FINAL REPORT:

THE ECONOMIC IMPACT OF ENERGY EFFICIENCY PROGRAMS AND RENEWABLE POWER FOR IOWA

by
Glen Weisbrod, Hagler Bailly Consulting, Inc.
Karen Polenske and Teresa Lynch, M.I.T;
And Xianuan Lin, Boston University

Prepared for:

Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, Iowa 50319

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Hagler Bailly Consulting, Inc.
77 Franklin Street
Boston, Massachusetts 02110
(617) 423-0545

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EXECUTIVE SUMMARY:

The Economic Impact of Energy Efficiency Programs and Renewable Power for Iowa

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In an area of increasing national and global economic competition in nearly all business sectors, it becomes particularly important to understand the economic consequences of state policies. The role and impact of energy policies is of special interest because of the rapid changes unfolding in the electric and gas utility industries. To address these needs, the State of Iowa -- in cooperation with the state's utilities -- commissioned this study to evaluate the impact of energy efficiency programs and renewable power facilities on the economic competitiveness and economy of Iowa. Key components of the analysis and key findings from them are as follows:

Overview of Literature Review

There has been a variety of "studies" of the economic impacts of energy efficiency programs. Until recently, nearly all such studies applied simplistic job multiplier factors to assess the potential job gains resulting from hypothetical energy programs. The key problems with these studies were:

(1) Reliance on "static" input-output models which ignore dynamic price, productivity and competitiveness impacts of energy policies over time;

(2) Lack of actual program cost and program impact data, use of inappropriate data from other states, or else misleading "hypothetical potential scenarios" (which are based on estimates of maximum potentially achievable savings and minimum potentially achievable costs) ;

(3) Lack of actual information on program spending patterns and state-specific "leakages" (outflows) of spending, with inaccurate assumptions used instead;

(4) Focus on job creation benefits while ignoring fundamental income and efficiency impacts.

This study attempts to address each of the above-cited problems through new forms of data collection and modeling.

Overview of the Analysis

The analysis conducted for this study consisted of three steps:

Step 1. Data Collection. Information on the current cost, spending and benefit characteristics of energy efficiency programs in the State of Iowa was assembled. Likewise, information was also collected on the current cost and productivity of renewable energy technologies which have been implemented in Iowa and elsewhere. The profile of the existing energy efficiency and renewable energy programs within Iowa provided a basis for assessing the magnitude and distribution of energy user savings, the costs involved and the types of external inter-industry flows of dollars involved.

To accomplish this, two surveys were conducted. The first was a Survey of Utility Staff concerning the program spending pattern, program participation pattern, program delivery mechanism, and patterns of affected contractors, dealers and suppliers. The second was a Survey of Manufacturers and Distributors of major home appliances, HVAC, lighting, water heating, refrigeration and process equipment. It included questions concerning types of products, types of customers, the extent of in-state purchases from suppliers and in-state sales to customers, as well as the extent of high efficiency product sales. Together, these two sources provided a solid basis for constructing a profile of the financial savings, the costs incurred and the business sector revenue gains associated with the specific types of energy efficiency programs present in Iowa.

Step 2. Model Development. A policy analysis and forecasting model for the State of Iowa was developed and calibrated for analyzing impacts of energy efficiency and renewable energy programs. A dynamic, time-series model approach was used, which extended the basic input-output (I-O) model framework to also account for price shifts, labor/capital substitution, business profitability and economic development competitiveness issues. The REMI model, calibrated for the State of Iowa, was used for this analysis. Results of the business and utility surveys were used to provide data on energy program spending flows and regional purchasing patterns in lieu of model defaults.

Step 3. Template Construction. The third element of the study was template construction and model testing. The model system (refined as part of the second step) was tested for sensitivity and robustness under alternative assumptions and scenarios, so that the nature and magnitude of calculated impacts and the reasons for them could be understood. Key impact multipliers were identified and placed in a spreadsheet-style template product. A customized user interface was then developed to minimize the likelihood of user confusion and/or inappropriate tampering with the calculations.

Analysis Results and Recommendations

The analysis of Iowa's economy and economic competitiveness provided the following results:

- REMI model forecasts indicate expectations of continued growth in Iowa's economy over the 1995 - 2015 period. Employment is projected to grow from 1.78 million to 2.0 million, while disposable income is projected to grow (on an inflation-adjusted basis of constant 1994 dollars) from $58.3 billion to $75.6 billion.
- Relative costs of manufacturing are lower in Iowa and profitability is higher in Iowa (compared to the national average) for manufacturing of machinery and electrical equipment, but the reverse is true (higher costs and lower profitability) for manufacturing of wood products, transportation vehicles, food and paper products. Among Iowa industries, the manufacturing of primary metals and chemical products are particularly sensitive to energy costs in their business growth patterns.

The Survey of Iowa Utilities provided the following results:

- Spending on energy efficiency programs topped $76 million in 1994, covering approximately 226,000 participating residential and business customers. Nearly 2/3 of the program dollars flowed to residential customers. The greatest amount of the spending was for improving the efficiency of lighting and HVAC (heating, ventilation and air conditioning) equipment.
- Program spending went predominantly to pay for financial incentives, followed by program administration and promotional activities. The proportion of total costs going to each of these spending categories differed greatly, depending on the type of program.
- Nearly all of the program delivery and marketing dollars went to in-state workers, while roughly half of the installation work and a majority of the evaluation work went to out-of-state specialists.

The Survey of Iowa Energy Product Manufacturers and Distributors provided the following results:

- Iowa is a national leader in the manufacturing of air conditioning, heat pumps, HVAC controls and major home appliances.
- Sales of high efficiency products are concentrated in the air conditioning, heat pump and HVAC controls products. There is a lesser focus on energy efficient products among Iowa's lighting, motor and appliance manufacturers.

- Overall, sales of energy efficient products account for nearly one-third of total sales reported by electrical product wholesale distributors in Iowa. They accounted for over half of the space heating and cooling products distributed in Iowa.

- Iowa manufacturers of electrical equipment obtain relatively little (5%) of their product inputs from within the state, and sell relatively little of their products (10%) to in-state buyers.

- Iowa distributors of electrical equipment obtain relatively little (11%) of their total products from in-state manufacturers, but do sell most of their products (78%) to in-state buyers.

- Nearly ½ of the Iowa manufacturers and over 4/5 of the Iowa distributors are aware and know details of the Iowa utility programs to promote energy efficiency. Over 1/6 of the manufacturers and 2/3 of the distributors report that they have changed their product mix as a result of those programs.

The economic model was used to evaluate the relative impacts of various energy efficiency and renewable scenarios, in terms of business output, personal income and employment. These results were distinguished by year over a twenty-year period, and broken down by business type. The <u>energy efficiency program scenarios</u> were defined to assume that levels of energy efficiency program spending either continue at current levels or are phased out, and include either the existing program mix or else special targeting to specific customer sectors and end uses (types of equipment). The <u>scenarios for renewable energy</u> focused on the two most promising technologies for large scale implementation in Iowa -- wind power plants and switchgrass combustion in existing coal-fired plants -- under alternative assumptions concerning magnitude of their adoption and relative cost differential of their implementation. Key findings were:

<u>Energy Efficiency Programs</u>

- Investing around $80 million on energy efficiency programs in one year can lead to the accumulation of roughly 2000 job-years of employment and $144 million of disposable income spread over the subsequent decade. That averages 200 job/years and $14 million/year of income over the period. It represents 25 job-years per million dollars invested, and $1.50 of additional disposable income per dollar invested.

- (Continuing the investment of $80 million/year for ten consecutive years can lead to the creation of nearly over 19,000 job-years over that decade of spending and the subsequent decade of continuing energy savings).

- These impacts represent both the jobs created by spending on energy efficiency in Iowa (rather than allowing additional fuel cost to flow out of the Iowa economy) and the income created in subsequent years from respending of energy savings -- after adjusting for increases in energy costs to pay for these programs.

- The overall impact of any of these scenarios, while significant, causes less than 1/10th of 1% change in Iowa's employment and income.

Biomass Energy Production

- If 1% of Iowa's electrical power could be obtained on a continuing basis from burning switchgrass in existing power plants (considered a possibly feasible goal), then there could be a net growth as high as 315 jobs/year of employment and $5.5 million/year of additional disposable income. (Over 20 years, that represents 6,300 job-years and a net increased $110 million of disposable income). Assuming that the additional operating cost of doing this is $3.77 million per year (with no additional capital investment needed), that represents up to 84 job-years per million dollars invested, and $1.45 of additional disposable income per dollar invested.

- If 15% of Iowa's electrical power could be obtained from burning switchgrass in existing power plants, then there could be a net growth of 4,725 jobs/year or 94,500 job-years of employment over 20 years. All of these figures, of course, assume that technological challenges concerning alkali slagging in combustion and logistical challenges concerning transportation and storage of switchgrass, as well as existing contracts for coal, will all be overcome.

- The job impact of biomass energy is particularly high, compared to the energy efficiency and wind energy scenarios, because it creates demand for a product which is produced entirely in Iowa. There is also no additional capital investment (and hence no adverse income impact) to the extent that there are existing electric generation facilities with excess capacity can be adapted to burn switchgrass instead of coal. However, even the 15% which market penetration scenario, which is not currently feasible, would cause no more than 2/10th of 1% change in Iowa's employment and income.

Wind Energy Production

- If 1% of Iowa's electrical power could be obtained on a continuing basis from wind power plants, (considered a possibly feasible goal), then there could be a net growth of 29 jobs/year and $1 million/year of additional disposable income. (Over 20 years, that represents a net increase of 584 job-years and $14 million of disposable income.) Assuming that the additional cost of doing this is $12 million per year (capital and operating costs), that represents 2.5 job-years per million dollars invested.

- The job impact of wind power is substantially lower than for an equivalent level of power generation from biomass because, unlike biomass, the wind is free and there are no associated increases in purchases of feedstock grown, harvested and transported by Iowa workers. In addition, wind power requires an additional capital investment in the purchase and installation of new electric power generation facilities. As long as there remains excess capacity at existing electric generating plants which can be used to serve Iowa, then there is an additional cost associated with the purchase and installation of new wind generator facilities which is ultimately borne by Iowa residents and businesses. The net effect of that additional capital cost is a reduction in disposable income which essentially offsets nearly all of the gains in income (and most of the gains in jobs) otherwise associated with expanding the wind power industry in the state.

The modeling results presented here indicate that, if properly targeted, energy efficiency and renewable power programs can contribute to the state economy. These results can be achieved with relatively little difference in state economic impact through any set of programs which satisfy the following two criteria: (a) the long-term energy cost savings exceeds the associated program costs by a sufficient amount so that business growth and income are enhanced, and (b) the flow of dollars to generate additional income for Iowa residents more than offsets the reduction in available income associated with funding the program. The economic model results provided here also suggest that energy efficiency programs targeted at residential energy savings and programs targeted to HVAC can keep more dollars in the Iowa economy than broad, untargeted spending in the commercial and industrial sectors. The results also indicate that biomass power has a particularly high potential for benefitting the Iowa economy.

Template Product

The template products are two spreadsheet models which makes it possible to assess the impacts of additional policy scenarios, beyond those evaluated in this report. Essentially, the template models makes it possible to interpolate the impacts of additional scenarios which represent alternative combinations of the scenarios factors which were examined in this study. Those factors are:

Template 1: Energy Efficiency (Demand Side) Programs -- level of spending, level of energy savings, customer sector focus, end-use focus, activity types, financing mechanism and rate impact

Template 2: Renewable Energy (Supply Side) Programs -- cost of capital equipment, operating cost, and market penetration (replacement of traditional fuel sources)

Future changes in technology development, market conditions, regulation or tax policies may reduce the cost and/or increase the effectiveness of various demand-side or supply-side technologies. Such future scenarios can be represented as combinations of the above-cited factors, and their impacts thus estimated through use of the spreadsheet templates.

SECTION 1: INTRODUCTION

1.1 Perspective: Evaluating the Benefits of Energy Programs

There are many motivations for energy efficiency (demand side) programs and renewable energy (supply-side) policies regarding power generation policies. Economic development is only one of them, and it is often **not** the primary motivation. Other motivations include optimization of resources use, minimization of environmental impacts and maximization of self-sufficiency. The optimum policies for maximizing economic development benefits may be different from the optimum policies from a resource planning or environmental impact perspective. From a public policy perspective, the most appropriate form of energy efficiency programs, renewable energy policies and energy rate policies may be dictated by any combination of these motivations. The solution for balancing these different motivations and evaluating their tradeoffs is an important topic for public policy. However, this report focuses exclusively on economic impacts.

Economic benefits are here defined as benefits which create additional real income for people through the expansion of salaries and profits. These are the monetary benefits, which can be spent and recirculated in the economy. While we can also set monetary values for environmental benefits for use in benefit/cost analysis, and those benefits can be very real, the value of those benefits do not necessarily translate directly into hard currency in peoples' pockets -- which can be spent at any store and recirculated in the economy. Thus, we make an important distinction between the value of overall benefits in a benefit/cost analysis and the "hard currency" impacts on the economy.

While advocates for energy conservation and renewable energy technologies may tout them as "good for the economy as well as good for the environment", the full impact of these policies and programs is more complex. As shown in this report, the economic impacts can be positive or negative or both (at different times), so it is important to fully evaluate the distributional and long-term impacts of such energy policies or programs.

1.2 Objective of this Report

Of the money spent on resources to generate electric power, over 90% flows to out-of-state suppliers, at a "tremendous burden on the state economy" (Iowa Energy Center, 1992 Annual Report). The outflow of dollars to pay for this energy includes over $300 million for purchased coal, which is the fuel for 85% of all electricity generated in the state (Energy Information Administration). To address and minimize this economic loss, the State of Iowa has had continuing investments in energy efficiency and renewable energy programs. These programs include those of the state and those offered by investor-owned utilities, municipal utilities and rural electric cooperatives.

Iowa's utilities are currently required by law to spend at least 2 percent of electric revenues and 1.5 percent of natural gas revenues on energy efficiency programs annually. These include rebates for efficient appliances and light bulbs, water heater measures, commercial and industrial lighting, high efficiency furnaces and boilers, thermostat controls, process and waste heat recovery systems, advanced drying systems and other industrial process technologies, and special programs for low income customers. The State of Iowa has also been promoting the development and initiation of renewable energy supply efforts. These include biomass energy (i.e., from burning crop residue and/or municipal solid waste), wind energy and tree planting to create a further biomass source.

This report is intended to assist the State of Iowa to assess the extent to which energy efficiency and renewable energy supply programs can, and currently are, helping to stimulate economic growth in the state. This includes the measurement of total employment and income impacts of these programs, and the development of an analytic template which can be used for subsequent policy analysis. For both the demand-side (energy efficiency) measures and the supply-side (renewable energy) measures, the economic impacts come from redirecting spending patterns and shifting business costs.

1.3 Background

This report follows upon an earlier (1987) study and spreadsheet analysis of the economic impacts of energy policies in Iowa. Of course, the current set of energy efficiency programs now present in Iowa did not exist at that time, nor were the current concepts of renewable energy systems defined as they are now. There have also been significant advances in economic impact modeling techniques and template products since that time. The analysis and results described in this report builds upon the lessons learned from past attempts to assess the economic impacts of energy efficiency programs in other states. The analysis specifically builds upon a set of key considerations:

(1) use of actual current program cost and energy impact figures, as reported by the state's utilities;

(2) use of new survey information concerning the pattern of program spending and the extent to which that spending stays within the Iowa economy;

(3) use of a dynamic simulation modeling system in which price, productivity and competitiveness impacts of energy policies are explicitly included;

(4) measurement of economic impacts in terms of fundamental income and efficiency benefits, as well as job impacts.

1.4 Report Overview

The remainder of this report is organized into four other sections. The methodology for analysis of economic impacts, including both a literature review and presentation of the approach for this study, is addressed in Section 2. The analysis and findings on energy efficiency programs are then presented in Section 3. The analysis and findings on renewable power generation are presented in Section 4. Finally, the computer software for analysis of future scenarios is described in Section 5.

