics of the state and the mission of the primary agency. Thus, an SEO in a natural resource agency in a prairie state might be involved in a wind farm project and/or a tall grasses bio-fuels project. An SEO in a Housing Agency might be involved in public housing energy efficiency retrofits through performance contracting. An SEO in a rapidly growing state might be involved in building code upgrades and home rating systems. An SEO in an agricultural state might be involved in various increased energy efficiency projects in farming and/or food processing.

Electricity restructuring programs in individual states may expand the role of some SEOs and broaden the agency's funding base for energy efficiency activities and/or renewable resource development. The concern over possible stranded public benefits such as energy efficiency programs, renewable resource development, energy research and development, and low income assistance programs has led many states to establish system benefit charges for funding such programs. The administration of these funds is often assigned to a government entity such as the SEO. It is the natural evolution for most SEOs.

CHAPTER III
ENERGY EFFICIENCY ACTIVITIES

Energy efficiency activities can be classified by program or measure. A measure is a specific action that increases end-use energy efficiency (i.e., what was done). A program is the delivery system that results in one or more measures being implemented. For example, a State Institutional Buildings program might include many measures — lighting retrofits, HVAC retrofits, shell upgrades, window upgrades, and even cogeneration of electricity.

The core of energy efficiency activities are the individual measures, since greater efficiency occurs only when a measure is implemented. Some programs have only one measure, usually focused on implementing a specific technology in a specific sector (e.g., compact fluorescent lamp purchase subsidies for residential customers). Other programs are focused on customers in specific sectors and the implementation of cost-effective measures (e.g., ESCO performance contracts in commercial buildings).

Examining the profile of energy use is useful in understanding the focus of energy efficiency activities. The U.S. primary consumption of energy by fuel type in 2000 was petroleum 37 percent, natural gas 24 percent, coal 23 percent, nuclear 8 percent, and hydro etal 7 percent. The primary consumption by sector was electric utilities 41 percent, transportation 30 percent, industrial 16 percent, residential 8 percent, and commercial 5 percent. The electricity consumption sectoral breakdown was 35 percent residential, 31 percent commercial, and 34 percent industrial. There is a wide variation in the profiles among states. For example, the New York electricity consumption breakdown is 31 percent residential, 45 percent commercial, 22 percent industrial, and 2 percent transportation; California's consumption is 30 percent residential, 35 percent commercial, 24 percent industrial, and 17 percent other, including agricultural.

Building Programs

Buildings are the major users of electricity; the residential and commercial sectors account for 66 percent of electricity use in the U.S. (66 percent in California). Also, residential and commercial buildings consume about 50 percent of non-electricity generation-related natural gas supplies. Buildings have been and continue to be a major focus of state energy efficiency activities.

Energy efficiency activities can be divided into prevention activities, such as energy efficiency building codes, and remedial action, such as building retrofits. Often the line between prevention and remedial activity is blurred by programs which encourage customers and suppliers to go beyond the minimum efficiency in both design and equipment.

Building Codes

Most state and/or local governments maintain and enforce residential and commercial building codes to ensure the health and safety of building occupants. These building codes have been enriched by the addition of an energy efficiency element. These code elements regulate the energy efficiency of the building shell and energy using equipment. The codes have a prescription section — "you must design and construct in this manner"; and often have a performance section — "if you can demonstrate a superior way to achieve the prescriptive energy efficiency or better, you may."

The evolution of the energy efficiency element of the building codes began with the Arab Oil Embargo of 1973. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) in 1975 developed ASHRAE-1975, an energy efficiency standard covering both residential standards and commercial building standards. The Energy Policy and Conservation Act (EPCA) of 1975 greatly encouraged states to adopt ASHRAE-1975 or a more energy efficient code. Some leader states such as California, New York and Florida adopted tighter codes. However, Texas and Illinois, without statewide building codes, lagged in code development.

The residential and commercial energy efficiency codes have evolved. The Council of American Building Officials (CABO), with considerable pressure from public home mortgage institutions, developed a Model Energy Code for one and two family residences in 1983. Annually, the model is reviewed for revisions; updates, which are approved, are added to the Model Code. Most states have adopted the CABO Model Code in whole or in part at one point in the Model Code evolution. ASHRAE has made changes to their model commercial code and are scheduled to produce an upgraded ASHRAE-90.1 in 2000 to cover commercial and multi-family buildings. International residential building codes are currently under review by many state and federal entities and the home building industry.

To realize its potential savings, a code requires enforcement through trained inspection. The verification of the code (and its measure) is through physical inspections that ensure proper installation. The performance of the design, shell and equipment are verified by the code development process and supporting research. If a given design, construction practice and specific equipment standards are implemented, the building will achieve a specific energy efficiency level.

The state's role in building codes includes maintaining the enforcement of the existing code through training of enforcement officials; reviewing model code updates; where desirable, proposing to upgrade the state code based on model code changes or other information; activating the proposed code changes in the state process (legislative or regulatory); and, if adopted, ensuring local code enforcement officials are aware of, and trained in, enforcing the new code items.

Building codes have been and continue to be a <u>major</u> source of energy savings. The California

Energy Commission estimated that as of 1998, 6000 megawatts have been saved as a consequence of their programs. Building code programs have been a major source of these savings.

As revisions or additions to model codes are approved, a state may choose to update its energy efficiency codes or not. Also, states may choose to go beyond the model codes in areas where they believe it is in the interest of their citizens. A state is not required to upgrade its codes when a model code is upgraded. For example, the new commercial building code ASHRAE 90.1 is a more energy efficient code based primarily on new technology. ASHRAE 90.1 is scheduled to have a further upgrade in 2005. Whether a state's commercial and multi-family buildings are built to these codes or a less energy efficient current standard is the state's decision. Automatic upgrading of a state building code is not “business as usual”. The decision regarding the upgraded ASHRAE 90.1 will have a significant impact on energy use in a major energy using sector for decades.

These decisions have a very significant impact upon energy consumption over the life of the affected buildings. Given the proportion of energy used in buildings, the level of energy consumption of buildings has a significant impact on total energy consumption in an individual state and in the nation.