SECTION 2: METHODOLOGY

2.1 Framework for Identifying Economic Benefits and Costs

In general, energy policies and programs cause economic impacts through the following mechanisms:

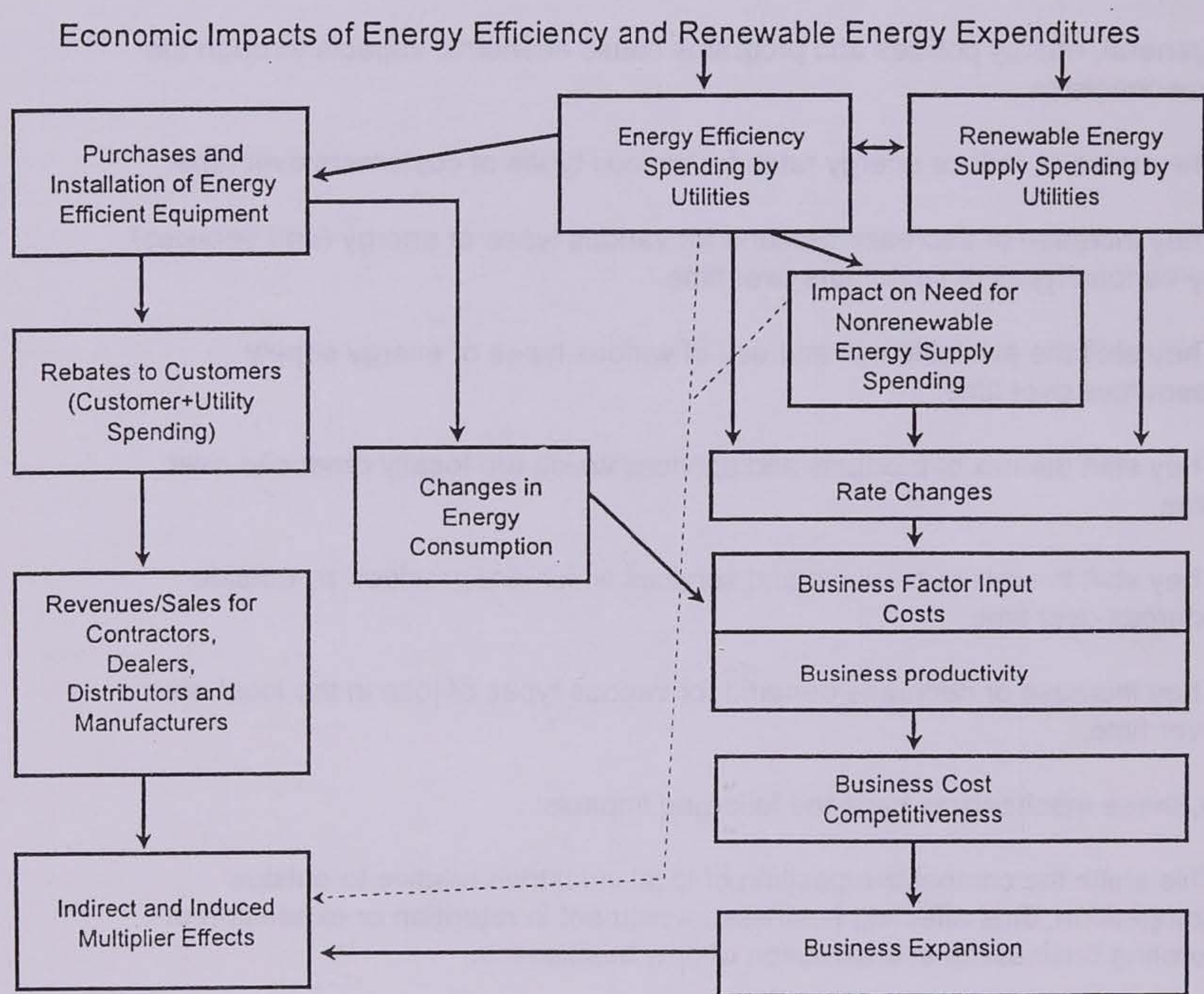
- They raise or reduce energy rates for various types of customers over time.
- They increase or decrease demand for various types of energy (and services) by various types of customers over time.
- They shift the available mix and use of various types of energy supply resources over time.
- They shift the mix of products and services which are locally produced over time.
- They shift the mix of products and services which are provided by outside sources over time.
- They increase or decrease demand for various types of jobs in the local area over time.

Ultimately, these mechanisms have the following impacts:

- This shifts the competitive position of local industries relative to outside competition, thus affecting business investment in retention or expansion of existing businesses and attraction of new businesses.
- They increase or decrease the housing costs and the cost of living for local residents over time. This changes disposable (spending) income as well as population movements.

Both of these impacts have consequences for the generation of personal income, corporate profits and energy demand. To illustrate how these mechanisms work to redistribute spending and income, consider the following two examples: (illustration Figure 1).

Figure 1:


Economic Impacts of Energy Efficiency and Renewable Energy Expenditures
Energy Efficiency Spending by Utilities
Renewable Energy Supply Spending by Utilities
Purchases and Installation of Energy Efficient Equipment
Impact on Need for Nonrenewable Energy Supply Spending
Rebates to Customers (Customer+Utility Spending)
Changes in Energy Consumption
Rate Changes
Business Factor Input Costs
Business productivity
Revenues/Sales for Contractors, Dealers, Distributors and Manufacturers
Business Cost Competitiveness
Indirect and Induced Multiplier Effects
Business Expansion

(a) Energy Efficiency Programs. These programs reduce demand for energy or increase the efficiency of energy use, through educational, organizational or incentive mechanisms. They effectively reduce costs of doing business for some segments of local businesses, and reduce cost of living for some segments of local residents. They are financed by increased energy rates for a period of time, which increases costs of doing business for some other segments of local businesses, and increases costs of living for some other segments of local residents. They accomplish their goals by immediately increasing local spending on purchases and installation of energy-savings equipment and materials, which generates short-term income for suppliers of these products and services. The long-term realization of their energy-saving goals may also translate into a reduction in local spending for purchases of energy and hence a reduction in revenue for its local suppliers and distributors. This latter impact may be offset by increased local economic growth or accentuated by additional contraction of the local economy.

(b) Renewable Power. These "programs" shift the supply of energy, by providing financial incentives or spending funds to facilitate the construction of renewable energy production facilities. By doing so, they generate short-term income for construction contractors and materials suppliers for building the facilities. They also generate income for ongoing workers at, and suppliers to, the new facilities. If there is existing reserve energy generating capacity in the local area, then they may also reduce demand for those older facilities, eliminating local income for workers at, and suppliers to, the older power plants. Short-term costs of constructing the new facilities and closing down any displaced older power plants, and longer-term net changes in operating costs of the new facilities compared to the displaced power production, are all ultimately financed over time by tax and energy rate changes. If those costs are increased, then they will increase costs of doing business for local businesses, and increase cost of living for local residents.

In both of the above examples, the economic development impacts are complex. In general, there are gains to the Iowa economy associated with saving energy costs and with substituting local energy suppliers for out-of-state energy suppliers. However, in both cases, there are shifts in spending patterns which make some segments of industry gain revenue while others lose revenue. There are also shifts in costs of doing business, which affect the competitive position and ultimately the relative growth of various types of local businesses, as well as shifts in costs of living. These factors can also affect regional purchase patterns --i.e., the extent of local spending which flows to local businesses. Most importantly, there is a significant time element in these patterns, in which benefits and costs occur at different times. Thus, some businesses may be both winners and losers at different times. Ultimately, these business expansion and contraction impacts will affect the generation of personal income, corporate profits and utility demand.

This report examines the job and income impacts on Iowa residents resulting from energy efficiency and renewable energy programs. Impacts of both capital and operating cost are considered. This is consistent with assessing the full range of impacts relative to the status quo, in which there is available generating capacity at existing facilities to meet Iowa's current trends. When additional generating capacity to serve Iowa's needs is required in the future, then it will be relevant to compare the relative benefits and costs of providing that capacity via building renewable power plants vs building traditional fuel power plants. The information provided in this report will be useful for that assessment, although additional information will the also be needed concerning the costs of building and operation new, state-of-the-art power plants using traditional fuels .

2.2 Economic Impact Definitions and Modeling Approaches

Definitions of Input-Output Economic Impact. In general, input-output (I-O) tables provide a means for identifying the inter-industry linkages, which show how purchases of goods and services in one industry lead to spending and purchases of goods and services in other industries. The direct impacts of energy-related expenditures are the purchases made to buy goods or services from specific industries. These, in turn, lead to indirect impacts on spending for "factor inputs" (other goods and services) in supplier industries. The additional workers hired as a result of the direct and indirect impacts provides income which then leads to additional consumer spending for consumer goods and services. This consumer spending effect is the induced impact. For any given type of spending within the state of Iowa, some of the recipients of the direct, indirect and induced spending will be within the state and some will be outside of the state. The extent of spending going to firms and individuals outside of the state is known as leakage. The percentage of overall purchases occurring within the state (i.e., not leakage) is known as the regional purchase coefficient (RPC). Employment and income multipliers are built on the basis of the inter-industry linkages and leakage/RPC values for the affected industries.

Of course, as noted previously (in section 2.1), economic impacts of energy policies may come from (a) changes for spending patterns, (b) changes in personal and business income, and/or (c) shifts in prices affecting productivity and economic competitiveness. I-O models can address the first two types of impacts, but not the third one. Structural policy simulation models, discussed later, can address all three types of impacts.

Basis for Constructing State Level I-O Models. At the national level, the inter-industry purchasing linkages (known as the "technological matrix" of the input-output tables) are constructed on the basis of millions of dollars of surveys of businesses conducted approximately every five years by the US Dept. of Commerce. The extent of leakage and RPC levels are based on international import and export trade flows, monitored by the US Dept. of Commerce.

Unfortunately, state and local organizations cannot afford to undertake millions of dollars of surveys to construct their own inter-industry linkage tables (technological matrices). There is also a lack of interstate trade statistics kept, meaning that there are no statistics kept on the extent of "imports" into any given state from others, or "exports" out of that state into others.

The low cost fallback alternative which has been developed to construct state or regional input-output studies is to "synthesize" them from existing data, in what is known as a "non-survey I-O model" (as opposed to the survey-based model developed at the national level). The idea behind the non-survey approach is that it is possible to assume that the national inter-industry technological matrix also holds at the state level, so that the types of factor inputs purchased by any given industry at the national level are assumed to also hold true at the state level. The I-O model can then be adapted to a state or regional level by adjusting for "leakages" of dollars flowing out of the state. These leakages, i.e. "imports" of goods and services from out-of-state, can be estimated synthetically, on the basis of the relative concentration level of various industries within the state. The assumption used to do this is to assume that industries with a higher than normal concentration in the state must be exporters, while industries with lower than average concentrations in the state must be importers. (The indices of local industry concentration are sometimes referred to as "location quotients".)

The demand for synthetically-produced state or regional-level I-O tables has produced an industry of its own. To assist in this process, three different groups within the federal government each produced their own similar approach for synthesizing state and county-level I-O models, using essentially the same basic approach as previously summarized. These groups were: (1) the US Dept of Commerce (RIMS-II model), (2) the US Dept. of Interior - Forest Service (IMPLAN model) and (3) the US Army Corps of Engineers. Subsequently, the IMPLAN model became distributed by a private group offshoot from the University of Minnesota. A similar type of synthetic regional model is also offered by the Regional Science Research Institute (PC I-O). While they have minor differences (such as how they interpolate missing state data and update to current times), it is an important factor to understand that all of these models are essentially similar in that they are synthetic, non-survey models constructed from the same basic 1985 national-level model.

Problems with Synthetic State Level I-O Models. The synthesized state level models offer a low cost alternative for producing multipliers, which can be used to estimate state income, employment, and output impacts of a wide range of investment and spending activities. These models have, in fact, been used directly for some energy policy studies. Unfortunately, there is a growing literature of studies (including studies in Texas, Michigan and Washington state) showing that non-survey statewide I-O multipliers can be subject to substantial miscalculation for some types of industries and policies. These types of problems occur when the industry being studied at the state level is either: (a) not representative of the production processes, technologies or input mix assumed for the national level, or (b) is not accurately represented by a single

S.I.C. (Standard Industrial Classification) group, which is the classification system used for all national (and synthesized state) I-O models. Problems with inappropriate use of I-O models have been increasingly noted in articles and conferences, including a report of the Heartland Institute (Hunter, 1989).

Unfortunately, the energy efficiency industry is an example of an industry which does not easily match to S.I.C. codes, and whose nature of which does differ significantly among states and regions of the U.S. The growing realization of this problem, and criticism of the simplistic approach used in some past impact studies, has jaded public and industry reaction to some studies of the energy efficiency industry in other states. The challenge for energy program analysis is to avoid that pitfall.

Dynamic Simulation Models. The other limitation of I-O models is that they are fundamentally accounting tables which trace how expenditure flows affect the economy. They are not sensitive to dynamic factors which can have significant impacts over time. One of these is price effects -- the fact that financing energy efficiency programs can positively or negatively affect energy prices and costs of doing business, which can ultimately affect the cost competitiveness of local industry and lead to changes in expansion and attraction of population and business over time. Shifts in business productivity resulting from energy efficiency programs can similarly affect business cost competitiveness and national market shares for Iowa industries. Yet another consideration is the shifting mix of population and business characteristics in the state, which can also change the nature of energy program impacts over time. Yet another time factor is the differential between the short-term impact of installation of energy efficiency and long-term employment impacts of maintaining that efficiency.

Three prominent national models, the REMI model, the INFORUM model and the McGraw-Hill/DRI model, incorporate I-O models but also add sensitivity to shifts over time in technology, business cost competitiveness and productivity, and then forecast additional shifts in business attraction/expansion (i.e., economic development) over time. This cannot be done by I-O models. In some cases, these additional factors are not significant, but in other cases, these models can demonstrate how public policy impacts can have cumulative growth effects over periods of 5 - 20 years. For that reason, this type of model is most applicable for scenarios affecting business competitiveness. Of the three models, the REMI model is notable in that has been most widely refined and applied in its full form for regional studies around the US.

Problems with Dynamic Simulator Models. The REMI model and the other dynamic simulation models noted here have a common set of short term to I-O models and share some of the same shortcomings. In similarities the policy simulation models rely on the same types of inter-industry technological and trade flow coefficients as I-O models. Thus, they share the same problems of : (1) state level inter-industry relationships which are synthesized from national I-O studies, and (2) reliance of SIC groupings which do not match well to the energy efficiency or renewable power industries . The key differences between the dynamic simulation models and the plain

I-O models come from the ability of the policy simulation models to distinguish impacts over time and the dynamic effects of price and cost charges.

2.3 Literature Review

Brief Review of Selected Other Studies. Evaluations of the economic impact of energy conservation and efficiency programs have a long and checkered past. The early studies, conducted over 1979-1986, were straight applications of input-output (I-O) models. These include studies for California (Cal. Energy Commission, 1979), Long Island (Buschsbaum et al., 1979), Pacific Northwest (Charles River Associates, 1984) and the Midwest (Nebraska Energy Commission, 1984). Most of the recent studies of the employment and income impacts of energy efficiency programs have also relied upon input-output (I-O models such as IMPLAN and RIMS-II (e.g., Economic Research Associates, 1993; Geller et al., 1992; Jaccard and Sims, 1991; Krier et al., 1993; Laitner et al., 1994; Megdal and Rammaha, 1992; NY State Energy Office, 1994). Unfortunately, some of the studies were unabashed advocacy pieces, intended to stop new power plant proposals. The Long Island Study for example, was motivated by opposition to a local nuclear power plant proposal. A Maine study was motivated by efforts to stop a proposed coal-fired generating station.

Of particular interest for this project is the predecessor (1984-1987) series of studies for Iowa, which utilized a simple I-O modeling process to evaluate impacts of hypothetical spending alternatives. The 1984 Midwestern study (Laitner, 1984) evaluated the direct, indirect and induced impacts of energy expenditures on the states of Iowa, Kansas, Missouri and Nebraska. An update analysis for Iowa over the next two years utilized the same basic approach (Macke and Associates, 1985). At that time, there was no major energy efficiency or conservation program spending in those states. Rather, those studies focused on evaluating the linkages of petroleum, natural gas, electricity and coal spending on the state economies. For each type of energy spending, those studies estimated state impacts of hypothetical energy conservation programs, with hypothetical results, by studying the associated labor intensity, profit margins and flow of dollars for other factor inputs of the energy industries. For those studies, "leakages" associated with spending dollars flowing to out-of-state suppliers were estimated on the basis of data on available expenditure estimates and state trend data on prices and energy use. An important further modeling effort, the Community Energy Choices model (Kegel and Laitner, 1987), provided a useful tool for Iowa communities which built upon those modeling approaches. Now, actual experience with ongoing energy efficiency programs and existing wind energy facilities, as well as surveys conducted for this study, and subsequent improvements in statewide simulation modeling methods, together provide new opportunities for improved policy analysis.

Some other recent studies (1991-1995) illustrate how progress has and has not been made in analysis methods. The Massachusetts study (Mass. Energy Efficiency Council, 1992) is illustrative of a very different sort of approach. Rather than dwelling on details of I-O modeling, that report focused on case studies and profiles of a new industry -- those contractors that are now actively providing energy conservation-related services, such as consulting, promotion, manufacturing or installation of energy efficiency equipment and conservation materials. While the study has promotional value, its lack of scientific rigor and the limited usefulness of extrapolating from the case studies.

There has been a set of other studies which have applied the classic static input-output models to estimate the potential future job impacts associated with the hypothetical situation where investment is made in electric efficiency instead of traditional energy supply sources. These include Florida (Krier et al., 1993), Minnesota (Economic Research Associates, 1993), British Columbia (Jaccard & Sims, 1991), Ohio (Laitner et al., 1994) and New York (NYS Energy Planning Board, 1994). For these reports, much of the study work actually concerned the definition and construction of the bundle of energy efficiency policies that would be feasible for the state or province. Once that was done, spending on energy efficiency was then allocated over selected S.I.C. codes and a synthetic I-O model (IMPLAN or RIMS-II in most cases) was then used to generate estimates of leakage and overall multiplier impacts on jobs in the supply area. Since each of these studies utilized a static I-O approach, employment effects of shifts in energy prices and business productivity were not fully accounted for.

The City of Austin Study (Megdal and Rammaha, 1991) was notable because although it too utilized a local-specific I-O model, synthesized from the national model to account for local leakages, the data for energy conservation multipliers were built from a local survey to profile local energy conservation of service providers rather than synthetic constructs. An important contribution of this study was that data for energy conservation multipliers were not all synthetic, but rather built upon a local survey to profile local energy conservation service providers and "trade allies". In addition, the I-O model was used not just to estimate impacts of increasing energy efficiency spending, but also to account for offsetting increases in energy rates to pay for that spending in the current year and in future years.

The 1990 California P.U.C. Study "Impacts of the SCE/SDG&E Merger" (Weisbrod and Moses, 1984), provided a first approach to the use of an economic simulated model for forecasting impacts of energy prices and policies on a regional economy. That study, utilized two different analytic approaches to predict the employment and income impacts of shifts in utility spending, prices, efficiency programs and community support programs in the San Diego area. One approach was to use the RIMS-II Input-Output model. The other approach was to use the REMI policy simulation model. In both cases, the model inputs and assumptions were modified on the basis of data collected on utility program spending patterns and the specific locations of suppliers and contractors. The study found that short term impacts were essentially similar for the REMI and RIMS models, but that long term impacts of alternative scenarios produced by REMI showed significant changes over the 1990 - 2000 study period. A parallel application of the national-level INFORUM model, which also incorporates general equilibium concepts in an integrated forecasting and simulation model, is described in Moscovich, 1994.

While there are other relevant studies which were conducted for Missouri, Michigan and New York, these examples illustrate the range of techniques used and the limitations of each. They also illustrate the best of analytic approaches to date, even though they all have limitations. They illustrate the limitations of simple I-O model approaches, and the movement towards understanding of price and time factors.