Commissioning

Commissioning refers to a practice, common in Europe, of retaining a third party to verify the performance of a new building's systems prior to the owner's final acceptance of the building from the builder. The efficiency performance of the energy systems is a major element of this commissioning. Usually the building operators are trained to operate the building's systems in an optimal manner as an element of the commissioning process. Commissioning reinforces the energy efficiency performance approach to energy efficiency building codes.

The increased use of sophisticated building systems controls and building commissioning are very compatible developments. A third party, skilled in optimal building system operation, can detect any problems in the construction or initial operation; suggest corrections; train the building operators; and verify the building's performance. The sophisticated building system controls via their computer systems continually monitor and verify the building's performance.

Commissioning is not as common a practice in the U.S. as it is in Europe. However, efforts are underway in Oregon, Washington, Wisconsin and Iowa to expand commissioning activities. Retail chain owners have cited building commissioning as a service that future energy service providers might offer as a value added service in competitive retail energy markets. For example, an electricity and gas marketer's energy service group would verify the optimal energy use by the individual discount store buildings under normal operating conditions for business with 200 such buildings. This discount chain might be opening one store per month. A commissioning service could be used to lower the building's energy cost.

Home Energy Rating Systems

While a state energy efficiency building code sets a minimum standard for the efficiency of a home, a home energy rating system (HERS) documents the relative efficiency of a specific home above the minimum standard. The objective of the HERS concept is to encourage the demand for a supply of homes built significantly more energy efficiently than the building code efficiency standard. A rating is established relative to the minimum standard usually in distinct classes (e.g., one star — ★; two stars — ★★, three stars — ★★★; four stars — ★★★★, five stars — ★★★★★). States encourage and oversee the development and operation of HERS to upgrade the efficiency of new housing through market transformation.

The life cycle cost for a highly efficient home is likely to be lower than the life cycle cost for a minimum standard home. The reduced energy use more than offsets any additional construction and/or equipment costs. In the homeowner's terms, the total (mortgage + energy) cost of a five star home is likely to be less than that of the minimum standard home. Mortgage lending institutions have recognized the potential for HERS programs to increase capital costs and mortgages slightly, lower total costs and reduce mortgage repayment risks. Their endorsement and use of HERS is likely to broaden the interest in, and use of, these programs by builders and customers. HERS is coupled with so-called Energy Efficient Mortgages (EEMs) in the program. The EEMs effort is being led by Fannie Mae and Freddie Mac.

The verification of the energy efficiency of the rated home is performed by using an established third party rater. The desire by a builder to meet an “above code” classification is driven both by marketing objectives (“built better”) and mortgage market objectives (“home meets mortgage market efficient classification — more home, same income”). HERS program are market-based means to upgrade the energy efficiency of future homes.

Working with mortgage lenders, the states are the vehicle for initiating and expanding HERS programs. The goal is to facilitate movement of private capital into energy efficiency improvements in the residential market. HERS programs and the linkage of Code programs to the mortgage market are not “business as usual” activities. The pursuit of such market transformation measures is an uphill fight state-by-state.

Building Retrofitting

The current building stock is not nearly as energy efficient as economic analysis shows it should be for optimal economic efficiency. There are numerous measures from lighting upgrades and heating and cooling equipment replacements to shell upgrades which would be cost-effective to the building owner and/or occupant. The reasons for sub-optimal building efficiency range from the building owner not paying for the energy, (hence, not motivated to pay for upgrade measures); to relatively small cost savings for parties unfamiliar with energy efficiency measures to pursue. Limited knowledge concerning what to do and a lack of knowledge on how to do it, result in a low interest in pursuing energy efficiency measures. Also, building operation and maintenance is a low priority item for most businesses; available capital is usually used to gain

markets and expand products.

There are several different programmatic approaches to delivering energy efficiency measures in buildings. Some approaches are holistic in that they attempt to deliver all cost-effective measures to all or a class of buildings (e.g., Institutional Buildings Program). Other approaches focus on a limited set of measures (e.g., EPA's Energy Star Buildings/Green Lights Partnership) using a specific type of technology upgrade. Some approaches focus on all elements from education through installation; others focus on the education and auditing for possible measures or on gaining corporate agreement to install a measure. Often two or more programs can lead to one or more measure being installed. For example, the Greater Gotham Hospital could agree to be a "Green Lights" institution, have a holistic audit and installation of several measures, including a lighting upgrade by an Energy Service Company under a State Institutional Building program with some of the installed equipment subsidized by a utility DSM equipment rebate program.

Governments have a direct fiscal incentive for energy efficiency in government buildings and buildings occupied by government-assisted institutions or people. The Institutional Buildings Program, Weatherization Program, Federal Energy Management Program (and the state counterparts), public and publicly assisted housing programs and the Department of Defense's ESCO-based efficiency program all have as a primary goal lowering government expenditures through increased energy efficiency.

Institutional Buildings

In 1975, the Energy Policy and Conservation Act launched the schools and hospitals energy efficiency program managed by the states. This program provided technical assistance funds for detailed audits and engineering analysis pertaining to measures and matching capital to implement cost-effective measures. This program has evolved through the years into the Institutional Building Program with many variations among the states.

The concept of performance contracting, a contract between an energy service company and the customer which guarantees the energy savings and is based on performance of the installed measures, was developed in the early schools and hospitals program. The ESCO industry is based on the simple process of inspecting a building for energy efficiency improvement measures, reviewing recommendations with building owners, implementing the measures accepted by the owner at no front-end cost to the owner. The ESCO guarantees the energy savings will cover the investment cost of the measures. Measures that perform better than guaranteed result in higher profits to the ESCO and lower costs to the building owner. Measures that perform more poorly than guaranteed, reduce or eliminate the ESCO's profit; hence, the measures are nearly always corrected to produce the savings that were guaranteed.

The evolution of the institutional buildings program in some states have included expanding the sector to cover potentially all government buildings, all health care institutions, most non-profits, all educational buildings, etc. Also, the linkage of private capital to the program is growing following the initial efforts by innovative state programs such as the Iowa Building Energy

Management Program.

Many institutions are retrofitted outside of this program by ESCOs using the concepts developed in the program. Performance contracting is gaining acceptance in the financial community as a low-risk investment. However, the projects must be aggregated by the ESCO or a third party since the transaction costs for the typical loan are high for the size of the loan.

Verification of performance contracts is essential for ESCOs. The actual performance of the measures usually determines the project revenue stream and profit to the ESCO. A series of verification and monitoring protocols have been developed for use in performance contracts. The verification of the results are basic to the performance contract. Typically performance contracts out-perform their guaranteed savings levels by 15-20 percent.

Loan Programs

The Oregon SEO has been operating a self-supporting loan program for energy efficiency and renewable energy sources since 1981 serving individuals, businesses, nonprofit organizations, state agencies, schools, and local governments. The loan capital funds are provided by State of Oregon bonds which may be issued up to $40 million each year. The loans to the private sector can be matched with Oregon's business energy tax credit of 35 percent.

The Nebraska SEO has been operating a loan fund in partnership with state banks and credit unions since 1990 initially capitalized with $10 million in oil overcharge funds. The program has leveraged $39 million in private financing using $22 million in oil overcharge funds and $19 million in loan repayment funds. The loans are limited to energy efficiency and waste minimization projects in the residential, business, public and agricultural sectors. Idaho offers a similar program.

Loan Facilitating

The transaction cost for individual energy efficiency project loans often discourages major lenders from becoming involved. Yet major capital lenders appear to have a growing interest in the efficiency market, especially if the transaction cost barrier can be overcome. Some states have solved this dilemma in some sectors by becoming the loan marketer and aggregator and maintaining project quality control for private capital providers. This facilitating function can be a major factor in whether private sector efficiency markets develop in a state.

An outstanding example of this loan facilitator activity is the Iowa Building Energy Management Program operated by the Energy Bureau of the Iowa Department of Natural Resources. This program provides loans for energy efficiency investments through Norwest Bank for public and not-for-profit agencies. The loan facilitator activities include aggressive marketing of the loan

program by the state energy office, technical assistance in identifying good measures, technical review of the loan application to provide quality control, and development of a package of loans. The Wisconsin Energy Bureau operates a similar program. Wisconsin Energy Initiative 2, initially targeted to all Wisconsin schools, is using performance contractors and a number of lenders. Montana uses state issued bonds to underwrite its school energy efficiency programs. The Maryland energy office has a loan facilitator program with GE Capital. Similar innovative financing programs are operated by Mississippi, and Oregon.

This broker function may work especially well for efficiency projects in education, medical, not-for-profit, public housing, and state and local government facilities. The broker brings together private efficiency providers with public and not-for-profit customers; verifies the quality of the proposed projects; bundles the projects into a financing package; and, selects a capital lender. This function may be very important to attract private capital to improve the energy efficiency of public and public related services, thus reducing the need for public funds for direct energy expenditures.

Government Facilities

A major effort is underway to upgrade the energy efficiency of all Federal facilities through performance contracting. Two major parallel efforts are the Federal Energy Management Program managed by DOE and a Department of Defense (DOD) program managed by the Corps of Engineers. Many states have similar programs underway in state facilities and in some cases include local facilities. The essence of the program concept is to allow selected ESCOs to search for cost-effective measures in the government facilities, recommend the measures, secure financing for the projects (to be repaid from savings), oversee the measure implementation and verify the savings. The government facility owner would have a limited investment of staff time and no investment in capital to implement the project. The President's Executive Order #12902 sets forth the goal to lower Federal government energy use by 20 percent by 2000.

The diversity of Federal and state facilities in function, especially those of DOD, is leading to the deployment of a greater diversity of cost-effective measures. The “lessons learned” by the ESCOs in Federal and state programs will be useful in developing non-government projects in the commercial and industrial sectors. Some states (i.e., Montana and Iowa) have contracted to perform some of the energy efficiency services on federal buildings in their states.

State Low-Income Weatherization Assistance Program

The Energy Conservation and Production Act of 1976 created the State Low-Income Weatherization Assistance Program. The concern which led to this legislation, and which has sustained the program for over 20 years, is the disproportionately large share of income which the poor spend for fuel and electricity. The weatherization of low-income homes lowers energy use

and expenditures, thus increasing the discretionary income of low-income families. This program is both an energy efficiency and a social program.

The program has evolved into a holistic approach to reduce energy use in a low-income home. The weatherization contractors determine what is cost-effective to implement and oversee the implementation. Very significant upgradings of efficiency are possible due primarily to the low energy efficiency of the existing homes. The scale of this program has been determined primarily by Federal appropriations, use of state petroleum overcharge funds and interest by utilities to provide funding under utility DSM programs. About 70,000 homes are weatherized each year due to this program.

Verification of the results of weatherization projects have evolved with the program. The need for and likely results of measures are determined through individual home testing. Determining that the recommended measures are installed correctly is central to weatherization project verification. A recent study prepared by Oak Ridge National Laboratory concluded that the program is highly successful and has improved over the years.

Public and Publicly-Assisted Housing Programs

A vast potential for increased energy efficiency exists in public and publicly-assisted multi-family housing. Unfortunately, this potential remains virtually untapped due to a lack of funding. However, an approach by the U.S. Department of Housing and Urban Development (HUD) to encourage public housing agencies (PHAs) to work with ESCOs to reduce energy use is attracting private capital into this sector.

Under this approach, HUD will allow a PHA to retain 100 percent of the value of the reduced utility consumption made possible through a performance contract for up to 12 years. The performance contract must guarantee that the reduction in energy use will occur through the measures taken. The financing of the measures must be from non-HUD funds. Many PHAs are beginning to use this approach. Many are also beginning to couple this concept with competitive procurement of electricity and natural gas as an evolution of the concept.

Verification of the energy savings is an essential element of the performance contract between the ESCO and the PHA. Often the guaranteed savings on such projects are conservative as a means to manage potential risks.