In several books on the topic (e.g., "Energy Efficiency and Job Creation" Geller et al., 1992), more general rules of thumb are offered. One finding common to several studies is including statements that these utility programs can generate 6 to 22 job-years per million dollars of DSM program spending. One problem with these rules of thumb is that they typically refer either to total job-years over a period of time or to jobs during the first year in which project funds are spent on equipment installation, rather than the longer term impacts. In addition, they do not account for substantial differences among utilities and among states in terms of the types of DSM programs offered, the characteristics of the eligible customer base importing of energy and local spending "leakage" rates. Equally important is that the ultimate impacts on economic development, which occur through business productivity and competitiveness changes, and which vary substantially from state to state, are not accounted for in those studies. In fact, job impact estimates that have been based on actual survey details (e.g., Megdal, 1990) or on simulation modeling (e.g., Moscovich, 1994), have been typically in the lower range of 1 - 4 job-years annually per million dollars of DSM program spending.

2.4 *Correct and Incorrect Ways of Measuring Economic Impacts*

From the preceding discussions of economic impacts and literature review, it should be clear that it is critical to understand how the pattern of shifting costs over time affects the expansion and contraction of various types of business. Adopting this perspective, we can then identify four common flaws in the measurement of economic development impacts of energy programs and policies. They are as follows:

(1) Reliance on Job Creation as the Benefit Measure. There have been a variety of reports on the job creation benefits of energy efficiency programs. Many of them are misleading. In essence, they all find that spending on energy efficiency programs create more local jobs than spending on purchases of generated electricity. The major reason why is that energy efficiency programs rely on materials production and installation processes that are more labor-intensive than are generating plants. In addition, it is assumed that much of the spending on energy efficiency programs flows to local firms, while in many cases much of the spending on generated electricity flows to non-local coal or oil producers.

The most serious flaw in those studies is the inference that such job creation alone is necessarily a net benefit. In fact, we can always create more jobs by substituting labor-intensive activities for more capital-intensive activities, but that in itself creates no real benefit. After all, we can create more jobs merely by new policies requiring that crops be harvested by hand rather than by harvesting machines, and that public streets be swept by people with brooms rather than by street sweeping machines. In these cases, we have created more jobs, but we have not attracted any more income generated by economic growth. In fact, in these cases we are likely to have increased costs of doing business, and actually caused a loss of economic activity which will reduce income. In reality, more jobs are desirable only insofar as they reflect economic growth and the generation of additional income in the state. When Iowa jobs are created because of Iowa products and services substituting for "imports" from other states, then those benefit criteria are also being met.

(2) Opportunity Costs of Capital. The second serious flaw in many economic impact studies is that they typically count as benefits the jobs and income created by up-front capital spending on constructing, purchasing and installing energy efficiency measures or renewable energy facilities without considering the lost opportunity for other uses of that money. In reality, these one-time capital costs are financed through some combination of taxes or energy rate increases. If the funds had not been spent on these projects, then they could have been either: (a) returned to the residents or businesses who would then be able to spend the money on other purchases, or (b) spent by the utility or government agency on other public construction projects. The jobs and income which are lost by forgoing those spending alternatives can offset the jobs and income which are gained by the spending on these energy projects.

The extent of the opportunity cost vary. For DSM programs, there are such opportunity costs associated not only with utility spending, but also with matching co-payment investments required of businesses and residents.

For renewable energy, the opportunity costs may be relative to the costs of building, and operating traditional fuel generating facilities or relative to other (non-energy) uses of the funds, depending on the need for additional generating capacity.

It is possible to calculate the incremental benefit (if any) associated with spending on particular projects over specific alternatives, but it may not be worth the effort. In many fields such as transportation infrastructure planning, the common practice for benefit/cost analysis is to evaluate benefits as the long-term value of the completed project or policy, ignoring construction activity impacts for the reasons cited here. Here too, we can conclude that the real economic value of energy efficiency and renewable energy projects should be measured as their long-term benefit in increasing productivity and expansion of business activity.

(3) Timing of Costs and Benefits. Another serious flaw in some past energy program impact studies was that they typically ignore the differential timing of program costs and benefits. The long-term energy savings benefits of these programs for these customers can continue on for a long period of time, and can grow as the use and value of the equipment technologies persists and expands over time. Basically, this means that the benefits may extend over a longer period of time than the payment of costs, which are incurred earlier on. (This occurs for example, when insulation is installed this year, bringing on a stream of annual savings over subsequent years.) This differential in timing of benefits and costs can be an important factor in the consideration of program costs and benefits, because there is a time value of money. Impacts occurring in future years should be appropriately discounted to correctly calculate the net benefit of a program. Impact studies which ignore the differential timing of benefits and costs can thus overestimate the net value of a program. The amount to which future year benefits should be discounted depends on assumptions about inflation, costs of borrowing capital (over and above inflation) and uncertainty risks. The latter two factors can differ between government and business, and can differ among types of businesses. Differences in the valuation of timing, and uncertainty associated with it, explains why businesses do not embrace energy efficiency measures which are supposedly "cost-effective."

(4) Cost Competitiveness. Ultimately, the economic development impact of energy programs and policies comes from their long-term effects on the economic competitiveness of the affected areas. Existing business activity is retained and expanded, and new business activity is attracted where the cost of doing business, cost of living and quality of life are attractive. Therefore, it becomes critical to evaluate economic development impacts of programs and policies in terms of their impacts on these factors. Yet that is exactly the step which many of the economic impact studies have failed to appropriately address.

Most of the studies of the employment and income impacts of energy efficiency programs have relied upon input-output models. Those models trace the flow of spending between sectors in a regional economy, and provide multipliers indicating the relationship of local spending to local employment and income. This is a well-accepted technique for assessing the contribution of an industry to a local economy, and for estimating the local impacts of gaining or losing a business activity. However, I-O models by themselves provide no basis for estimating how programs which affect local prices and costs of goods and services will ultimately affect the competitive position and hence relative pattern of economic growth or decline of an area. To address those issues, it is necessary to supplement the I-O model with some exogenous analysis. There are three ways to accomplish that: (a) by surveying businesses about how they would react to price and business cost changes, (b) by building an economic model which evaluates competitive prices and business cost factors and forecasts their impacts, or (c) by setting an arbitrary rule for how businesses would react to cost changes.

The arbitrary rule most often used with I-O models to evaluate economic impacts of energy efficiency programs has been that any savings in energy costs will trigger an identical expansion in spending by those parties receiving the energy savings. This is a convenient but not necessarily correct assumption. In reality, a small change in productivity and relative costs of doing business may trigger much larger expansion or contraction of some highly competitive and footloose industries. The same relative change in business costs for other "captive" local industries may trigger little or no change in volume of business activity (and merely a shift in prices). That is why it is important to evaluate how energy-related policies can affect the relative competitive position of various local industries, and the extent to which changes in that position will affect the retention, attraction and expansion of various local industries over time.

2.5 Data Collection and Modeling Framework

A unified economic impact evaluation system was developed for this study to address issues of program design for energy efficiency programs and renewable energy programs. This framework identifies the necessary information to be collected and the types of analysis necessary to evaluate their impacts. The elements of this system are as follows:

Step 1: Program Cost and Benefit Profile. The first step in the economic impact evaluation system is to identify the distribution of business costs and benefits, by type of business and over time. This involves addressing five questions:

1. **What is the program mix** - What is the profile of program offerings by sector, by end use and by technology?

2. **What are the costs** - What is the distribution of utility spending on program marketing, administration, implementation, incentive payments, capital spending, monitoring and evaluation?

3.. **Who pays the cost** - What is the distribution pattern of residential and business customers_incurring costs of energy efficiency programs through rates?

4.. **Who benefits** - What is the profile of Iowa businesses participating in utility programs to encourage purchases of energy efficient equipment, the pattern of financial incentives flowing to them and the pattern of copayment investments by them?

5. **What is the timing** - How are energy efficiency program costs and benefits distributed over time?

This information is important because it is these elements of program design which affect the flow of dollars in the economy and which can raise or lower the productivity and cost competitiveness of area businesses. They can vary greatly by type of program.

Step 2: State or Regional Economy. The next step is to document the flow of funds involved in supplying the products and services which are being encouraged and discouraged by program. This involves two additional questions regarding the state or regional economy:

6. **Who are the suppliers** - What is the profile of in-state and out-of-state businesses supplying energy efficiency equipment and services, and the pattern of sales revenue flowing to them?

7. **What is being displaced** - What are the traditional in-state and out-of-state energy sources which are being displaced by the energy efficiency or alternative energy policy?

This information is important because these aspects of the state economy affect the magnitude and mix of dollars flowing to business sectors within the state and magnitude of dollars flowing out of the state. They can vary greatly among states and regions.

Step 3: Analysis of Local Business Competitiveness. The third step is to evaluate the relative strengths and weaknesses of the local economy for attracting or retaining different types of business, and the impact of energy cost factors on them. This involves two more questions:

8. **Relative Business Competitiveness.** What is the cost of doing business for various types of businesses in this state, relative to elsewhere?

9. **Relative Importance of Energy Costs.** What is the contribution of energy costs to overall cost of operations, for the given industry?

10. **Sensitivity to Cost Changes.** What is the relative sensitivity of business expansion and contraction in various types of industries to relative changes in business costs? (This is a function of business spending patterns, the ease of relocating the industry while serving the same market base, and prevailing profit margins in the industry.)

This analysis is critical because the same change in energy costs can have a very large or very small impact on business activity, depending on the industry, its competition and locational alternatives. Thus, for example, an industry which has thin profit margin and low transportation costs (making it easy to work from alternative locations) may be very sensitive to energy costs even if they appear to account for only a small portion of overall business cost. For those industries, a change in energy efficiency (affecting consumption) or energy rates (also affecting cost) can lead to disproportionately larger changes in rates of businesses relocating, contracting or expanding in the affected area. For other industries, the opposite may be true.

Step 4: Results. The final step is to evaluate the economic impact of alternative program designs. This addresses two related questions:

11. **Economic Development Impacts.** What is the effect of the programs or policies on personal income and business revenue in the state or region?

12. **Implications.** How will these economic development affect net revenues for government and for utilities?

These answers will depend on the program cost and benefit profile (step 1), state or regional economy (step 2) and local business competitiveness (step 3). For the last question, they will also depend on the financial structure of the affected government agencies (or utilities).

2.6 Data Collected

Program Cost and Benefit Profile. In prior studies of the economic impacts of DSM and energy efficiency programs, there has been a dearth of information on the distribution of costs by spending category and type of program, as well as the distribution of benefits. Most often, the approach has been to assume that: (a) there is a constant pattern to DSM program costs regardless of program type or size, (b) program costs and benefits are equally or proportionally distributed among sectors of the economy, and (c) timing is not an issue. To avoid the pitfalls of such assumptions, three steps were taken.

- The first was to construct an inventory and database of Iowa's energy efficiency programs, including information on program types, program costs, participation and program benefits.

- The second was to collect detailed information on the distribution of program costs by different utilities for different types of programs, using data from filings with the Iowa Utilities Board and additional data provided directly by the individual utilities.

- The third step was to construct a profile of participants receiving financial incentives from Iowa DSM programs, by customer type.

State Economy. In a few prior studies of the economic impacts of DSM and energy efficiency programs, surveys were conducted to identify the size and character of the state or region's "energy efficiency sector". In most cases, however, this has been accomplished by non-survey estimation, i.e., estimates based on employment data by S.I.C. (Standard Industrial Classification) group. Unfortunately, S.I.C. codes provide only a very rough and error-prone estimate of potentially relevant industries, and they provide no basis for distinguishing manufacturers of energy efficient equipment from manufacturers of only standard efficiency equipment. To address this need, we utilized Dun & Bradstreet and the Harris Directory to identify potentially relevant firms, and then sent them a survey of their product sales and purchasing patterns, and the energy efficient portion of their in-state and out-of-state sales.

Local Business Competitiveness. The third step is to evaluate the relative strengths and weaknesses of the local economy for attracting or retaining different types of business. For this study, relative costs of doing business in Iowa were compared to other states in terms of the costs of energy, transportation, labor, capital, housing and taxes. These comparisons were calculated by Regional Economic Models, Inc.(REMI). Information on fuel use and electric energy expenditures by sector and relative cost differences between Iowa and other states were derived from the Energy Information Administration and US Economic Census data.

In order to calculate the relative sensitivity of Iowa business growth to relative changes in business costs, the REMI Model was developed for Iowa. This model utilized historical data for 1972 - present on the cost competitiveness of doing business in Iowa relative to elsewhere in the U.S. (for each of 53 industries) and the growth of the Iowa economy relative to national growth (for each of those industries). Based on this information, estimates of relative sensitivity of industry growth to local cost factors were developed. These factors are highly dependent on characteristics of the Iowa economy and hence are not transferable to elsewhere.

2.7 REMI Model

Overview. (This is drawn in part from an article by Glen Weisbrod in REMI NEWS).

The REMI Economic and Demographic Forecasting Model is a structural model that can be calibrated to any combination of counties or states in the United States. The model includes all of the inter-industry interactions among the 49 private sections in the economy. It also includes the trading flows by industry between any areas and the rest of the US areas. In addition to containing a complete inter-industry and trade flow structure, the model also includes aspects of the economy that are regarded as important in standard economic theory. These include the effect on the location of industry, in the present and future, of changes in the relative cost of doing business. This relative cost of doing business is built up for each industry based on tax costs, fuel costs, wage costs, and costs of all the intermediate inputs in the areas. The model uses a flexible production function that allows for substitution among capital, labor and fuel, based on shifts in relative costs in these factor inputs. It has a wage determination response for each of the 94 occupations based on shifts in relative demand for labor in each occupations category. The wage changes, for each occupation, are then used to recalculate costs of doing business for each industry via an occupations matrix. The model includes a migration response to employment conditions in the areas. In making a forecast the model also includes area specific industry mix effects at a three digit level and unexplained trends by industry for employment and wage rates.

While the theory behind the development of the model and the model structure is maintained from one area to another, the model is calibrated specifically to the areas in question. This calibration starts with the detailed analysis of the economy at the level of 500 separate industries. At that level, the proportion of local use supplied locally for each industry is estimated using results form quantitative work done across all states and state specific adjustments derived from direct observation in the Census of Transportation. Once these results are obtained at the detailed level, they are then aggregated to 53 section. (See Figure 2).

Differences from Input-Output Models. The REMI model incorporates the later-industry technological coefficients and employment -income-sales relationships contained in from simple input-output models, and adds sensitivity to the following regional features:

- relative differences in labor wage rates and total factor productivity between the region and rest of the nation (for each industry sector);

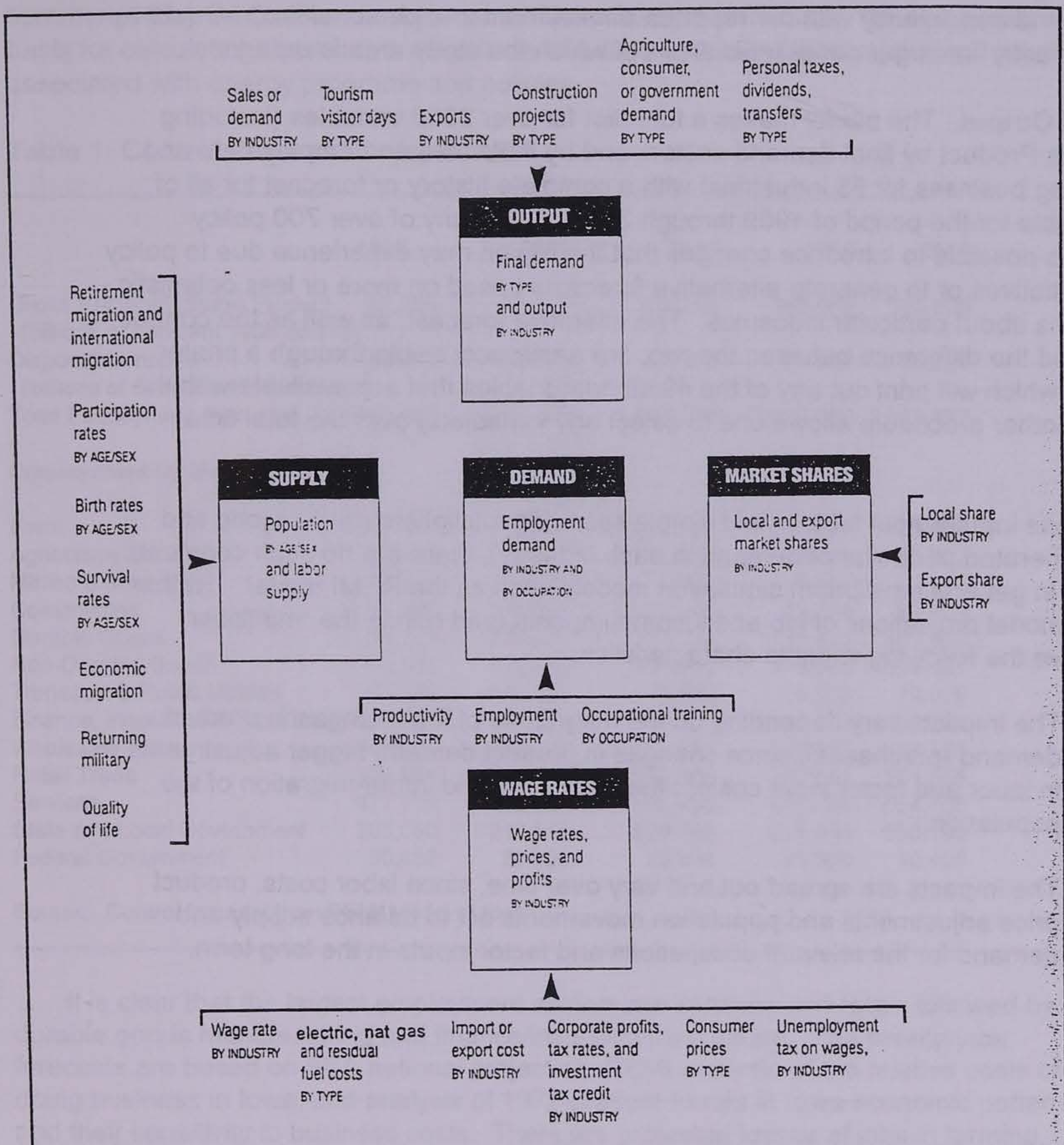
  relative differences in electrical, gas and oil fuel costs between the region and rest of the nation (and differences in fuel use by industry sector);
- relative differences in state corporate and average property taxes between the region and the nation;
- relative differences in capital costs for equipment inventory and structures;
- relative differences in production costs and in profitability by industry
- relative differences in labor intensity (i.e, labor input per unit of output for each industry sector)
- occupation mix of the region's labor force;
- residential and non-residential investment levels for the region;
- endogeneity of import-completing production and production for exports.
- general equilibrium adjustments over time in labor markets, factor prices and locations of population and employment.