Commercial Buildings

The lighting and HVAC systems of commercial buildings are favored targets of opportunity for energy efficiency retrofits through a number of delivery programs. Utility DSM programs in the past have offered audits and equipment rebates. State programs have offered cost-shared audits and technology demonstrations. EPA, through the Green Lights Program, has offered

encouragement through information, recognition and verification of good intentions fulfilled. ESCOs, with prior knowledge garnered in the public sector, offer no front-end lost financing which is repaid through savings. The ESCOs, working with banks, provide the financing.

The emergence of energy service providers (ESPs) in the competitive retail market for electricity and natural gas provides another delivery system for energy efficiency upgrades in the commercial sector. An ESP joins with an ESCO and offers energy efficient upgrades, as well as electricity and/or natural gas. For example, Duke Energy Services is providing energy and energy efficiency services to all First Union Bank branches in a number of states. Carolina Power and Light's energy services unit, Strategic Resources Solutions (SRS), has acquired an energy efficient lighting firm, Parke Industries, to give SRS a national presence in the business of designing, installing and financing energy efficiency lighting systems. The primary delivery mechanism is a form of performance contracting.

The building owners and managers associations (BOMAs) of major metropolitan areas are in the process of aggregating the electricity demand of participating owner's buildings, where and when retail choice is permitted. In some cases energy efficiency services are included in the proposed procurement. A major initiative to upgrade the energy efficiency of major commercial buildings in a metropolitan area could result from such a procurement program.

If performance contracting is the delivery mechanism, the verification of energy savings follows standard performance contract methods. In many cases, the energy efficiency upgrade is a lighting and/or HVAC system change. The savings from such changes are usually stipulated based upon the relative equipment efficiency upgrade. The key to the verification is “whether the equipment was installed and, if so, was it installed properly.”

Industrial Programs

Many states are very active in industrial energy efficiency projects, programs and demonstrations. The variation in projects tend to mirror the diversity in industrial base among the states. Often the state programs are industrial class-specific, targeting significant industries in the individual state (e.g., pulp and paper in New York; fish farming in Mississippi). These programs tend to focus on the perceived needs of the industrial customers. States with strong agricultural and/or industrial outreach assistance programs often place a heavy emphasis on energy efficiency components.

States with major research and development functions (i.e., New York State Energy Research and Development Authority, California Energy Commission) often partner with a state industry or industrial association to demonstrate an emerging energy efficiency measure and/or a renewable energy resource application. Once the “proof of concept” is documented in the demonstration project, the measure is ready for replication in the broader competitive market place.

The Environmental Protection Agency and U.S. Department of Energy's National Industrial

Competitives through Energy, Environment and Economics ($NICE^3$) program is a model of industry-state partnerships. It is one element of a comprehensive industrial process review. $NICE^3$ is active in nearly half the states with a wide range of projects which reduce energy use and meet environmental compliance in a cost-effective manner. The need for environmental compliance often triggers a comprehensive review of industrial process.

Total Assessment

Industrial firms, seeking to increase productivity and profitability, may perform a total assessment of all aspects of their production including energy use per unit of production. Firms that are facing either an environmental compliance order or have an expensive compliance problem are often interested in a total assessment. The desire to reduce their waste stream is the primary driver of this assessment, while energy efficiency gains and other productivity improvements may be a secondary means to pay for some or all of the compliance costs. A total assessment of an industrial process productivity, waste generation and energy efficiency is a means to help improve the firm's economic competitiveness, reduce environmental residuals and increase overall energy efficiency. Such an assessment recommends measures which, if implemented, would significantly improve the firm's profits.

The measures implemented can be generic (i.e., motor system retrofits) or very specific to the individual process (i.e., replace pumping units). The key to a total assessment is the holistic nature of the recommendations and the direct link to improving the industrial process.

A New York program, the Flex-Tech program, provides industrial firms with a variety of professional services through contractors on a cost-share basis. The services include process improvement analyses (including waste stream reductions), detailed energy efficiency analysis, commissioning of energy efficiency measures, and technical training. This program is targeted to specific manufacturing sectors vital to the New York economy.

Motor Driven Systems

Motor driven systems use most of the electricity consumed in the industrial sector and more than half of all electricity consumed in the U.S. (i.e., appliances, HVAC systems in residential and commercial sectors are motor driven). In many industries, motor driven systems account for more than 70 percent of the electricity used. Hence, the focus on the efficiency of motor driven systems.

The energy efficiency of a motor driven system can be improved by use of more efficient motors, use of variable speed drives that match motor performance with system demand, and improvements in the basic equipment driven by the motor (i.e., pumps, fans, compressors). Determination of the optimal motor driven system can be very complex; system designers often oversize equipment resulting in poor efficiency.

The Department of Energy's Motor Challenge program works with the states, industry and utilities to showcase efficient motor driven systems and gain the commitment of individual industrial firms to use such systems. The Motor Challenge program provides information and analytical software to help firms (or their consultants) to evaluate motor system upgrades. States help implement this program; for example, in New York, the Flex-Tech program has a major motor driven system element which builds on the Motor Challenge program.

The transformation of motor driven systems to greater energy efficiency can require a long-term series of efforts focused on providing information to a range of customers, demonstration of specific high efficiency systems in specific applications, and financial incentives to manufacturers to develop high efficiency systems for specific applications. It is ideal if the market transformation of more efficient motor driven systems occurs across numerous specific applications.

Some existing utility and state programs have provided information, technical assistance and in some cases financial incentives (through rebates) to the customer. The utility efforts are likely to be greatly reduced if not eliminated as competition develops. Furthermore, state industrial programs are suffering from reduced funding. Thus, current efforts to transform the motor driven systems markets are likely to be greatly reduced unless a new approach is taken.

Fully competitive retail electricity markets can lead to the coupling of high efficiency motor driven systems with electricity sales. A retailer can offer to provide energy services, including new equipment, or as an alternative, sell thermal energy, compressed air, lighting and mechanical power.