The REMI simulation model thus shares with simple input-output matrices the same limitations associated with reliance on SIC group definitions and state-level inter-industry relationships synthesized from national I-O studies, although it does add sensitivity to a range of additional time and cost factors.

The employment data and personal income date for each area are from the Bureau

Figure 2:

How policy variables enter the REMI model



To answer the question pertaining to decreasing electric rates for businesses, a user would change the variable highlighted in white.

of Economic Analysis (BEA). Any industries which are not reported by the BEA due to disclosure requirements or the level of detail are included using additional data programming developed over the years that ensures both internal consistency within the region and consistency with the reported employment and personal income data by detailed industry for larger geographic areas of which the study area is a part.

Model Output. The model makes a forecast for over 2000 variables (including Gross State Product by final demand sectors and by industries and employment and cost of doing business for 53 industries) with a complete history or forecast for all of these variable for the period of 1969 through 2035. Using any of over 700 policy variable it is possible to introduce changes that the region may experience due to policy variable initiatives or to generate alternative forecasts based on more or less optimistic assumptions about particular industries. The alterative forecast, as well as the control forecast and the difference between the two, are easily accessible through a printer procedure which will print out any of the 49 standard tables that are available with the model. Another procedure allows one to select any variable(s) over the total time horizon.

Whereas input-output tables yield simple spending multipliers (ratio of jobs and income generated per dollar of demand in each industry), there are no such constant multipliers in general equilibrium simulation models such as the REMI model. Rather, the REMI model projections of job and income impacts (and hence the "multiplier effect") have the following variable characteristics:

- The impacts vary depending on the magnitude of the changes in product demand (purchases), since changes in product demand trigger adjustments in labor and factor input costs, affecting prices and in/out-migration of the population.

- The impacts are spread out and vary over time, since labor costs, product price adjustments and population movements act to balance supply and demand for the relevant occupations and factor inputs in the long term.

2.8 Iowa Baseline

The REMI Model baseline projections for the Iowa economy over 1995 - 2015 summarized by S.I.C. (Standard Industrial Classification) in Table 1. This provides a basis for calculating the relative magnitude of (percent charge in) total jobs and income associated with energy programs and policies.

Table 1: Control Forecast for Iowa, 1995

	1995	2000	2005	2010	2015
Gross Regional (State) Product (billions of constant 1994 dollars)	82,258	92,337	101,379	109,065	115,905
Disposable income (billions of constant 1994 dollars)	58,314	63,729	68,658	72,229	75,656
Total Employment (persons)	1,782,6780	1,884,761	1,968,278	2,000,026	2,015,137
Employment by Major Sector					
Farm	121,802	113,387	105,550	100,377	95,457
Agriculture Service	17,639	19,541	21,464	22,088	22,373
Mining & Minerals	2,705	2,559	2,367	2,247	2,113
Construction	81,494	85,495	87,996	91,398	94,939
Durable Goods	134,100	133,015	126,977	117,422	107,028
Non-Durable Goods	110,202	116,458	120,865	118,966	115,481
Transport & Public Utilities	73,243	76,520	78,672	79,662	79,979
Finance, Insurance & Real Estate	125,661	135,890	143,915	150,553	155,788
Wholesale Trade	93,506	98,427	101,672	103,857	104,753
Retail Trade	309,074	315,932	321,869	322,694	321,866
Services	477,706	540,407	600,235	632,056	654,706
State and Local Government	205,090	217,340	226,743	228,395	230,195
Federal Government	30,457	29,789	29,954	30,309	30,458

Source: Control forecast from REMI Model of Iowa

It is clear that the largest employment sectors are services and retail, followed by durable goods manufacturing and finance/insurance/real estate. The twenty-year forecasts are based on BEA national projection, REMI analysis of the relative costs of doing business in Iowa, and analysis of 1972-present trends in Iowa economic patterns and their sensitivity to business costs. There are projected losses of jobs in farming, federal government and durable goods manufacturing (esp. Metals, machinery and instruments). These are offset by projected gains of jobs in finance/insurance/real estate; services and non-durable goods (esp. food products, printing and plastic/rubber products.

Factors affecting the relative cost of doing business in Iowa are shown in Table 2. It shows significant variation in costs of labor, energy, capital and intermediate product inputs among the various economic sectors.

The REMI model forecasts, discussed in Sections 3 and 4, essentially represent the impacts of energy efficiency and renewable energy programs on relative business costs and relative economic growth decline, superimposed on these existing patterns of business costs and economic growth/decline.

Table 2: Factors Affecting Competitive Cost of Doing Business in Iowa, 1995 (Index Relative to U.S. Average of 1.00)

	Labor Intensity	Labor Cost	Fuel Cost	Capital Cost	Interm. Input/Cost	Factor Productivity	Profit (Index)
Durable Goods Mfg.							
Lumber & Wood Prod.	0.96	1.17	0.88	0.97	0.94	0.91	0.95
Furniture	0.97	1.10	0.87	0.97	0.93	1.06	1.04
Stone/Glass/Clay/Prod.	1.00	1.07	0.90	0.97	0.90	1.53	1.00
Fabricated Metal	1.03	0.85	0.87	0.97	0.95	0.91	1.04
Machine & Computer	0.97	1.04	0.87	0.98	0.95	1.24	1.12
Electrical Equipment	1.03	0.87	0.87	0.97	0.94	1.16	1.14
Transp. Equipment	1.04	0.85	0.87	0.97	0.97	0.55	0.80
Instruments	1.23	0.63	0.85	0.97	0.92	0.98	1.16
Misc. Mfg.	0.92	1.19	0.86	0.98	0.92	0.85	0.91
Non-Durables							
Food	0.88	1.00	0.89	0.97	0.93	0.82	0.93
Paper	0.95	1.05	0.89	0.97	0.95	0.61	0.75
Printing	1.08	0.80	0.86	0.97	0.90	1.05	1.00
Chemicals	0.97	0.93	0.90	0.97	0.92	1.45	1.20
Rubber	0.98	0.94	0.87	0.97	0.94	1.05	1.08
Construction	1.09.	0.86	0.85	0.97	0.91	0.97	1.00
Transport & Utilities	1.08	0.82	0.86	0.94	0.85	1.15	1.00
Finance/Insurance/Real E.	1.28	0.75	0.84	0.95	0.78	1.36	1.00
Retail Trade	1.10	0.80	0.84	0.97	0.82	0.99	1.00
Wholesale Trade	1.07	0.74	0.84	0.98	0.82	1.05	1.00
Services	1.13	0.73	0.84	0.95	0.82	1.10	1.00

Source: Regional Economic Models, Inc., based on data from US Dept. Of Commerce

2.9 References for the Literature Review

Buchsbaum, S. Et al. 1979. *Jobs and Energy.* Council on Economic Priorities. New York.

California Energy Commission. 1979. *The Comparative Effects of Energy Technologies on Employment.*

Hunter, William. 1989 “Economic - Impact Studies: Inaccurate, misleading and unnecessary”. *Industrial Development Section, IDRC*. August.

Economic Research Associates. 1993. *Energy Efficiency and Minnesota Jobs: The Employment Impacts of Electric Utility Demand-Side Management Programs*. prepared for the Izaak Walton League of America, Minneapolis..

Geller, H., J. DeCiccio and S. Laitner. 1992. *Energy Efficiency and Job Creation: The Employment and Income Benefits of Investing in Energy Conserving Technologies*. American Council for an Energy Efficient Economy (ACEEE), Washington, D.C.

Goodman Group. 1992. *A Comparison of the Employment Creation Effects of the AS - Hartman Cove Generating Station and Maine Demand Side Management. Boston, MA.*

Jaccard, M. and D. Sims. 1991. "Employment Effects of Electricity Conservation: The Case of British Columbia", *Energy Studies Review* 3:1, pages 35-44.

Kegal, J. And D. Laitner. 1987. *Community Energy Choices: The Goal Programming Concept as An Economic Development Assessment Tool for Utility/Community-Based Energy Management Programs.*

Krier, B., I. Goodman and P. Kelley-Detwiler. 1993. *Employment Impacts of Electricity Efficiency in Florida*. The Goodman Group, prepared for the Florida Energy Office.

Laitner, S. 1984, *Region VII Economic Indicators Study, Nebraska Energy Office, October.*

Laitner, S. et al. 1994. *Energy Efficiency as an Investment in Ohio's Economic Future*. ACEEE, prepared for the Campaign for an Energy Efficient Ohio.

Macke and Associates, 1986. *Energy Efficiency Impacts and the Iowa Economy,* prepared for the Iowa Energy Policy Council.

Massachusetts Energy Efficiency Council. 1992 *The Energy Efficiency Industry and the Massachusetts Economy.* Boston

Megdal, L. and H. Rammaha. 1992. "The Development of a Local Electric Energy Efficiency Economic Impact Model for Use in Integrated Resource Planning." *Proceedings of the ACEEE Summer Study 8.127-133.* American Council for an Energy Efficient Economy, Washington, D.C.

Moscovitch, E. 1994. "DSM in the Broader Economy: The Economic Impact of Utility Programs." *The Electricity Journal.* May.

New York State Energy Planning Board. 1994. *New York State Energy Plan, Vol. III: Supply Assessments.* pp. 606-621.

Weisbrod, G. And S. Moses 1990. *Impacts of the Proposed SCE & SDG&E Merger* Cambridge Systematics, Inc. For the California Public Utilities Commission. April.

SECTION 3: ENERGY EFFICIENCY PROGRAMS

3.1 Profile of Existing DSM Programs

Many of the studies of energy efficiency program impacts on other states have been based on hypothetical data concerning the program mix, market penetration and costs associated with these programs. This study starts by identifying the actual program mix, market penetration and costs associated with these programs occurring in Iowa as of 1994. This provides a solid basis for modeling the economic impacts of the current program activities, as well as a strong foundation for extrapolating these results to represent other possible future scenarios.

Information Needed.

In prior studies of the economic impacts of DSM and energy efficiency programs, there has been a dearth of information on the distribution of costs by spending category and type of program, as well as the distribution of benefits. Most often, the approach has been to assume that: (a) there is a constant pattern to DSM program costs regardless of program type or size, (b) program costs and benefits are equally or proportionally distributed among sectors of the economy, and (c) timing is not an issue. To avoid the pitfalls of such assumptions, three steps were taken.

1. An inventory and database of Iowa's energy efficiency programs, including information on program types, program costs, participation and program benefits, was assembled.

2. Detailed information on the distribution of program costs by different utilities for different types of programs was compiled, using data from filings with the Iowa Utilities Board and additional data provided directly by the individual utilities.

3. A profile of participants receiving financial incentives from Iowa DSM programs was estimated based on utility data and state economic data.

Methodology.

In order to obtain data on current energy efficiency programs, the project team undertook a two-stage process. The first stage involved working with the Iowa Utilities Board to identify all of the relevant utilities, agencies and programs, as presented in filings with the state. The large quantity of filed documents were then examined in order to extract simulation model data on program types, costs and expected benefits. This was then followed up with a survey of the utilities and agencies operating these programs. The survey covered the following areas:

1. List of current energy efficiency, conservation and load management programs
2. Categorization of each program by sector (commercial, industrial, agricultural, institutional, residential)
3. Categorization of each program by end use (heating, cooling, lighting, motors, process equipment)
4. Categorization of each program by type (new construction or retrofit)
5. Level of annual funding for each program.
6. Current annual participation level for each program.
7. Expected annual energy savings (kWh or therms) and peak savings in demand for each program
8. Method of program financing, and rate impact by sector
9. Pattern of program costs for each type of program , end-use and sector type (distinguishing administration, marketing, delivery/installation, subsidies/rebates paid, monitoring and evaluation)
10. Mix of in-state vs. out-of-state spending for program vendors, for each cost category cited above.
11. Characteristics of program participants.

Results: Statewide Profile of Programs

A summary of the inventory of Iowa DSM programs is shown in the Appendix. A total of 151 programs were identified. These included the following types of programs:

- Conservation programs -- insulation, weatherization, windows, setback thermostats
- High efficiency equipment promotions and incentives -- appliances, motors, lighting, air conditioning, space heating, water heating, refrigeration, process equipment, street lighting,
- Load Control -- time of use rates, direct load control of air conditioners,

interruptible/curtailable rates (these programs do not save energy, but they shift demand from high-cost peak periods to lower-cost off-peak periods).

- Special targeted sectors -- low income, small commercial, new construction, cogeneration, tree planting, farm, large industrial
- Methods -- audit programs, information programs, rebate programs, direct installation programs
- Fuels -- electric, natural gas

The sponsoring organizations, number of different program types and total 1994 funding are shown in Table 3.

Table 3: Programs and Spending Levels of Energy Efficiency and DSM Programs in Iowa

Company	# of Programs	1994 Spending
IES	11	$ 12.4 million
Interstate Power*	15	$ 6.9 million
Iowa - Illinois Gas & Electric*	16	$ 7.3 million
Iowa Dept. of Natural Resources*	1 (statewide)	$ 8.9 million
Midwest Gas	12	$ 6.4 million
Midwest Power*	34	$ 20.4 million
Municipal Utilities*	27	$ 8.4 million
People's Natural Gas	9	$ 1.8 million
Rural Electric Cooperatives	23 (types)	$ 3.4 million
Waverly Light & Power	1	$ 58.0 thousand
United Cities Gas*	2	$158.0 thousand
TOTAL	151 programs	$76.1 million

* denotes respondent providing program details; other detail from Iowa Utilities Board
Source: Survey of Iowa Utilities and the Iowa Utilities Board (IUB).

Overall, the completed database revealed the following attributes of DSM programs in Iowa (as of 1994):

- $76 million spent per year
- 225,743 participants

- 234 gWh annual electricity energy savings
- 10.8 million therms annual natural gas savings

Results - Participation

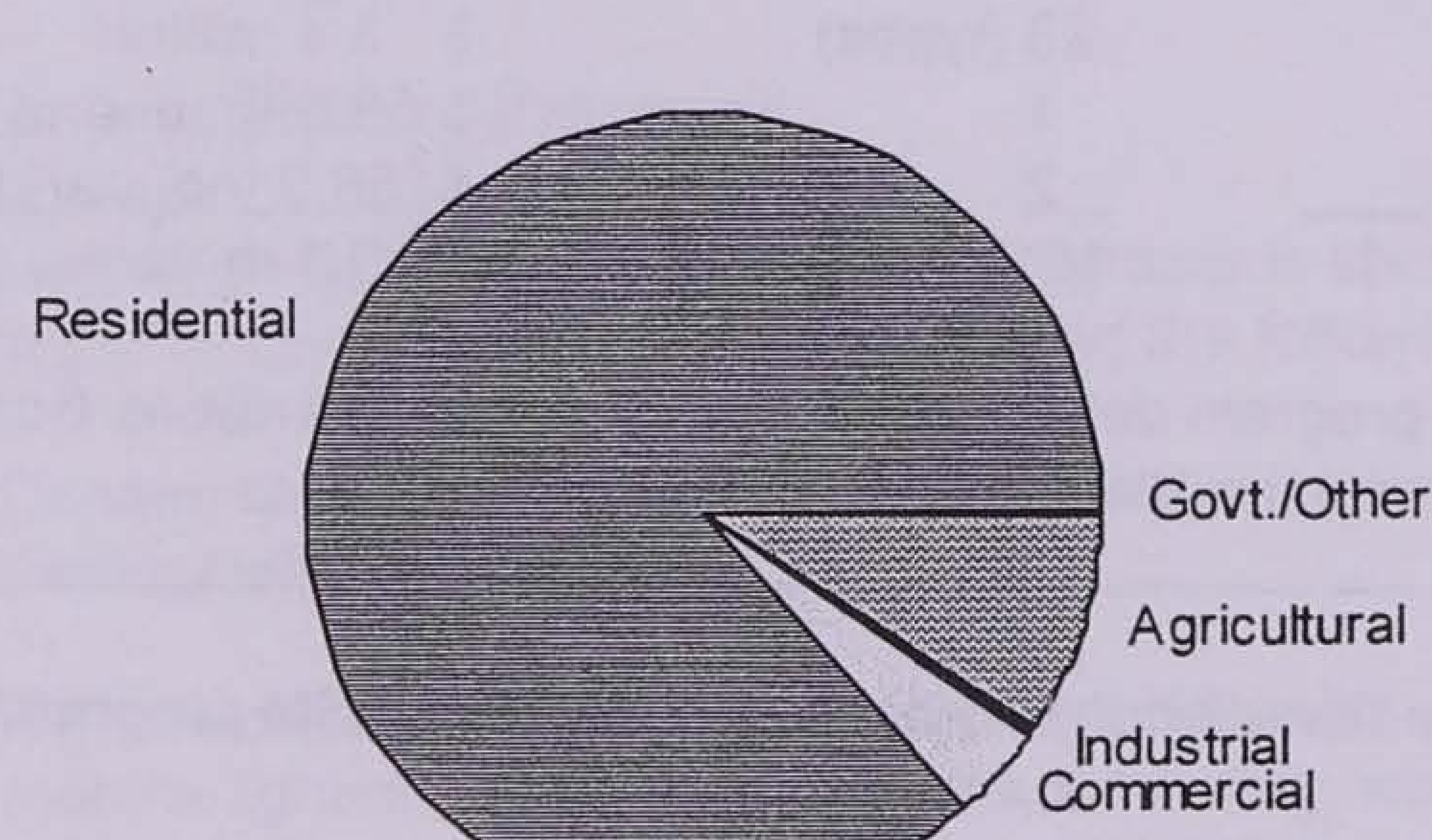
The utilities supplied information on the mix of program recipients, among the commercial, industrial, agricultural, institutional and residential sectors. The overall breakdown of program spending, by type of recipient, is shown on Table 4 and Figure 3.

Table 4: Program Participation, Spending and Savings by Type of Participant, 1994

Sector	Participants/yr		Incentives/yr (Millions)		GWh Saved/yr		Therms Saved/yr (Millions)
Commercial	8,786	(3.8%)	$ 8.9m	(11.7%)	51	(21.6%)	3.9m (36.1%)
Industrial	1,099	(0.5%)	$ 3.4m	(4.5%)	23	(9.8%)	0.01m (0.01%)
Agriculture	20,275	(9.0%)	$ 1.5m	(12.4%)	7	(3.1%)	0
Instit/Govt	390	(0.2%)	$ 13.5m	(17.8%)	20	(8.7%)	0
Residential	195,193	(86.5%)	$ 48.5m	(64.0%)	133	(56.8%)	6.9m (63.8%)
	225,743	(100%)	$75.8m	(100%)	234	(100%)	10.m (100%)

*includes incentives administration and operations
Source: Survey of Iowa Utilities

Fig 3: Distribution of Energy Program Incentives in Iowa
(Flow of Incentive $$ to Participants, by Sector)



Program Spending Pattern.

The estimated distribution of incentives from Iowa DSM programs (summarized in preceding Figure 3) indicates that some business sectors received a particularly large benefit of energy efficiency incentives. This is a function of the composition of businesses in the state, the DSM program mix, and the pattern of business response to DSM program offers. Other estimated breakdowns of program spending by end-use is 48% HVAC, 23% lighting, 14% hot water, 6% building shell, 4% new construction, and 5% motors and process equipment.

In addition, profiles were developed of program spending patterns for marketing, service delivery, incentives, monitoring & evaluation and quality control. The results, shown in Table 5 and Figure 4, indicate that the various elements of program cost vary significantly in magnitude and in relative size among different program types. In general, a majority of the program costs go for incentive payments (rebates), although there are exceptions. New construction programs have particularly high administrative costs, while residential lighting programs have particularly high promotional costs, when expressed as a percentage of total program costs.

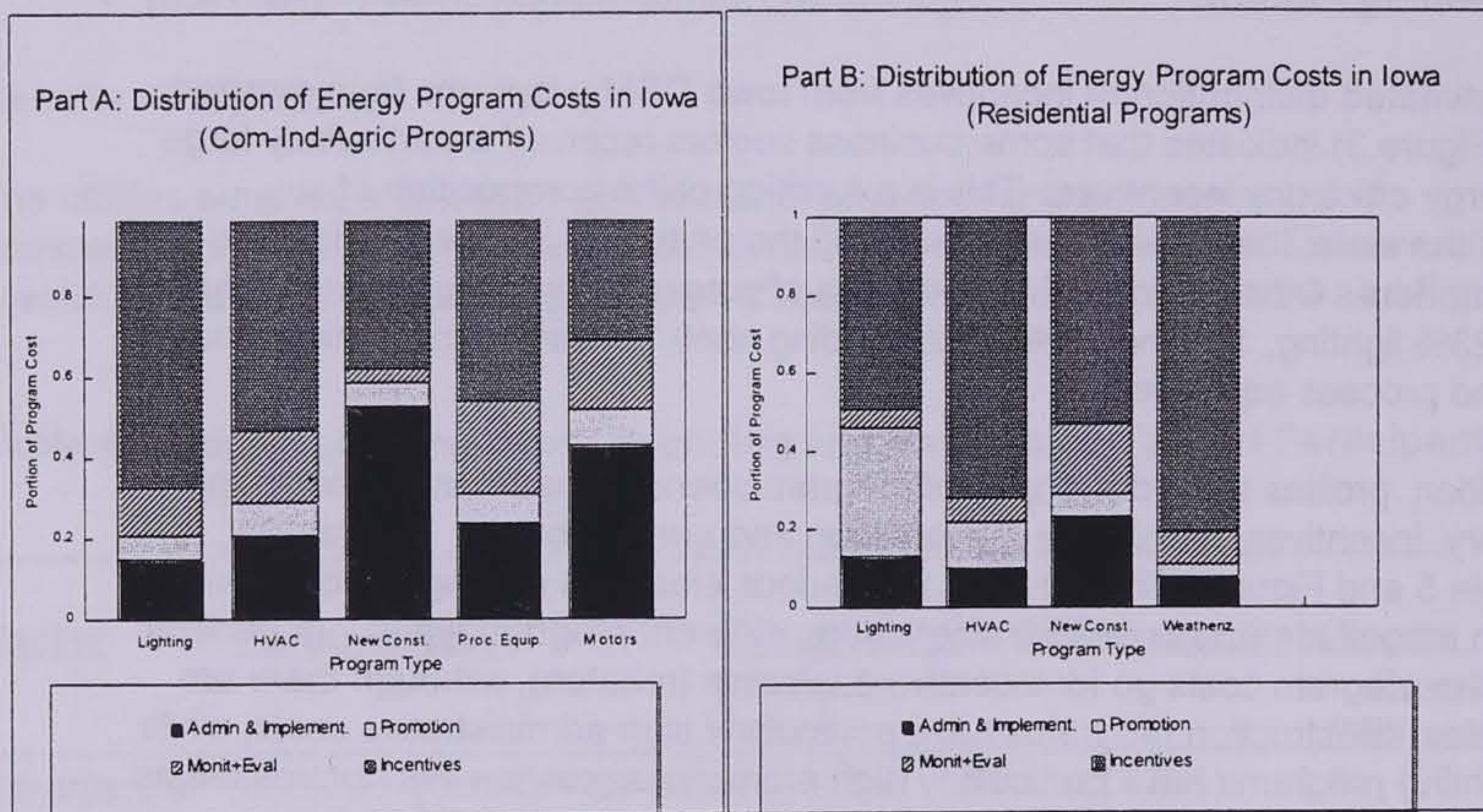
TABLE 5: Breakdown of Costs for Iowa DSM Programs

Cost Category	Lighting	HVAC	New Const.	Proc.Equip.	Motors
Commercial & Industrial Programs					
Admin & Implement.	15%	21%	53%	24%	43%
Promotion	6%	8%	6%	7%	9%
Monit+Eval	12%	18%	3%	23%	17%
Incentives	67%	53%	38%	46%	31%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Cost Category	Lighting	HVAC	New Const.	Weatherization
Residential Programs				
Admin & Implement.	13%	10%	23%	8%
Promotion	33%	12%	6%	3%
Monit+Eval	5%	6%	18%	8%
Incentives	49%	72%	53%	81%
Total	**100%**	**100%**	**100%**	**100%**

Source: Survey of Iowa Utilities

FIGURE 4: Breakdown of Costs for Iowa DSM Programs



In addition, profiles were developed of the frequency of in-house vs. use of vendors for program marketing, service delivery, monitoring & evaluation and quality control, as shown in Table 6. They show that Iowa firms are used for most program delivery and marketing, although 1/2 of the installation dollars and 4/5 of the monitoring & evaluation dollars flow to out-of-state specialists.

Table 6: Use of Vendors for Utility Programs

Type of Service	Percent In-House (no vendor)	Percent In-State Vendor	Percent Out-of-State Vendor	Total Percent
Program Delivery	10%	90%	0%	100%
Marketing	20%	80%	0%	100%
Monitoring & Eval.	0%	13%	82%	100%
Installation	0%	43%	57%	100%
Qual Control + Eng.	40%	27%	33%	100%

Source: Survey of Iowa Utilities

Uses of the Program Information.

The results described here provide the following important Iowa-specific data, for use in economic modeling for the State of Iowa:

- Determination of **program participant mix by economic sector** of recipient
- Determination of program **equipment mix** (and associated economic sector)
- Determination of program **costs per kWh and per therm**, by participant sector and end use type
- Determination of program **cost mix** by type of program (participant sector and end use type)
- Determination of **regional purchase coefficients** (in-state supply) for program implementation spending, by program cost element.

3.2 Survey of Iowa Manufacturers and Distributors

Information Needed

An important element of realistic and useful economic modeling is the use of appropriate values concerning flows of spending on energy efficiency programs -- specifically the portion of local spending on energy efficiency products and services which is supplied by locally-produced (in-state) manufacturers and service providers. In order to obtain this information, we conducted a study of the manufacturing and distribution of major energy-consuming products and the "high efficiency portion of their sales. The results were then used to adjust the economic model assumptions on spending flows for energy-saving equipment.

Survey Methodology

To study the above issues, a survey was conducted of Iowa businesses which manufacture or distribute major electricity-consuming equipment.

Survey Coverage. Types of businesses which were covered in the survey are shown in Table 7.

Table 7: SIC Codes of Surveyed Energy Product Manufacturers and Distributors

3585-99	Refrigeration and Heating Equipment
3612-02	Lamp Ballasts
3621	Motors and Generators
3631	Stoves and Ovens
3632	Refrigerators and Freezers
3633	Washers and Dryers
3641-01,02	Electric Lamps and Parts
3645-99	Residential Lighting Equipment
3646	Commercial, Industrial, and Institutional Lighting Equipment
3648-01	Outdoor Lighting Equipment
3585	Air Conditioning and Warm Air Heating Equipment (Com./ Ind.)
3822-01	Air Conditioning and Refrigerator Controls
Distributors	
5063-9	Electrical Apparatus and Equipment
5075	Warm Air Heating Equipment
5719-02	Lighting Equipment
5999-07	Engine and Motor Equipment and Supplies

Survey Content. The survey instrument is shown in Appendix A. It covered the following questions:

1. Types of products made, distributed, installed & repaired
2. Portion of #1 (above) which is "high efficiency" (as opposed to "standard efficiency")
3. Percentage of business sales revenue which is from in-state
4. Portion of in-state revenue (#3) and out-of-state revenue which is high efficiency
5. Wholesale or retail channels through which the products (#1) are sold.
6. Percentage of business spending on intermediate supplies and services which is from in-state
7. Knowledge of utility energy efficiency programs
8. Impact of utility energy efficiency programs on their business
9. Business sales and employment characteristics

Survey Mailing. Initially, Dun & Bradstreet's DMI (Duns Market Indicators) database was used to identify manufacturers and distributors located in the State of

Iowa with 10 or more employees or $1 million or more sales revenue within the state. The Harris Directory of Iowa Manufacturers was used to supplement and cross-check that data. As a result, a total of 40 manufacturers and 100 distributors were identified. A mail reply survey was sent to those businesses. A breakdown of these businesses, by type, is shown in Table 6.

Survey Results.

Of the 140 firms which were mailed surveys, 66 responded. Of those, nearly 25% (16 of the 66) had few or none of the questions filled out, and were accompanied with notes explaining that the firm was not really involved in business activity relevant to the survey. Most frequently, these were firms manufacturing or selling gasoline-powered automotive or marine motors, oil-fired boilers for specialized commercial or industrial processes, or other gasoline or oil-based equipment. In addition, three of the responses were received too late to be used. Thus, most of the results reported here are based on 47 fully-completed surveys. A breakdown of the surveys received is shown in Table 8.

Table 8: Profile of Surveys Sent Out and Received

	Sent Out (Census)*	Returned (Survey)
Manufacturers		
Space Heating and Air Conditioning	12	2
Lighting	4	3
Refrigeration	4	2
Motors	3	2
Controls & Misc. Appliances	15	4
Insulation	3	1
	40	14
Distributors		
Heating, Ventilation and Air Conditioning	51	18
General Electrical (Lighting, Motors, Controls)	49	15
	100	33

*businesses with at least 10 employees or $1 million revenue in Iowa
Source: Survey of Iowa Energy Product Manufacturers and Distributors

Product Mix

The Dun & Bradstreet DMI database and Harris Directory of Manufacturers, along with the survey results, showed that Iowa has a concentration of major national manufacturers of major household appliances -- washers, dryers, refrigerators and stoves. (See Table 8.) Iowa also has a major manufacturer of heating and cooling equipment, including heat pumps. On the other hand, Iowa has relatively little representation of lighting manufacturing.

This pattern is further illustrated by the distribution of survey responses on types of products manufactured and distributed in Iowa, as shown in Table 10. The results again show that among responding manufacturers, there is significant representation of refrigerators and refrigeration equipment products. Some other Iowa manufacturers reported producing lighting, space heating and cooling products, motors and ice machines. The state's distributors reported handling all of the above-listed equipment, as well as humidifiers, hot water heaters, transformers and controls, as well as insulation, and insulating windows.

Table 9: Largest Iowa Manufacturers of Electrical Products (ranked by Employment)

(Employing 1000 - 3500)		
Maytag Corporation	3632	Stoves, Refrigerators, Washers
Amana Refrigeration	3632	Refrigerators
Fisher Controls	3612	Lamp Ballasts & Controls
Lennox Industries	3585	Heating & Cooling Equipment
White Consolidated Industries	3633	Refrigerators
(Employing 100 - 999)		
Dexter Company	3632	Refrigeration
Burcliff Industrial	3585	Heating & Cooling Equipment
EMW Groschopp	3621	Motors
Frigidaire Company	3633	Refrigerators
G.E. Appliance Controls	3556	Electrical Controls
Musco Sports Lighting	3641	Lighting
Products United	3612	Ballasts
SNC Manufacturing	3612	Ballasts
IMI Cornelius	3585	Ice Makers

Source: Survey of Iowa Energy Product Manufacturers and Distributors

Table 10: Products Produced and Distributed by Survey Respondents

Product	Manufacturers	Distributors
Lighting Equipment	2	11
Cooking Equipment (Stoves, Ovens)	0	3
Refrigeration Equipment	3	3
Washing Machines	0	2
Heating Systems	1	9
Air Conditioners or Heat Pumps	2	12
Motors	3	13
Other Equipment		
Humidifiers	0	6
Hot Water Heaters	0	10
Transformers	0	8
Controls	0	12
Insulation	0	4
Windows	0	4
- Miscellaneous	1	7
TOTAL	12	103
(sample size reporting results)	(n=12)	(n=29)

Source: Survey of Iowa Energy Product Manufacturers and Distributors

High Efficiency Products

Manufacturing. Essentially, the survey responses showed reported sales of high efficiency products by Iowa manufacturers as concentrated in five product categories -- Air Conditioners and Heat Pumps (49% of sales of energy saving products), other HVAC Equipment and Controls (35%), Refrigerators and Freezers (11%), Motors (3%) and high efficiency ballasts (2%). The "other" category reflects sales of ice vending machines by one large company. None of the five major companies involved in lighting equipment manufacturing reported any sales of high efficiency lighting equipment, except for ballasts. The portion of total product sales which is high efficiency equipment (as defined by the respondent) averaged in the 50 - 80% range for the responding manufacturers of HVAC, refrigerators and motors. (See Table 11)

Distributors. Overall, sales of high efficiency products account for nearly one-third of total sales reported by electrical product wholesale distributors. The high efficiency portion of total distributor sales was highest for space heating and cooling equipment (in the 51 - 64% range), followed by refrigeration equipment (35%). The energy efficient portion was lowest for lighting (9%) and washing machines (0%). (See Table 11). In between was the distribution of high efficiency motors and controls.

Table 11: Percent of Products Which are High Efficiency

Product	Iowa Manufacturers mean (range)	Iowa Distributors mean (range)
Lighting Equipment	0% (0%)	9% (0 -100%)
Cooking Equipment (Stoves, Ovens)|	NA	16% (0 - 50%)
Refrigeration Equipment	81%(70 - 100%)	35% (0- 100%)
Washing Machines	NA	0% (0%)
Heating Systems	60% (60%)	64% (50 - 95%)
Air Conditioners or Heat Pumps	70% (60-100%)	51% (0 - 100%)
Motors	58% (10-60%)	25% (0 - 100%)
Other Equipment	NA	
Humidifiers		23% (0- 100%)
Hot Water Heaters		25% (0 - 70%)
Transformers		27% (0 - 100%)
Controls		42% (0 - 100%)
Insulation		5% (0 - 20%)
Windows		22% (0 - 90%)
Miscellaneous		NA NA

Source: Survey of Iowa Energy Product Manufacturers and Distributors

Customers and Suppliers

Manufacturers. Iowa manufacturers reported a mix of customer types, with the largest portion of sales, 33%, being sold to direct contractors and installation companies. Twenty-four percent of sales go directly to retail businesses, while OEMS and wholesale distributors account for 15%, contractors account for 33% and GEMS and other sellers account of 28% account for a further 15%. (see Table 12) Only 10% of the manufactured products were sold to Iowa customers; the rest were located in other states. (See Table 13.) Iowa Manufacturers also obtain relatively little of their supplies from within the state (See Table 14).

Distributors. Iowa wholesale distributors reported that 55% of their sales are to contractors and installation companies, with another 14% sold to other wholesaler distributors and resellers. Retail customers and other end-users accounted for 30 percent of sales. In contrast to manufacturers, wholesale distributors in Iowa sell principally within the state. A reported 78% of distributor revenues were reported attributable to customers within Iowa. (See Table 13). However, distributors obtain most of their products from out-of-state manufacturers (See Table 14).