Best Practices - Communities

A number of state-community energy efficiency partnerships are under development. Many of those partnerships are in response to the Department of Energy's Rebuild America program. For example, the Iowa Energy Office has organized such a partnership, which provides a local capital pool below prevailing interest rates. The concept of the community “best practices” program is to demonstrate broad application of energy efficiency measures in “typical” communities. These programs are often implemented through private sector providers such as energy service companies (ESCOs). Under such a program, an ESCO can be selected on a bid basis to blanket the community offering a determined set of measures to residences and businesses. The measures can be funded primarily by the customer.

Procurement

One fundamental way to transform a market is through new procurement standards established by a group of major consumers. For example, the recycled paper content requirement of the Federal government, some state and local governments and others have transformed the paper industry.

The procurement standard induced-demand led to major recycled waste paper investments for a variety of paper products. Procurement standards by governments and others can have an impact upon the demand for energy efficient equipment. Development of procurement system innovations that emphasize energy efficiency standards and life cycle costing can transform the market for some electric equipment.

Many states have energy efficiency criteria for the procurement of some equipment. State governments, working with the Federal government and other institutions, can significantly influence the market for new office equipment and buildings designed for the information age. For example, EPA and DOE are working with state and local governments to develop an energy efficiency procurement system (Energy Star Purchasing) using information from Energy Star-labeling products and the Federal Energy Management Program's Product Energy Efficiency Recommendations (PEERs). This procurement system, once integrated into state and local government procurement, would complement programs such as EPA's Green Lights and Federal Procurement Challenge programs. State and local governments spending for goods and services is about 11 percent of the national economy as compared with 6 percent for the Federal government. The opportunity to transform markets through government procurement is significant. Public housing equipment procurement can provide a specific opportunities to transform residential equipment markets. For example, the New York Power Authority and the New York Housing Authority developed a high efficient procurement program for small refrigerators typically used in public housing. The increased demand for high efficiency small refrigeration helped transform the market for such equipment.

Systems Benefit Charge

Future levels of efficiency activities and procurement of renewable resources can be funded through a charge placed on the distribution (monopoly function) of electricity. The terms used to describe such a charge include system benefit charge, access charge, wires charge, meter charge, public benefit charge and universal service charge. While terms differ, the concept is the same.

In all likely future electricity industry structures, the distribution function will be regulated by the state due to its inherent monopoly status. All sales will be distributed through regulated distribution companies. This charge on sales can be non-bypassable to ensure that the charge is competitively neutral and all electricity customers pay the charge.

A very positive feature of the system benefit distribution charge is that it would function effectively throughout the transition phases of electricity restructuring to the final electricity market structure, since the distribution function will remain a state regulated monopoly under all the foreseeable future industry structures. As many states decided, the distribution charge to ensure that public benefits continue as industry restructuring occurs is very feasible.

The direct solution to ensuring a long term effort to increase electricity energy efficiency and

continued procurement of renewable resources is to fund some level of these actions through a portion of a system benefit charge on the distribution of electricity to the customer's meters. This charge can be an element in the comprehensive solution to mitigating, to the degree possible, the negative consequences of industry restructuring. Since both efficiency activities and renewable resource procurement are at great risk early in the transition, most state energy policy makers believe the early development and operation of this mechanism is critical.

System benefit charges have been established in most states that have enacted restructuring laws. California, Connecticut, Illinois, Maine, Massachusetts, Montana, Pennsylvania and Rhode Island have some level of energy efficiency funding through a system benefit charge. However, the level of funding on a per kilowatt-hour basis varies significantly among these states. Previous Administrations have proposed federal system benefit charges that would match state funding, however the current Administration's National Energy Policy does not make specific references to these state funds.

Energy efficiency programs that can be funded by the system benefit charge can easily include all of the above programs, especially those that use the market to transform the market demand for energy efficient buildings and equipment. Programs that facilitate the movement of private capital into public sector areas and programs that expand the use of ESCOs in the private sector are likely to be supported and expanded by states through the use of system benefit funding. Also, system benefit charges can fund various renewable energy programs.

Transportation

States operate a variety of programs in the transportation sector targeted to reducing the use of petroleum. The focus of a number of these programs is replacing gasoline and/or diesel oil with an alternative transportation fuel (i.e., ethanol, methanol, natural gas, electricity). Other programs focus on reducing highway transportation demand — vehicle miles of travel (VMT) or in improving the efficiency of the highway system. Such programs usually are in cooperation with state transportation agencies and /or state environmental agencies.

Alternative transportation fuel and vehicle programs (ATVs) require considerable coordination among vehicle fleet operators, vehicle manufacturers, fuel suppliers and state agencies. The vehicles require fueling stations in the appropriate locations, the fueling stations require an adequate number of vehicles to be profitable, and the manufacturers require a demand for their vehicles. The SEOs of many states have been in the forefront of coordinating of ATV activities. The California Energy Commission is a prime example of state agency involved in the various activities of ATV development.

EPACT has encouraged ATVs by requiring the Federal, State and fuel provider vehicle fleets to be converted to ATVs on a phase-in schedule. Also, private and municipal fleets are encouraged to convert to ATVs over time. SEOs, often through the use of PV funds, have been coordinating the state efforts SEO's are involved in a number of activities that focus on reduction in highway

travel demand. These programs range from the van and car pool programs that peaked in the early 80's to the early telecommunication programs of today. SEOs, using PV funds have been involved in numerous traffic signal optimization programs in partnership with state and local traffic officials.

CHAPTER IV
RENEWABLE ENERGY ACTIVITIES

Renewable energy sources can be either direct sources (e.g., solar hot water systems) or used to produce electricity for on-site use (e.g., roof PV systems) and/or grid applications (e.g., wind systems). The direct renewable sources appear to the electricity and/or gas distribution systems as reductions in demand similar to energy efficiency measures. The on-site electricity generation appears as a reduction in demand for grid supplied electricity. Renewable source generation for the grid is one source of electricity supplies.