Table 12: Customers of Iowa -- Energy Product Manufacturers and Distributors

Customers	Manufacturers	Distributors	Install/Repair
Retail	24%	30%	--
Wholesalers	15%	5%	2%
Contractors	33%	55%	24%
OEMs & Resellers	28%	10%	1%
End Users	0%	0%	73%
	100%	100%	100%

Source: Survey of Iowa Energy Product Manufacturers and Distributors

Table 13: Percent of Final Products & Services Being Sold to In-State Buyers

	Manufacturers	Distributors	Repair Service
Mean Percentage	10%	78%	97%
Percentage of Respondents Reporting			
Relatively Little (0-10%)	82%	10%	0%
Less than Half (11-44%)	9%	0%	0%
About Half (45-55%)	9%	15%	0%
Most (56-89%)	0%	10%	0%
Nearly All (90-100%)	0%	65%	100%
	100%	100%	100%

Source: Survey of Iowa Energy Product Manufacturers and Distributors

Table 14: Percentage of Supplies (intermediate Goods) Being Purchased from In-State Suppliers

	Manufacturers	Distributors	Repair Service
MEAN PERCENTAGE	5%	11%	64%
Percentage of respondents reporting			
Relatively Little (0-10%)	55%	80%	25%
Less than Half (11-44%)	45%	20%	25%
About Half (45-55%)	0%	0%	0%
Most (56-89%)	0%	0%	25%
Nearly All (90-100%)	0%	0%	25%

Source: Survey of Iowa Energy Product Manufacturers and Distributors

Impact of Utility Programs.

The manufacturers and distributors were also asked about their awareness of the DSM and energy efficiency programs operated by Iowa's utilities, and the impact that these programs had on their product offerings. The results, shown in Table 15, indicate that nearly all distributors and contractors are aware of the programs. A lesser level of familiarity was indicated by the manufacturers, which is to be expected given that most of their business is sales to outside areas. In addition, most of the manufacturers and distributors indicated that they normally carry high efficiency products anyway.

Table 15: Percentages Which Knew About Utility DSM Programs and Changed Product and Services Sold

	Manu-facturers	Distrib-utors	Repair	Overall
Heard of Utility Incentives and Grants				
Yes -- Knew details	42%	82%	100%	74%
Yes -- Knew of them (but not details)	42%	11%	0%	17%
No -- not aware of them	16%	7%	0%	9%
Products/Services Affected as a Result of Utility Incentives				
New energy efficient products introduced	17%	68%	20%	74%
Normally sell energy efficient products anyway	50%	27%	40%	18%
Considering introducing energy efficient products	0%	0%	0%	0%
No impact	33%	5%	40%	8%

Source: Survey of Iowa Energy Product Manufacturers and Distributors

Uses of the Business Survey Information.

The results described here provide the following important Iowa-specific data, for use in economic modeling for the State of Iowa:

- Equipment Regional Purchase Coefficients -- portion of high efficiency equipment sold in Iowa which is manufactured in Iowa

- Business Regional Purchase Coefficients -- portion of supplies purchased by Iowa manufacturers and service firms which come from in-state firms.

- Employment / Sales ratios for Iowa manufacturers and distributors of energy efficient equipment

- Capacity of Iowa Manufacturers & Distributors to benefit from alternative future energy efficiency programs (by equipment type)

3.3 Description of Potential Scenarios

The following alternative scenarios were defined:

1. Varying the level of spending and energy savings (high/low, rising/falling)

2 Shifting the program focus by customer sector (commercial, industrial and/or residential focus)

3. Shifting the mix of program activities by type of end-use measure (lighting, HVAC & electrical, equipment vs. Weatherization & building shell)

4. Shifting the mix of program activities (incentives, information activities)

5. These or other scenarios can also shift the overall cost-effectiveness and cost recovery (cost/savings ratio, cost recovery period, rate impact) of these programs.

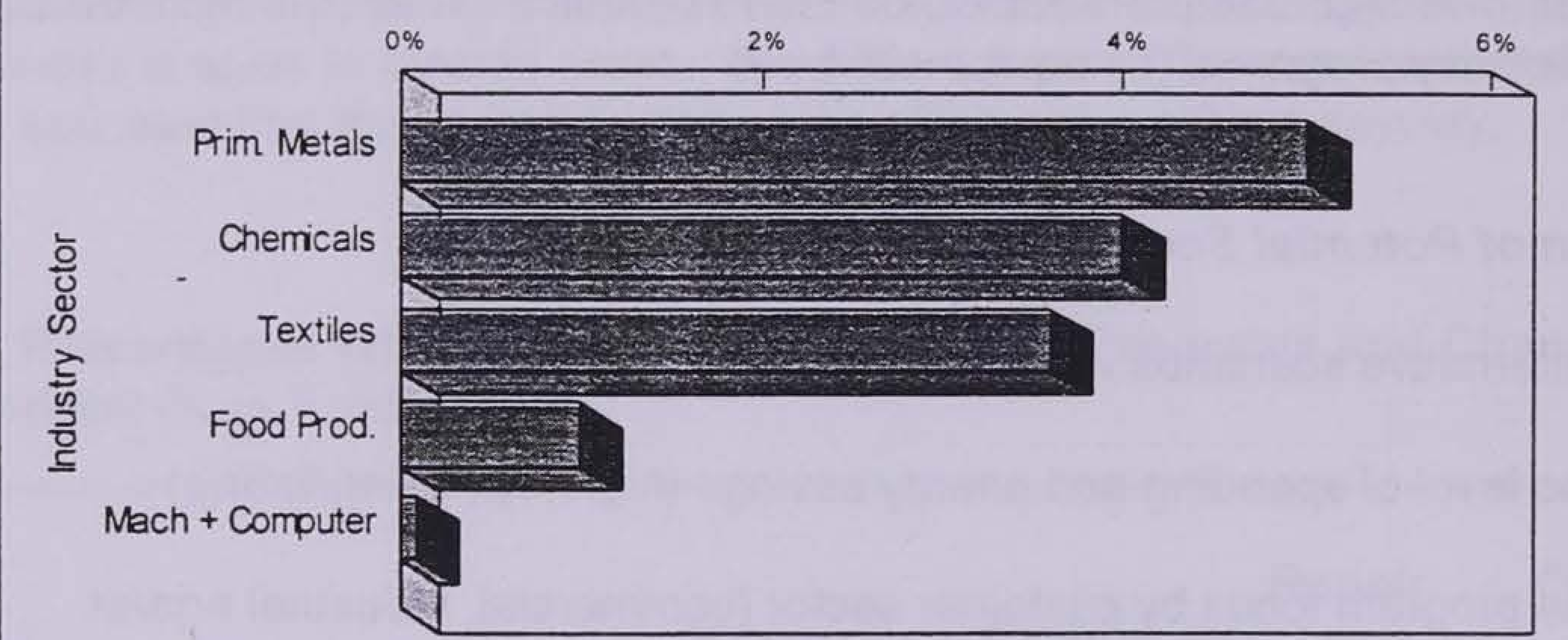
3.4 Construction of Model Parameters and Results for Scenarios

Local Business Competitiveness.

Energy costs affect the overall costs of doing business in Iowa. However, the impact of energy costs on various segments of Iowa's economy is **NOT** simply a function of the relative level of energy costs compared to elsewhere nor is it simply a function of the relative portion of total costs which energy represents. Rather, energy costs affect Iowa's economy insofar as the locations of certain types of businesses are more cost-sensitive than others, and an Iowa location is more cost competitive for some types of businesses than for others. Thus, it is important to examine the relative cost competitiveness of locating a business in Iowa to serve national markets, compared to locating the same type of business elsewhere.

Accordingly, the REMI model utilized historical data for 1972 - present on the cost competitiveness of doing business in Iowa relative to elsewhere in the U.S. (for each of 53 industries) and the growth of the Iowa economy relative to national growth (for each of those industries). Based on this information, estimates were developed of the impact of changes in the operating cost of business in Iowa on the growth of industries in the state. Figure 5 illustrates how businesses differ in their sensitivity to energy costs. It shows how the energy portion of overall business costs differs by industry.

Fig. 5: Energy Portion of Overall Business Costs by Industry



Construction of Scenarios

The following program scenarios are represented (see Table 16):

Table 16: ENERGY EFFICIENCY SCENARIOS

Scenario	Amount	Years	Sectors	Technologies
1.	\$80m	1	All	All (current mix)
2.	\$80m/yr	10	All	All (current mix)
3.	\$80m/yr	10	Residential only	All (current mix)
4.	\$80m/yr	10	All	Bldg. Shell & New Constr.
5.	\$80m/yr	10	All	Lighting, Process, Appliance
6.	\$80m/yr	10	All	HVAC & Water Heating
7.	\$15m/yr	4	Residential	Low Income: Bldg. shell & Weatherization & Heating
8.	\$80m phase down to \$0	4	All	All (current mix)

Scenario 1 was designed to show the impact over time (i.e., the next ten years) resulting from one year of spending on energy efficiency programs at roughly current levels. (Revised calculations of current programs indicate a spending level $76.1 million down from initial estimates of $80 million. For purposes of modeling, a spending level of $80 million was assumed). Scenario 2 was designed to show the cumulative impact on the Iowa economy from ten years of program spending and an additional ten years of energy savings. Scenarios 3 - 6 represent variations on Scenario 2, in which the mix of energy efficiency programs is shifted to focus on particular customer sectors or particular types of end uses (equipment). Scenarios 7 - 8 represent "phase out" scenarios, in which energy efficiency programs are either cut down to just low income residential programs for four years or else phased out totally over four years. Óf course, these scenarios are just meant to be illustrative examples. The template discussed in Section 5 is designed to allow estimation of impacts associated with other program mixes and spending levels.

All of the scenario variations are represented in the REMI model by the following set of factors:

Demand Factors (Effect of Program Spending)
- Increased demand for purchases of electric equipment & gas appliances
- Increased demand for purchases of building and insulation materials
- Increased demand for purchases of installation & engineering services
- Reduction in demand for electricity and gas

Relative Cost Factors (Effect of Energy Savings and Price Changes)
- Shift in Residential disposable income (reduced by initial co-payment and rate impact, increased by energy savings over time)
- Shift in commercial business operating cost (reduced by energy savings and increased by co-payment and rate increase impacts)
- Shift in industrial business operating cost (reduced by energy savings and increased by co-payment and rate increase impacts)

The demand factors are directly sensitive to the types of technologies being installed, and also vary systematically by economic sector. The cost factors are directly sensitive to the target sectors and also vary systematically by type of technology.

3.5 Results for Alternative Scenarios

Results for a one-time spending of $80 million -- the first scenario -- is shown in Table 17. It shows that a one-time $80 million campaign leads to the creation of accumulated 2029 job-years, $144 million of increased disposable income in the state and $80 million increase in Gross State Product (GSP) spread over the subsequent decade. (Note that GSP, which represents state value added, rises less than income because of the import substitution effect. That occurs insofar as some of the added personal income is associated with in-state production of products which had previously been purchased from out-of-state suppliers. That represents a relocation of employment and associated personal income from out-of-state to in-state; but it does not necessarily represent any net gain in business value -- which is sales revenue minus costs - for Iowa businesses. Overall, 25 job-years of employment are added and $1.8 million of additional disposable income are created per million dollars of spending. (That represents a relocation of employment and associated personal income from out-of-state, but it does not necessarily represent any net gain in business value added-- which is sales revenue minus costs for long businesses.)

Table 17: Economic Impacts of $80m Spending on of Energy Efficiency Programs in State of Iowa

	Absolute Amount	Ratio: Per Dollar Spent	Percent Increase Over State Total
Spending			
Total Over 10 yrs	$800m	n.a.	n.a.
Average Year	$80 m	n.a.	n.a.
Peak Year	$80 m	n.a.	n.a.
Net Present Value*	$80 m	n.a.	n.a.
Change in Jobs			
Total Over 10 yrs (Job-yrs)	2,029	2.5	0.008%
Average Year	203	2.5	0.008%
Peak Year	301	4.0	0.013%
Net Present Value*	1,561	2.0	0.008%
Change in Disposable Income (millions of constant 1994 $)			
Total Over 10 yrs	$144m	$2.0	0.010%
Average Year	$14m	$0.2	0.010%
Peak Year	$21m	$0.3	0.020%
Net Present Value*	$109m	$1.4	0.010%
Change in Gross State Product (millions of constant 1994 $)			
Total Over 10 yrs	$80m	$1.0	0.008%
Average year	$8m	$0.1	0.008%
Peak year	$14m	$0.2	0.016%
Net Present Value*	$60m	$0.8	0.008%

* Net Present Value is based on 5% discount rate, over and above 4.5% average inflation (All dollar amounts are already represented in constant 1994 $)

The results for each of the 8 scenarios are shown on the following pages. Since the impacts of energy efficiency programs are also sensitive to timing factors, including the lifetime of the installed measures and the number of years in which rate impacts are allocated, therefore these results are shown for every year from 1995 - 2015, rather than just at five year increments. All of these results are based on the following timing assumptions:

- The Rate impact is allocated over 4 years
  (so $80 million translates to a 1.25% rate increase over that period)
- The installed measures provide savings for ten years.
- The up-front rebate co-payment cost for the customer is incurred in the first year.

These jobs are not all created instantaneously, or even at the same time. The first scenario also reflects calculations that, as a result of the above timing assumptions, there is a net economic gain in the first year (due to purchase installation of energy saving measures), a loss in years 2-4 (due to additional cost of financing the measures) and major savings for years 5 - 10 (after financing is through, as energy savings are realized). The annual job estimates reflect a first-year gain due to the purchasing and installation of program measures, followed by a pattern of losses attributable to financing in the next few years and then made up by gains in the latter years.

If energy efficiency programs are continued at a high rate of $80 million/yr for ten years, as assumed for Scenario 2, then the total impact is over 19,000 job-years spread over twenty years. Scenario 3 shows that higher impacts result from focusing programs on the residential sector. This result is projected to occur because according to the REMI model data, residential customers in Iowa reinvest more of their energy savings on purchases of other Iowa products and services than do commercial and industrial customers. That result is also a reflection of the relatively low level rate of industrialization in Iowa. Comparison of Scenarios 4 - 6 show that targeting impacts on building Weatherization, HVAC and water heating measures provide more jobs and income than targeting programs on lighting technologies, due to the higher content of Iowa jobs associated with those technologies. Note, however, that this finding only holds for the state of Iowa. Impacts of other alternatives, representing low income residential programs and phase-out scenarios, are shown in Scenarios 7 and 8.

Overall findings are as follows:

- Iowa's current level of annual energy efficiency spending, totaling nearly $80 million, directly or indirectly supports nearly 500 current -year jobs in the stat, and the continuing energy savings will help support an average of over 200 annual jobs in future years.

- In general, spending on energy efficiency programs for one year can lead to the creation of 25 job-years per million dollars spent, and $1.50 of additional disposable income per dollar spent. These jobs and this income is, however, spread out over a decade.

- These impacts represent both the jobs created by spending on energy efficiency in Iowa (rather than allowing additional fuel cost to flow out of the Iowa economy), and the income created in subsequent years from respending of energy savings -- after adjusting for increases in energy costs to pay for these programs.

- The overall impact of any of these scenarios, while significant, causes less than 2/100 of 1% change in Iowa's employment and income.

Tables 18 a - h, shown on the following pages, provide details of the scenario results.

TABLE 18

ENERGY EFFICIENCY SCENARIO 1. Full DSM Mix -- $80m/yr for One Yr.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	32	-10	-10	-10	12	13	12	13	13	14	0
Disposable Income	19	0	0	-0	20	21	20	21	21	21	0
Total Employment	498	-60	-62	-68	272	286	280	287	294	301	0
Employment by Sector											
Agriculture	-128	0	0	0	9	10	9	9	10	10	0
Mining	6	4	3	3	16	17	16	16	16	16	0
Construction	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0
Durable goods	15	-28	-27	-27	-7	-5	-5	-4	-3	-3	0
Non-durable goods	-13	-43	-43	-42	-30	-28	-27	-26	-25	-24	0
Transport	18	1	1	0	20	21	20	21	21	21	0
FIRE	62	-5	-6	-7	67	70	69	70	72	73	0
Wholesale	13	-8	-8	-8	3	4	4	4	4	5	0
Retail	233	6	5	2	127	130	128	130	132	134	0
Services	0	0	0	0	2	2	2	2	2	2	0
State & Loc Gov't	38	15	14	13	67	68	66	67	68	68	0
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	0	0	0	0	0	0	0	0	0	0	80
Disposable Income	0	0	0	0	0	0	0	0	0	0	144
Total Employment	0	0	0	0	0	0	0	0	0	0	2029
Employment by Sector											
Agriculture	0	0	0	0	0	0	0	0	0	0	186
Mining	0	0	0	0	0	0	0	0	0	0	113
Construction	0	0	0	0	0	0	0	0	0	0	-19
Durable goods	0	0	0	0	0	0	0	0	0	0	-96
Non-durable goods	0	0	0	0	0	0	0	0	0	0	-303
Transport	0	0	0	0	0	0	0	0	0	0	146
FIRE	0	0	0	0	0	0	0	0	0	0	466
Wholesale	0	0	0	0	0	0	0	0	0	0	14
Retail	0	0	0	0	0	0	0	0	0	0	1026
Services	0	0	0	0	0	0	0	0	0	0	13
State & Loc Gov't	0	0	0	0	0	0	0	0	0	0	483
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	80	60
Real Disp Inc	144	109
Employment	2029	1561

Note: GRP and disposable income in 1994 million dollars; employment in persons

ENERGY EFFICIENCY SCENARIO 2. Full DSM Mix -- $80m/yr for 10 Yrs.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	32	-0	-9	-20	-8	9	21	37	26	64	67
Disposable Income	19	8	9	9	29	52	72	96	76	139	128
Total Employment	498	180	126	49	321	660	938	1275	1009	1793	1708
Employment by Sector											
Agriculture	128	18	19	19	28	39	47	58	48	63	58
Mining	6	9	13	16	32	49	66	84	67	116	103
Construction	-2	-4	-6	-8	-10	-12	-14	-15	-13	-17	-14
Durable goods	15	-38	-65	-92	-99	-98	-103	-104	-95	-93	-61
Non-durable goods	-13	-69	-112	-154	-184	-204	-231	-256	-223	-277	-216
Transport	18	7	9	9	29	53	73	97	77	143	131
FIRE	62	21	17	9	76	157	226	309	243	463	433
Wholesale	13	-7	-14	-22	-19	-13	-9	-3	-6	10	16
Retail	233	190	197	192	319	465	592	737	611	887	813
Services	0	1	1	1	3	5	7	9	7	13	12
State & Loc Gov't	38	52	68	79	146	219	285	360	293	484	433
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	97	108	93	78	60	40	21	0	0	0	713
Disposable Income	159	161	139	115	89	59	30	0	0	0	1391
Total Employment	2206	2300	1988	1647	1278	848	438	0	0	0	19264
Employment by Sector											
Agriculture	71	72	62	51	39	26	13	0	0	0	859
Mining	124	123	105	86	66	44	23	0	0	0	1131
Construction	-14	-12	-10	-8	-6	-4	-2	0	0	0	-173
Durable goods	-39	-14	-9	-6	-3	-3	-1	0	0	0	-907
Non-durable goods	-211	-175	-146	-118	-89	-60	-30	0	0	0	-2770
Transport	161	163	140	116	90	60	31	0	0	0	1406
FIRE	545	559	483	401	311	206	107	0	0	0	4628
Wholesale	31	38	34	28	22	15	8	0	0	0	122
Retail	1004	1016	875	723	559	372	192	0	0	0	9980
Services	14	14	12	10	8	5	3	0	0	0	128
State & Loc Gov't	519	515	442	364	281	187	96	0	0	0	4861
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	713	398
Real Disp Inc	1391	827
Employment	19264	11470

Note: GRP and disposable income in 1994 million dollars; employment in persons

ENERGY EFFICIENCY SCENARIO 3 -- Resid. Only DSM Mix -- $80m /yr for 10 Yrs

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	45	24	25	24	62	107	145	190	150	261	239
Disposable Income	28	24	32	37	79	125	166	213	171	297	266
Total Employment	692	513	591	630	1273	1998	2639	3376	2727	4529	4103
Employment by Sector											
Agriculture	131	27	31	34	55	78	98	121	99	146	130
Mining	11	19	27	34	66	100	132	167	134	228	202
Construction	-1	-3	-4	-6	-7	-8	-9	-10	-9	-11	-9
Durable goods	26	-12	-25	-40	-20	8	28	55	36	112	115
Non-durable goods	-2	-43	-71	-99	-107	-107	-113	-115	-106	-103	-70
Transport	26	21	29	35	76	122	162	209	168	294	264
FIRE	94	78	101	115	258	418	560	726	583	1022	924
Wholesale	20	6	4	1	17	37	53	73	57	107	100
Retail	326	326	375	405	660	942	1195	1479	1221	1831	1644
Services	1	2	3	3	7	10	14	18	14	25	22
State & Loc Gov't	61	91	122	147	268	398	518	653	530	878	781
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	297	302	258	212	163	109	56	0	0	0	2669
Disposable Income	322	320	275	226	174	116	60	0	0	0	2929
Total Employment	5012	5031	4320	3557	2744	1826	939	0	0	0	46499
Employment by Sector											
Agriculture	156	156	133	108	83	55	28	0	0	0	1670
Mining	241	238	202	165	127	84	43	0	0	0	2220
Construction	-9	-7	-6	-5	-4	-2	-1	0	0	0	-113
Durable goods	163	178	154	128	100	66	34	0	0	0	1107
Non-durable goods	-48	-22	-17	-12	-8	-6	-3	0	0	0	-1052
Transport	318	317	272	224	172	115	59	0	0	0	2884
FIRE	1121	1121	964	795	615	409	211	0	0	0	10114
Wholesale	128	132	114	94	73	48	25	0	0	0	1089
Retail	1982	1972	1693	1393	1074	716	368	0	0	0	19602
Services	27	26	23	19	14	10	5	0	0	0	242
State & Loc Gov't	932	920	788	648	499	333	171	0	0	0	8737
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	2669	1605
Real Disp Inc	2929	1766
Employment	46499	28242

Note: GRP and disposable income in 1994 million dollars; employment in persons

ENERGY EFFICIENCY SCENARIO **4 --Bldg. Shell & Const. only-- $80m/yr for 10 Yrs**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	17	14	11	7	24	47	64	86	69	118	112
Disposable Income	14	19	25	29	53	81	105	134	110	182	163
Total Employment	327	357	400	411	758	1181	1535	1959	1613	2568	2340
Employment by Sector											
Agriculture	22	24	27	28	40	52	63	75	64	81	72
Mining	9	15	22	27	46	66	84	105	86	139	122
Construction	-1	-3	-5	-7	-9	-10	-11	-13	-11	-14	-11
Durable goods	3	-16	-34	-54	-54	-45	-43	-37	-36	-23	-4
Non-durable goods	-9	-44	-78	-112	-135	-148	-168	-186	-162	-208	-160
Transport	13	19	25	30	54	82	106	135	111	183	164
FIRE	77	91	107	116	199	298	382	483	400	627	567
Wholesale	40	36	33	27	33	43	49	57	51	41	41
Retail	135	170	210	237	388	562	714	891	740	1143	1022
Services	1	1	2	3	5	7	9	12	10	16	14
State & Loc Gov't	38	64	91	115	191	274	349	437	360	582	513
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	142	147	127	105	81	54	28	0	0	0	1253
Disposable Income	194	192	165	136	105	70	36	0	0	0	1812
Total Employment	2852	2855	2463	2038	1579	1049	541	0	0	0	26826
Employment by Sector											
Agriculture	86	85	73	60	46	31	16	0	0	0	944
Mining	143	139	119	98	75	50	26	0	0	0	1371
Construction	-11	-10	-8	-7	-5	-3	-2	0	0	0	-141
Durable goods	20	37	34	30	24	15	8	0	0	0	-174
Non-durable goods	-153	-124	-103	-83	-62	-43	-21	0	0	0	-2001
Transport	195	192	165	136	106	70	36	0	0	0	1825
FIRE	682	677	584	483	375	249	129	0	0	0	6526
Wholesale	56	60	52	44	34	22	12	0	0	0	730
Retail	1217	1199	1032	852	659	438	226	0	0	0	11835
Services	17	16	14	12	9	6	3	0	0	0	158
State & Loc Gov't	601	584	502	413	319	212	109	0	0	0	5755
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	1253	746
Real Disp Inc	1812	1101
Employment	26826	16339

Note: GRP and disposable income in 1994 million dollars; employment in persons

ENERGY EFFICIENCY SCENARIO 5 -- Lighting, Elec. Equipment -- $80m/yr for 10 Yrs

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	19	-10	-23	-37	-32	-23	-17	-9	-13	8	19
Disposable Income	13	3	1	-1	13	30	45	62	48	96	90
Total Employment	345	56	-44	-162	9	243	423	648	488	1014	1033
Employment by Sector											
Agriculture	91	12	11	10	17	25	31	38	32	43	40
Mining	4	6	9	11	23	37	49	63	50	88	79
Construction	-2	-5	-7	-10	-12	-14	-16	-18	-15	-20	-16
Durable goods	-1	-51	-84	-116	-131	-138	-151	-161	-143	-159	-116
Non-durable goods	--27	-85	-133	-181	-219	-246	-280	-312	-271	-339	-268
Transport	12	2	1	-1	14	32	47	65	50	101	94
FIRE	39	-2	-14	-30	16	75	123	183	138	302	293
Wholesale	6	-13	-22	-32	-32	-29	-29	-28	-26	-19	-9
Retail	191	149	142	126	218	328	421	528	437	626	585
Services	0	0	1	1	2	4	5	7	5	10	9
State & Loc Gov't	31	42	52	60	113	170	223	283	229	380	341
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	42	55	48	41	32	21	11	0	0	0	133
Disposable Income	115	119	103	85	66	44	23	0	0	0	955
Total Employment	1427	1551	1347	1122	874	578	300	0	0	0	11252
Employment by Sector											
Agriculture	50	52	45	37	28	19	10	0	0	0	590
Mining	96	95	82	67	52	34	18	0	0	0	864
Construction	-16	-14	-12	-10	-7	-5	-2	0	0	0	-199
Durable goods	-101	-72	-59	-46	-34	-24	-12	0	0	0	-1599
Non-durable goods	-267	-226	-190	-153	-116	-79	-40	0	0	0	-3431
Transport	119	122	105	87	67	45	23	0	0	0	986
FIRE	383	403	349	290	226	150	78	0	0	0	3001
Wholesale	2	11	10	9	8	5	3	0	0	0	-184
Retail	739	759	655	542	420	279	144	0	0	0	7290
Services	11	11	10	8	6	4	2	0	0	0	97
State & Loc Gov't	412	410	352	290	224	149	77	0	0	0	3838
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	133	30
Real Disp Inc	955	556
Employment	11252	6433

Note: GRP and disposable income in 1994 million dollars; employment in persons

ENERGY EFFICIENCY SCENARIO 6 --HVAC and Hot Water: $80m/yr for 20 Yrs

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	36	5	-2	-9	7	28	44	64	48	98	96
Disposable Income	21	10	12	12	35	60	83	109	87	157	144
Total Employment	538	217	192	144	469	855	1183	1572	1249	2187	2043
Employment by Sector											
Agriculture	143	19	20	21	31	43	53	64	54	72	65
Mining	6	9	13	16	34	52	70	89	71	124	110
Construction	-1	-3	-5	-7	-8	-9	-11	-12	-11	-14	-11
Durable goods	23	-27	-47	-69	-69	-62	-60	-55	-54	-35	-13
Non-durable goods	-5	-54	-88	-121	-143	-156	-175	-191	-168	-203	-156
Transport	21	9	11	12	35	60	83	110	87	159	145
FIRE	68	26	27	24	102	192	269	363	286	536	495
Wholesale	13	-6	-11	-17	-11	-3	4	12	6	31	34
Retail	234	190	203	204	345	505	646	805	664	991	903
Services	0	1	1	1	3	6	8	10	8	14	13
State & Loc Gov't	37	52	67	79	150	227	297	377	306	511	458
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	129	138	119	98	76	50	26	0	0	0	1053
Disposable Income	177	179	154	127	98	65	34	0	0	0	1565
Total Employment	2586	2661	2294	1897	1469	976	503	0	0	0	23037
Employment by Sector											
Agriculture	80	81	69	57	43	29	15	0	0	0	958
Mining	133	132	113	92	71	47	24	0	0	0	1205
Construction	-11	-9	-8	-6	-5	-3	-2	0	0	0	-136
Durable goods	13	33	31	27	22	14	8	0	0	0	-319
Non-durable goods	-147	-117	-98	-78	-59	-40	-20	0	0	0	-2020
Transport	178	179	154	127	98	65	34	0	0	0	1567
FIRE	617	628	542	448	347	231	119	0	0	0	5321
Wholesale	50	56	48	40	32	21	11	0	0	0	309
Retail	1109	1118	962	794	614	408	210	0	0	0	10904
Services	15	15	13	11	8	6	3	0	0	0	137
State & Loc Gov't	550	546	469	386	298	198	102	0	0	0	5110
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	1053	613
Real Disp Inc	1565	934
Employment	23037	13815

Note: GRP and disposable income in 1994 million dollars; employment in persons

ENERGY EFFICIENCY SCENARIO **7 -- Low Income Resid.-- $80m over 4 Yrs**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	10	6	6	6	11	21	31	41	42	42	36
Disposable Income	7	6	8	10	16	26	34	44	44	45	38
Total Employment	155	122	145	158	222	378	520	686	695	702	596
Employment by Sector											
Agriculture	29	7	8	9	9	13	17	22	22	22	18
Mining	3	5	7	9	14	21	27	34	34	34	28
Construction	-0	-1	-1	-2	-2	-1	-1	-1	-1	-1	-1
Durable goods	6	-3	-6	-10	-5	5	13	23	24	24	21
Non-durable goods	-1	-11	-18	-25	-23	-17	-11	-5	-5	-4	-3
Transport	6	6	8	10	16	25	34	43	44	44	38
FIRE	24	22	28	32	53	86	116	152	154	156	133
Wholesale	6	3	3	2	3	8	12	18	18	18	16
Retail	68	71	84	94	102	158	210	271	273	276	234
Services	0	0	1	1	2	2	3	4	4	4	3
State & Loc Gov't	14	22	30	37	54	78	101	127	128	129	109
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	23	13	0	0	0	0	0	0	0	0	287
Disposable Income	25	14	0	0	0	0	0	0	0	0	316
Total Employment	389	214	0	0	0	0	0	0	0	0	4983
Employment by Sector											
Agriculture	12	7	0	0	0	0	0	0	0	0	195
Mining	18	10	0	0	0	0	0	0	0	0	243
Construction	-1	-0	0	0	0	0	0	0	0	0	-13
Durable goods	14	8	0	0	0	0	0	0	0	0	113
Non-durable goods	-2	-1	0	0	0	0	0	0	0	0	-125
Transport	24	13	0	0	0	0	0	0	0	0	312
FIRE	87	48	0	0	0	0	0	0	0	0	1091
Wholesale	10	6	0	0	0	0	0	0	0	0	124
Retail	152	84	0	0	0	0	0	0	0	0	2076
Services	2	1	0	0	0	0	0	0	0	0	26
State & Loc Gov't	71	39	0	0	0	0	0	0	0	0	941
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	287	198
Real Disp Inc	316	219
Employment	4983	3470

Note: GRP and disposable income in 1994 million dollars; employment in persons

ENERGY EFFICIENCY SCENARIO 8. Phase Down Full DSM: $80m to 0 in 4 Yrs.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	32	-2	-12	-20	-3	16	26	33	35	36	24
Disposable Income	19	6	5	2	20	37	46	53	54	54	36
Total Employment	498	120	18	-84	176	462	625	735	754	771	519
Employment by Sector											
Agriculture	128	14	10	5	10	17	21	24	24	25	16
Mining	6	8	9	9	21	32	38	42	42	42	28
Construction	-2	-3	-5	-6	-5	-5	-5	-5	-4	-4	-3
Durable goods	15	-35	-53	-64	-48	-29	-18	-11	-9	-7	-3
Non-durable goods	-13	-63	-88	-102	-94	-80	-73	-67	-65	-62	-39
Transport	18	6	5	3	21	38	47	53	54	55	37
FIRE	62	14	4	-7	58	120	156	180	184	188	126
Wholesale	13	-7	-13	-17	-8	2	7	11	11	12	9
Retail	233	144	103	54	132	234	293	332	338	343	229
Services	0	1	1	1	2	4	4	5	5	5	3
State & Loc Gov't	38	43	45	40	87	130	155	171	173	175	116
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	12	4	0	0	0	0	0	0	0	0	180
Disposable Income	18	7	0	0	0	0	0	0	0	0	358
Total Employment	253	96	0	0	0	0	0	0	0	0	4943
Employment by Sector											
Agriculture	8	3	0	0	0	0	0	0	0	0	305
Mining	14	5	0	0	0	0	0	0	0	0	293
Construction	-1	-1	0	0	0	0	0	0	0	0	-48
Durable goods	-2	-1	0	0	0	0	0	0	0	0	-265
Non-durable goods	-19	-7	0	0	0	0	0	0	0	0	-773
Transport	18	7	0	0	0	0	0	0	0	0	363
FIRE	62	23	0	0	0	0	0	0	0	0	1171
Wholesale	4	2	0	0	0	0	0	0	0	0	25
Retail	112	42	0	0	0	0	0	0	0	0	2589
Services	2	1	0	0	0	0	0	0	0	0	33
State & Loc Gov't	57	21	0	0	0	0	0	0	0	0	1250
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	180	123
Real Disp Inc	358	253
Employment	4943	3523

Note: GRP and disposable income in 1994 million dollars; employment in persons

Comparison to Prior Study

Prior to this study, the State of Iowa utilized an energy job impact spreadsheet template which was developed in 1987. The results shown here provide generally smaller impacts than those forecasted by the 1987 spreadsheet. The reasons for this difference are as follows:

Coverage of Key Issues. The old spreadsheet had the following limitations which are addressed in the new analysis models.

- **time dimension** - The old spreadsheet assumed that energy savings are the same every year, even though we know that many types of installed DSM measures have significant loss of savings over time, while some types of programs can also accumulate savings over time. Most seriously, the old template assumed that program costs are amortized over the lifetime of the energy savings (and without any explicit financing costs). In fact, utilities now typically recover costs with interest over a 1-4 year period.

- **program mix** - The old spreadsheet assumed that there is a fixed spending multiplier for all program investments. It was not sensitive to differences in type of DSM programs (e.g., direct installation of insulation and weatherization measures vs. appliance rebate programs), even though we know that they have very different levels of labor requirements and cause very different types of product demand for Iowa industries.

- **program targets** - The old spreadsheet assumed that there was a fixed energy savings multiplier effect on jobs. It was not sensitive to differences in the sectoral mix of program beneficiaries (i.e., residential, commercial, industrial, agricultural), even though we know that they have very different responses to cost factor changes.

Assumptions. The old spreadsheet and new analysis model differ in some major assumptions.

- **energy costs** - Impacts were estimated from the old template by effectively assuming that energy costs will escalate at a rate of 3% per year <u>over and above the normal rate of inflation occurring for other goods and services.</u> This served to increase the economic value of energy savings over that assumed in our new estimates, which is that energy prices in real (inflation adjusted) terms will remain stable).

- **program and cost recovery** - Impacts were estimated from the old template by effectively assuming that program costs can be amortized over a ten-year period. This served to decrease the project life cycle cost, since further-out years are heavily discounted. Our new estimate reflects the current real situation, which is that the Iowa utilities recover their DSM cost, with interest over 4 years.

- **labor intensity and prices responses** - Impacts estimated from the old template were built on an assumption of a very high difference in labor intensity between DSM activities and electric power provider activities. This served to increase job impacts (although not income impacts) compared to our new estimates, which incorporate REMI model forecasts of program impacts on labor costs and prices of product inputs as a result of additional demand for them.

3.6 Conclusions: Implications of Results

In the examples illustrated here, spending on energy efficiency programs is shown to create roughly 25 job-years of employment per million dollars invested, although in any one year this represents just 2.5 - 4.0 jobs per million dollars spent. Of course, these findings are calculated on the basis of program spending patterns, costs and benefits claimed by Iowa's utilities for their 1994 programs. Given that those programs and prior year programs have already served a portion of the residential and business sectors in accomplishing their work, it is not clear whether or not continuing the same types of programs at the same spending levels would necessarily continue to provide the same energy saving benefits. However, that is assumed for the calculation of economic impacts associated with continued, ten year spending.