The Public Utility Regulatory Policies Act of 1978 (PURPA) set the stage for growth in electricity production from renewable sources such as wind, water, solar, geothermal and bio-mass crops. PURPA required utilities to purchase electricity from qualifying facilities (QFs) at the utility's long run avoided cost. Some states such as California ("Standard Offer Four") and New York ("Six-Cent Law") set by government action a powerful market incentive to develop renewable resource QFs.
The renewable resources industry developed over 10,000 mw of capacity from 1980 to 1994, most is hydropower. Most of the capacity was added in the 1980's. In the mid-90's, the development of renewable energy electricity projects began to slow down significantly.

Significant barriers to renewable resource development can be overcome. Usually the capital costs for these projects are high and their fuel costs are absent or low, relative to fossil fuel generation. Thus, renewable resource projects benefit from long-term electricity purchase contracts at low interest rates. Low fossil fuel prices, especially natural gas delivered to high electricity demand centers, currently are a significant barrier to further renewable resource development. Also, the ability of wind, small hydro and solar generation to follow the load curve is less than a gas-fired generation unit. This load following capability has growing importance in the competitive generation market. However, some renewable systems (i.e., small hydro) can serve as peaking units which can command a higher price in the competitive market.

The potential customer of electricity generated from a renewable source is likely to see a price premium for this electricity. Generally, a customer concerned only with price and not the co-benefits of electricity from renewables is unlikely to choose this source. Unfortunately, the co-benefits, especially national security and the "zero carbon" emission are not reflected in the price differential.

States have been the leaders in policies that promote renewable resource development and in the demonstration of renewable resource technologies. "Proof of concept" demonstrations at state facilities or in partnership with state industries have been useful in commercializing various renewable resource applications (i.e., photovoltaics (PV) at remote sites, displacing new diesel generators). States have a strong incentive to promote the use of in-state renewable resources for economic development. The sum of the individual state programs have demonstrated a wide variety of renewable fuels for a number of applications. Electricity generation is the primary target for many new programs.

Electricity industry restructuring and the resulting competition has lead to a need to refocus efforts to promote electricity production from renewable resources. The refocused efforts include renewable resource portfolio standards, “green” electricity marketing and targeted assistance from funds raised through a systems benefit charge.

Renewable Resources Portfolio Standard

A direct means to maintain and expand renewable resource generation procurement is to require a diversity portfolio for all retailers of electricity. The effect of the renewable portfolio standard (RPS) is to establish a minimum renewable resource generation content in all supply purchases by the retailer. A trading program in renewable resources generation credits can be established to ease the burden of retailers securing the needed generation portfolio. The renewable resource credit market could be useful in encouraging more renewable resources and providing a well functioning market with low transaction costs. The credit trading approach would tend to favor lower-cost renewables in the short term.

As a result of the RPS, the above market costs of renewable resource generation can be included in the retailer's supply purchase. All retailers can be required to participate on an equal basis, thus creating the equivalent of a non-bypassable charge for above market renewable resource procurement.

Representatives in both the U.S. House and Senate have previously proposed some form of a RPS requirement as an element of Federal restructuring legislation. Most proposals would require electricity sellers to cover a percentage of their electricity sales with generation from non-hydroelectric renewables. The percentage would rise from the current ratio (±2%) to 5.5% in 2010. At the State level, an RPS was enacted in Connecticut (0.5% from solar, wind and fuel cells; 5.5% other renewables → 6.0% and 7% by 2009), Maine (30% renewables content from ≤ 100 mw units); Massachusetts; and Nevada (0.2% — 2002 → 1.0% — 2005; ½ of which is to be from solar).

Green Marketing

Customer demand for electricity from renewable resources instead of other sources is the certain to result in expanded markets for renewable sources. A fully competitive retail market could create a significant incentive for renewable resources by selling to customers who care about the source of their electricity and/or are concerned about their "green" image. Some retailers are likely to offer "green" electricity as a means to gain a niche market and to gain public interest in their related (and unrelated) products in a fully competitive retail market. This has already begun in California and the Northeast.

Green marketing is already a means for a competitive retailer to gain greater market share and greater public awareness. The degree of actual customer interest in "green" electricity is unknown, since retail customers do not now have a choice of suppliers. Generally, the early programs of vertically integrated utilities to collect renewable resource funds through a voluntary surcharge on their bills (i.e., green pricing) have not generated significant participation. However, surveys show a majority of Americans are concerned about environmental quality and many consumers are willing to pay a premium for goods that are less damaging to the environment.

The results of recent polls and market research show a strong willingness to purchase "green" electricity. These surveys and early retail choice pilot programs have raised expectations for "green" power marketing.

Green marketing requires a fully competitive retail market to achieve maximum penetration. Fully competitive retail markets will likely occur late in the transition from a monopoly to a competitive market structure, perhaps constraining the development of "green" marketing. However, some marketers are already offering "green" power in California, Connecticut, New Jersey, and Pennsylvania.

Disclosure

Disclosure of the fuel mix and resulting environmental emissions for all retail electricity sales is central to "green" marketing . Marketing researchers point out that the nutritional labeling system for food products required by the Food and Drug Administration leads with the negatives — calories, fat cholesterol, and sodium, because that is what the customer is checking for. Customers appear to be more interested in avoiding the "bad" than in buying the "good". Surveys have shown that current electricity customers are not knowledgeable concerning the sources of their electricity; the renewable sources are assumed to be a much greater share than they actually are.

A uniform label citing the fuel mix and resulting air emissions occurring from a retail electricity sale would aid "green" marketers. An important primary policy issue is whether to label all sales (i.e., full disclosure) or only sales claiming to have "green" content (i.e., "green" verification). A uniform label for all sales will be the equivalent of the "nutritional facts" labeling of food products.

There is considerable debate over whether "green" electricity (or electricity generated by any means) can be tracked in a competitive market. However, for the system to be stable, system operators will need to know each minute which generators are contributing to the grid. Some parties argue that "green" generation credits can be traded to retailers. A "green" retailer requiring "green tags" would pay the "green tags" market clearing price for them. Customer research has raised a concern that the public might be less inclined to purchase electricity from retailers who acquire the right to call their electricity green than from retailers selling electricity from pure"green" generation.

Disclosure tends to be required by most state restructuring legislation; however, the type of disclosure often is determined by implementing rules and the level of disclosure varies from state to state. How an individual state proceeds on disclosure will have a significant impact upon the demand for "green" electricity and the resulting development and/or retention of renewable resource generation. Unless there is federal restructuring legislation, including a full disclosure requirement, the future of "green" marketing will be decided on a patchwork basis, state-by-state.

Certification

Closely allied with disclosure requirements is the certification of "green" labeled electricity. A "green" electricity claim verification system, such as the Green-E label advanced in California, Connecticut, New Jersey, and Pennsylvania, is a means to assure customers that a product is "green"; "mostly green" or "significantly green". The "green" label becomes an identification badge for a desired product.

The likely market penetration of "green" electricity would be greatest when full disclosure and

“green” certification is combined. A certification program without full environmental disclosure results in a “green” versus “average” marketing campaign. With full disclosure the campaign broadens to “green/clean” vs. “dirty/dangerous”. As the food labeling research has shown, customers are more interested in avoiding the “bad” then buying the “good”.

Systems Benefit Charge

A portion of a systems benefit charge can be used to fund some level of renewable resource development. For example, California's restructuring legislation provides about $135 million per year (for four years) for renewable energy (0.8 mills/kwhr) which is allocated at least 45 percent for existing sources: 30 percent to new sources, 10 percent to emerging sources, and 15 percent to consumer-side sources. These funds will be administered by the California Energy Commission (CEC). The CEC’s market based funding distribution system that has allocated $162 million for new technologies; $54 million for emerging technologies; and $81million to benefit consumers choosing renewable energy.

Montana’s Public Service Commission (PSC) ruled that Montana Power’s allocation of the expected $8.6 million collected from consumers for the “universal system benefits charge,” as mandated by the restructuring law, would be divided as follows: 50% to the industrial consumer rebate account; 21% to low income weatherization, bill payment assistance, outreach, and Energy Share; 13% to market transformation such as R&D for renewables; 13% for renewable research projects; and 3% to Montana Power's research, development, and demonstration projects.

New York’s PSC set rules for a Systems Benefit Charge to fund R&D related to energy service, storage, generation, the environment, and renewables; pilot programs for energy management for low-income consumers; and environmental protection.

System benefit charge funding can also be used to “buy down” interest loans for renewable resource project development, guarantee loans (lowering interest rates), “buy” renewable projects by providing an above market subsidy, and to demonstrate new or emerging concepts in pilot applications. In most states which have adopted a system benefit charge, some portion of the funding is allocated to support renewable resource development.

Net Metering

Net metering is a means to promote and reward on-site renewable distributed generation. The key to net metering is to provide a set of appropriate non-discriminatory safety standards for the interconnection of the distributed on-site generation and the distribution grid. The on-site generation owner would be able to move electricity into the grid and pay or receive the “net” of the electricity exchange. Such a net metering system would be very supportive of small scale PV installations. At the present time, approximately twenty-three states have net metering statutes in place.

CHAPTER V
ENERGY EFFICIENCY AND RENEWABLE RESOURCES — ENVIRONMENTAL QUALITY

For over 20 years energy efficiency and renewable resource development programs have moved on a parallel track with environmental quality programs. The value of these programs to environmental quality efforts was noted, but not directly rewarded. For example, a factory that closes retains a transferrable permit to emit a given level of SO_x, NO_x, and particulates; this permit can be used as an emission reduction credit (ERC) for pollutant emissions of SO_2 and NO_x. These ERCs can be traded to whoever needs a permit to emit. However, if a factory undergoes dramatic energy efficiency investments and reduces its energy use and environmental emissions by half, its owners may not be able to sell the "saved" emissions. Therefore, the current system would appear to favor factory closings over factory retrofits and retained jobs for American workers.

The disconnect between energy efficiency and renewable resource development and environmental quality can end by providing these sources with their economic co-benefits in terms of reducing SO_x, NO_x, particulates, air toxics and CO_2. Their value in reducing demand for air pollutants and greenhouse gases is well known and documented. If the developers and/or customers of these sources were to receive their equivalent emission reduction credits, the parallel paths would link. As CO_2 reduction becomes more of a global and national issue, the essential need to link these paths becomes apparent. In the short term, efficiency and fuel switching among established technologies are the means to reduce CO_2 emissions. In the long term, new technology not yet developed can be a significant factor in CO_2 reductions. However, the CO_2 emissions emitted in the near-term will continue to be present in the long-term. Actions which reduce near-term CO_2 emissions can have considerable value.

The co-benefit potential of energy efficiency measures are large; a megawatt-year of saved electricity in New York would result in 5.7 tons of NO_x, 13.2 tons of SO_2, and 3863 tons of CO_2, not generated. If the potential energy efficiency project owner receives a payment for all emissions avoided by a completed project, the economics of the project will improve and it is more likely to be implemented.

"Energy Innovations", a 1997 report by the Alliance to Save Energy, American Council for an Energy Efficient Economy, Natural Resources Defense Council, Tellus Institute and the Union of Concerned Scientists, sets forth a very detailed analysis and a series of recommendations to reduce energy use and promote the use of renewable energy sources. This study shows a possible 12 percent reduction in energy intensity by 2010 over the present path forecast (which may be somewhat optimistic given recent trends) and a 40 percent increase in renewable energy development over an optimistic present path forecast. The study claims that at least a 7 percent energy savings in the residential buildings sector and a 21 percent savings in the commercial buildings sector is possible through implementing certain recommendations. The authors note that these savings are conservative since the potential savings are on the order of 20-50 percent in buildings.

The competitive retail electricity market may provide a new energy efficiency delivery system. The future energy service providers (ESPs) can offer energy efficiency measures with electricity and/or gas supplies. If customers asked for the efficiency services, the ESPs are very likely to provide such services either directly or through subsidiaries. Emission reduction credits (ERCs) for energy efficiency projects and measures will increase the interest of ESPs in offering, and customers in requesting, efficiency services.

The ESP involvement will solve the problem of aggregating a large number of small ERCs without a large transaction cost. An ESP providing energy efficiency services will include acquiring the ERCs from the customer for any efficiency services implemented and verified.

The ESP, as a generation purchaser, will be able to trade the accumulated ERCs as part of their electricity procurement.

The ESP based efficiency services are likely to be the best hope for energy efficiency activities to flourish and not die in the transition to a competitive electricity market. Inclusion of ERCs can significantly increase the ESP interest in marketing energy efficiency services.

Generally, the current major delivery systems for electricity energy efficiency are dead, dying or struggling. The concept of integrated resource planning (IRP) by the monopoly utilities has been declared dead. DSM programs by utilities are ending or being converted to sales programs. The state energy programs are struggling with funding as petroleum overcharge funds dry up. Systems benefit charge funding, if implemented, will help, but new delivery systems will still be needed. ERCs tied to verifiable energy efficiency actions will increase the interest of the ESPs in offering energy efficiency services.

CHAPTER VI
VERIFICATION

Verification of the actual energy saved by an energy efficiency measure is central, in many cases, to the payment for the investment made to implement the measure. Energy efficiency performance contracts include verification and monitoring of energy savings as an essential element of the contract. Energy efficiency equipment is guaranteed by a warranty usually. Unlike 20 years ago, the energy use profile of buildings is known for the described design and construction and measured for the performance design and construction. The measurement and verification (M&V) of energy savings has evolved over the past 20 years into a science with many specialists.

The evolution of M&V activities has resulted in the development of two major protocols; New Jersey Measurement Protocol for Commercial, Industrial and Residential Facilities, and the International Performance Energy Measurement and Verification Protocol (IPMVP). Both these protocols are the products of major efforts and have been tested in the marketplace. Millions of dollars are exchanged based upon the M&V elements of performance contracts. The energy efficiency customer must be assured that the savings are real and sustainable or the energy efficiency contractor will not be paid.

The New Jersey protocol was developed as an element of the New Jersey DSM program. This program included a "standard offer" (each utility was required to pay ESCO/customer partnerships the avoided cost value of electricity energy and capacity savings) which required a careful agreement structured on the actual results of an energy efficiency investment. The serious nature of this protocol is captured by its text:

The measurement Protocol sets forth methodologies that describe the means and principles involved in determining savings from general classifications of energy savings measures. The methods are grouped generally by usage patterns and the operating principles of the electric load controlled or modified. This Measurement Protocol also contains examples of how each methodology is to be applied to a specific technology or system improvement. The inclusion of a specific technology or system improvements as an example indicates the approved measurement methodology for that technology or system improvement, and are set forth in Appendix B. Any substantive deviations from the examples and their intent must be approved by NJ BRC Staff and Rate Counsel in order for the energy savings (as measured under the Measurement Protocol) to be used from the purpose of payments by a Utility or the earning of Utility incentives and recovery of lost revenue.

The IPMVP protocol resulted from the collaborative efforts between federal and state agencies and experts in the energy and efficiency industries in America, Canada, and Mexico. The ESCO industry, working with DOE, was the driving force behind the development of this comprehensive protocol.

The Protocol's chief objective is “that, by providing greater and more reliable savings and a common approach to efficiency installation and measurements, the financial markets will respond with financial products allowing the securitization of energy and water efficiency projects.” The intended result would be the development of a secondary market for efficiency investments, with increased availability of low-cost and off-balance sheet financing, allowing the efficiency industry to grow and much more rapidly resulting in widespread benefits in the form of increased employment, lower energy and water bills and reduced damage to the environment. Essentially, the IPMVP must pass the “bankers test” for loans to be packaged into a secondary market.

These protocols cover the residential, commercial and industrial retrofit markets both in a comprehensive and in-depth analysis of individual generic measures. One would be hard pressed to find a more vigorously researched set of measures that lead to emissions reductions.

The energy efficiency of new buildings is determined by its design and equipment selection; all easily verified measures. A building built to a “high” code or “above” existing code will consume energy at a lower rate. Normalizing the data for typical occupancy, climate, etc., will yield the typical savings per unit resulting from implementing a given program.

Equipment (lighting, refrigeration, HVAC, motor system, et al) has a given energy efficiency rating which may be compared to what is being replaced and/or the industry standard. The difference in efficiency multiplied by the typical operations yields the typical savings.

The verification of supply-side renewable source electricity production is the simple measurement of kilowatt hours produced/required in selling the electricity. The demand-side renewable energy sources (e.g., PV, solar water heating) require verification protocols similar to those used for energy efficiency measures.

CHAPTER VII

CONCLUSION

The value of energy efficiency and renewable energy sources to the reduction of air emissions of SO_2, NO_x, CO_2; air toxics etal from the burning of fossil fuels is well documented and beyond dispute. Verification of specific actions has been established through commercial transactions. The importance of both increased energy efficiency and greater use of renewable energy sources is recognized by every serious discussion of how to deal with air quality and greenhouse gas issues. The rhetoric is clear; energy efficiency and renewable energy sources are basic tools in dealing with these issues in a cost-effective manner.

The twin benefits—reduced air emission and improved economic performance are worthy of greater promotion and assistance by public policy and programs. The rhetoric needs supporting actions. Too often greater penetration of energy efficiency and/or renewable energy sources are assumed events (and the resulting benefits) under a "business as usual" scenario. This "assumption without assistance" approach fails to recognize that both energy efficiency and renewable resources are in a difficult time period due to low fossil fuel prices, collapsing delivery systems and a restructured electricity industry.

Increased energy efficiency investments and greater use of renewable energy sources can occur with encouraging public policy and programs from the federal and state governments. Emission reduction credits (ERCs) for energy efficiency investments and zero emission renewable energy sources can be one of such supporting actions. States have considerable experience and expertise in energy efficiency, renewable resources and air quality implementation plans. The next step is to integrate these activities instead of continuing on parallel paths.