SECTION 4: RENEWABLE ENERGY PRODUCTION

4.1 Approach

In this section, we present estimates of the economic impact of adoption of renewable energy in the electric utility sector. Specifically, we look at the potential effects of replacing a portion the existing purchases of coal-generated electricity with purchases of electricity from switchgrass or wind-powered generating facilities.

It is assumed that switchgrass would be co-fired in an existing coal-fired power plant, which means no additional capital cost is involved (although there is a higher operating cost involved). It is assumed that the substitution of wind power for coal power will, however, require new generating facilities. Impacts of adopting these energy options are analyzed relative to a "do nothing" status quo, in which Iowa continues to rely on available generating capacity which primarily utilizes coal from out-of-state. These assumptions are appropriate for analysis at this point in time, insofar as there is currently excess reserve generating capacity available to serve Iowa's electricity needs.

Because of the range of choices that can be made about adoption of renewable energy -- e.g., amount of capacity replacement, year of facility construction -- and the importance of factors that cannot be predicted with great certainty -- e.g., which regions in Iowa will supply switchgrass, yield per acre, land costs -- it is impossible to predict the effects of a specific renewable energy program. What we attempt to do in this section, however, is to set reasonable bounds on the likely impacts of renewable energy programs in Iowa. To do this, we run a number of scenarios that use both different modeling assumptions and different modeling techniques. For example, we use different assumptions about land prices and switchgrass yield per acre in the biomass modeling; we also experiment with different techniques in wind energy modeling by testing the likely effects if consumers absorb all the costs (i.e., the utility passes on all costs to consumers or construction of facilities is funded with a tax increase) versus if the costs are treated as simply an increase in costs to public utilities.

The scenarios are not to be read as predictions. For example, when we model an increase in costs by decreasing purchasing power we are not suggesting that renewable energy programs will be directly funded by consumers which, in fact, seems unlikely. Rather we are trying to set a bound on the maximum effect of renewables energy programs on consumers. Similarly, when we model spending on renewables by increasing costs to electric utilities, we are not predicting that program costs will be treated in the same way as an increase in the price of coal or the construction of new transmission lines. However, by modeling it as a routine cost, we are able to bound the likely effects on the average electricity consumer.

We also experiment by changing the year in which construction costs are absorbed. In some of the scenarios, we model all construction costs as expenses incurred in the year the facility is built. This has the advantage of capturing the shock effects of construction projects, but does not address the likelihood that construction costs will be spread over a long period of time either through changes in electricity prices or a change in investment. Recognizing the shortcomings of this approach, we also run scenarios in which construction costs are finance overtime through charges on each kW hour of wind-generated electricity consumed--that is, we assume that construction costs will be financed through price increases for the lifetime of the equipment. This has the advantage of more realistically capturing the price mechanism. The shortcoming of the approach, though, is that can't capture the fact that the effects of expenditures are realized during facility construction. However, by using both of the approaches, we can capture the range of potential effects of the construction of wind facilities on the Iowa economy. In the following sections, first biomass power technologies and then wind energy technologies are discussed.

4.2 Overview of Existing Biomass Technologies

Biomass resources in Iowa include corn, metropolitan solid waste, wood wastes, residues from annual crops, manure from livestock in feedlots, and biomass from natural forests. The following is a summary of Biomass potentials. Iowa, according to the Iowa State University report "The potential for Biomass Production and Conversion in Iowa". (Robert Brown, et al., 1994)

Corn. The grain availability for ethanol production does not appear to be limiting for these production-capacity goals. A level of 0.38 quads per year or 3.8 billion gallons per year would require that 12 to 15 million acres of corn be planted annually. That is roughly the current level of corn planting in Iowa.

Metropolitan Solid Waste (MSW). Increasing costs (tipping fees, transportation costs, etc.) for the disposal of waste materials, limits on available sanitary landfills, and changes in state and federal laws affecting the options for disposal of residential, commercial, industrial, and agricultural wastes are factors influencing the potential of energy recovery from the various organic waste streams in Iowa.

For Iowa, the estimated energy MSW generation rate is 560 pounds of MSW (and hence potential energy feedstock) each year. Given the 1992 population for Iowa is 2,802,944 (Risser, 1995), there is the potential of producing 784,824 tons per year of energy from MSW (Iowa State University).

Wood Wastes. The cost and environmental limits of disposal of wood wastes have caused the Iowa wood industry to find alternative ways to dispose of the material. In 1988 the Iowa primary wood industry produced 8.7 million cubic feet of coarse, fine, and bark residues. If market prices for the wood residue as a biofuel were to exceed those paid for the residue used as livestock bedding, composting, or landscape chips, then conceivably all 8.7 million cubic feet would be available.

Residues from Annual Crops. In Iowa (and nationwide), farmers who choose to be involved with the farm program and receive price-support payments (for Iowa the commodity support is for corn) must have approved conservation plans (for soil and water resources). One of the guidelines used in these conservation plans is a minimum requirement of retaining one ton of crop residue on the field to aid in reducing water- and air-borne soil erosion and improving or maintaining the soil tilth and long-term productivity. Iowa has about 12 million acres classified by the Soil Conservation Service (SCS) as highly erodible lands (HEL). When the Iowa Soil Conservation Service criteria for removal of 1 ton per acre from corn lands with 0-3% slopes is applied to all the counties in Iowa, it is estimated that over 11.5 million tons of corn residue is potentially available each year.

Manure from Livestock in Feedlots. The use of animal manure for biofuels (biogas or biosolids) is another possible option for the Iowa farmer. Manure from livestock in feedlots could produce an estimated 2.9 million tons of biomass each year primarily from cattle and swine. Manure from cattle and swine can be used to produce methane in technically advanced systems.

Biomass Resources from Iowa's Natural Forests. Beyond the potential use of wood residues from the Iowa wood industry, the forests of the state can contribute biomass from (1) logging residues, (2) forest improvement activities, and (3) capture of natural mortality. Without increasing the annual removal volume of growing stock and by increasing the use of the annual removals, it is theoretically possible for the natural forests of the state to produce 116 thousand tons of biomass. Also by recovering logging residues associated with the annual removals, an additional 24 thousand tons could be produced each year. Other factors such as preservation of wildlife and recreational areas, may also affect the availability of land for logging on Iowa's 2 million acres of forest land.

Iowa's transportation infrastructure is equipped to support various biomass-to-energy systems. The state's road, rail and waterway systems already support a strong and viable agricultural economy based on the movement of bulk commodities. The geographically limited areas in which a biomass-to-energy system would operate makes Iowa's road system, which already accesses all of Iowas' farms, the most feasible modes of transportation to support a biomass-to-energy system.

According to the Brown et al. report (1994), switchgrass is the lowest cost of any of the perennial grasses, and Brown seems to favor it throughout the report. That report presented a very thorough study of the yields, production costs, environmental impacts, etc. of different biomass possibilities. It surveyed results of the tests of four perennial grasses (alfalfa, reed canary grass, switchgrass, and big bluestem), five annual crops (sweet sorghum, sorghum and sudan grass hybrid, rye, corn, and soybean) and variations of intercropping some of them. It also examined feasibility and potential for municipal solid waste and short rotation woody crops in Iowa. It concluded that the production cost for switchgrass is generally one-half to one-sixth that of any of the other three grasses.

Environmental Concerns. It should be noted that the use of corn is not recommended for burning in power plants for several reasons: (1) it is better used to produce ethanol, and (2) it is also needed to be either left in the field or to be plowed back into the soil.¨ Corn, sorghum, and other annual herbaceous species have the following negative environmental effects: soil erosion, nitrate run-off, and high pesticide applications (p. 401). Switchgrass and hybrid poplar reduce these problems "if employed in buffer strips along riparian zones". Also, biomass generally has low concentrations of heavy metals and low ash content (2-3 percent), while coal emits large amounts of toxic heavy metals, including mercury and cadmium, and ash of up to 20 percent or more by weight. In addition, biomass that has to be stored creates a potential health hazard for the handlers who are exposed to the spores and microorganisms that form. (All quotes from Brown et al., 1994)

Transportation of biomass creates additional energy costs and environmental concerns. Most biomass, like switchgrass, will have to be transported by truck. Diesel engines in trucks create significant air pollution of CO_2, CO, hydrocarbons, nitrogen oxides, particles, and sulfur dioxide. A switch to ethanol fuel from diesel fuel could cut the CO_2 emissions of the transportation industry in half. As of 1990, the estimated energy cost for hauling switchgrass to a biomass processing plant was 2.79 gigaJoules per hectare, and the environmental cost was estimated to be 449.6 pounds of CO_2 per hectare. Note that biomass power plants of 50 mW electrical generating capacity are considered to be the optimal given the constraints of economics of scale and limits on transporting biomass. (Source: Brown et al., 1994)

Net Impacts of biomass power generation involve both economic and environmental issues. Economically, the issues is the generation of jobs through substitution of a locally-supplied product in place of one supplied from out-of-state. There are, however, additional potential costs associated with storage and transportation of the bulkier biomass fuel and handling of alkali slagging from its combustion. Environmentally, the substitution of biomass for coal has potentially negative impacts associated with fertilizer and pesticide use as well as truck emissions, but these are offset by reduced emissions of heavy metals. The valuation of these "environmental externalities" is not included in the economic analyses for this study.

4.3 Construction of Scenarios for Biomass-Generated Electricity

There are many different biomass electric generation technologies. Based on a literature review and expert consultation, the decision was made to focus on modeling economic impacts of co-firing switchgrass in a coal-fired power plant, which looks quite promising for Iowa in the near future. This methodology and these results can also be used to assess economic impacts of other biomass electric generation technologies.

Modeling Approach

The economic impacts of co-firing switchgrass in coal fired power plant, and the modeling of these impacts, occurs through four main channels:

1. Increased Demand for Switchgrass, to be burned by electric utilities

2. Reduced Demand for Coal. A portion of coal will be replaced by switchgrass. This reduced Iowas' dependence on imported coal.

3. Electricity-Cost Increases. Because electricity from switchgrass is more costly than that from coal, electricity prices will have to be increased to finance generation cost increases. Electricity-cost variables and consumer-price are used to estimate macroeconomic impacts of electricity cost increases.

4. Increased Production of Switchgrass. The estimated input/cost structure of switchgrass production, transportation, and processing reflects a change in final demand patterns.

We assume that there is no significant construction cost associated with co-firing and that all the cost of co-firing switchgrass will be financed through electricity price increases. These assumptions can be modified and should be if, for example, there are major facility construction and modification and if the federal government provides funding for switchgrass electricity.

Steps in Data Preparation and Development of Scenarios

The scenario and data inputs for REMI modeling are prepared in seven steps.

1. Obtain information on current total electric generation capacity (Kw) and electricity production (Kwh) in Iowa.

2. Obtain information on the percentage/amount of electricity generated from coal and its fuel requirement.

3. Assume a given percentage of coal (Btu) will be replaced by switchgrass

using co-firing technology. We then develop several scenarios for a range of replacement percentages for the period between 1995 and 2015.

4. Calculate the amount of dry switchgrass required by comparing energy content (Btu) of dry switchgrass with that of average coal used in Iowas electric utilities.

5. Convert tons of dry switchgrass into switchgrass production and acreage.

6. Estimate cost and input structure of switchgrass producing, transportation, and processing.

7. Estimate the impact of replacing coal with switchgrass on electricity prices based on cost $ / Btu difference between switchgrass and coal and the replacement percentage.

Construction of the resulting scenarios is summarized in Table 19 and the text which follows.

Table 19: Construction of Scenarios for Biomass Electricity

	Percentage of Coal Replaced by Switchgrass			
	1%	3%	5%	10%
Electricity from switchgrass:				
gWh/yr	275	825	1,376	2,751
gBtu/yr	938.3	2814.9	4694.9	9,386.4
Switchgrass required: (dry ton/yr):	55,194	165,582	276,171	55,2141
Acreage required/yr:				
high (normal, yield)	22,437	67,310	112,264	234,448
low (max yield with nitrogen)	11,218	33,655	56,132	112,224

Scenario	Replacement of Coal (% of electricity)	Switchgrass Yield (tons/acre)	Switchgrass Production Cost ($/acre)
1	Low (1%)	Low (2.5)	Low (226)
2	Low (1%)	Low (2.5)	High (261)
3	Low (1%)	High(4.9)	Low (226)
4	Low (1%)	High(4.9)	High (261)
5	High (10%)	Low (2.5)	Low (226)
6	Slow Growth (1-5%)	Low (2.5)	Low (226)
7	High Growth (1-10%)	Low (2.5)	Low (226)
8	Slow Growth (1-5%)	High(4.9)	High (261)

Supporting Data for Table 19

1. **Total electricity generation in Iowa (1993)**
   32.104 billion kWh: $1.916 Billion
   (Source: Electric Power Annual, 1994)

2. **Generating Capability at Electric Utilities of Iowa (1993):**
   8074 mW Summer, 8427 mW winter
   (Source: Inventory of Power Plants, 1994)

3. **Electricity generation from coal in Iowa (1993):**
   26,643 gWh; 85.7% of total
   (Source: Electric Power Annual, 1994)

4. **Heating value of switchgrass**
   7,741 Btu/lb (dry matter) = 17 million/dry ton
   (Source: Brown et al., 1994)

5. **Comparison of energy densities of biomass and coal:**

	biomass	coal
Calorific value (GJ/dry ton)	16-24	29-37
Energy Density of net material (GJ/m^3)	< 1-15	43

(Source: Boyles, 1984)

6. **Switchgrass Yield (dry-matter):**
2.46 - 4.73 ton/acre (depending on nitrogen use) in Ames
3.14 - 4.92 ton/acre (depending on nitrogen use) in Chariton
Source: (Brown, 1994)

7. **First year production costs for switchgrass production** (per acre):

(Unit: $)	High Cost (Ames)	Low Cost (Chariton)
seed	24.50	25.20
fertilizer (excl Nitrogen)	23.98	23.98
Herbicide	3.95	3.95
machinery fuel	4.99	4.99
R & M	18.01	18.01
fixed cost	43.35	43.34
labor	9.38	9.38
interest	4.76	4.78
transportation	13.78	13.03
land	115.00	80.00
total establishment	$261.70	$226.68

Source: Brown et al., 1994

8. **Estimated biomass acreage required for electricity generation:**

heat rate of power plant (50-MW)	Acreage required
12,500 Btu/kWh	65,000
10,200 Btu/kWh	53,000

Source: Brown et al., 1994

9. **Prevailing biomass price in the U.S.:** $42.00 dry ton.
Source: Brown et al., 1994

Description of Scenarios

Biomass Scenario 1: Low replacement of coal; low switchgrass yield per acre; low production costs

1) Penetration of biomass energy: 1.0% of coal-generated electricity, 1995-2015

2) Annual utility cost increase for electricity production of $3.77 million. (Computed as 321 million kWh @ 1.17¢/kWh estimated additional cost) .

3) Increased demand for switchgrass assumed to be met by Iowa producers; annual agricultural products sales increase of $8.97 million dollars.

Biomass Scenario 2: Low replacement of coal; low switchgrass yield per acre, high production costs

1) Penetration of biomass energy: 1% of coal-generated electricity, 1995-2015

2) Annual utility cost increase for electricity production of $8.01 million.

3) Increased demand for switchgrass assumed to be met by Iowa producers; annual agricultural products sales increase of $13.21 million.

Biomass Scenario 3: Low replacement of coal; high switchgrass yield per acre, low production costs (assumes use of added nitrogen)

1) Penetration of biomass energy: 1.0% of coal-generated electricity, 1995-2015

2) Annual utility cost increase of $1.5 million for electricity production

3) Increased demand for switchgrass assumed to be met by Iowa producers. Annual agricultural sales increase of $6.70 million dollars.

Biomass Scenario: 4 Low replacement of coal; high switchgrass yield per acre, high production costs (assumes use of nitrogen)

1) Penetration of biomass energy: 1.0% of coal-generated electricity, 1995-2015

2) Annual utility cost increase of $4.04 million for electricity production

3) Increased demand for switchgrass assumed to be met by Iowa producers. Annual agricultural sales increase of $7.24 million.

Biomass Scenario 5: High replacement of coal, low switchgrass yield per acre; low production costs

1) Penetration of biomass energy: 10% of coal-generated electricity, 1995-2015.

2) Annual utility cost increase for electricity production of $37.7 million.

3) Increased demand for switchgrass to be met by annual agricultural sales increase of $89.7 million.

Biomass Scenario 6: Slow growth replacement of coal; low switchgrass yield per acre; low production costs

1) Penetration of biomass energy: 1% of coal-generated electricity in 1995; 2% in 2000; 3% in 2005; 4% in 2010; 5% in 2015.

2) Annual utility cost increases for electricity production of $3.77 million (1995-1999); $7.54 (2000-2004); $11.31 million (2005-2009); $15.08 million (2010-2014) and $18.85 million (2015).

3) Increased demand for switchgrass assumed to be met by Iowa agricultural sales increase of $7.86 (1995-1999); 15.72 million (2000-2004); $23.58 million (2005-2009); $31.44 million (2010-2014) and $39.30 million (2015) Increased fertilizer demands of $1.10 million (1995-1999); $2.21 million (2000-2004); $3.31 million (2005-2009); $4.40 million (2010-2014) and $5.52 million (2015).

Biomass Scenario 7: High growth replacement of coal; low switchgrass yield per acre; low production costs

1) Penetration of biomass energy: 1% of coal-generated electricity in 1995; 4% in 2000; 6% in 2005; 8% in 2010; 10% in 2015.

2) Utility generating cost increases of $3.77 million (1995-1999); $15.08 million (2000-2004); $22.62 million (2005-2009); $30.16 million (2010-2014), 37.70 million (2015).

3) Increased demand for switchgrass assumed to be met by Iowa producers. Increased agricultural sales of $28.61 million(1995-1999); $31.44 million (2000-2004); $47.16 million (2005-2009); $62.89 million (2010-2014) and $78.61 million (2015). Increased fertilizer demands of $1.10 million (1995-1999); $4.42 million (2000-2004); $6.63 million (2005-2009); $8.84 million (2010-2014) and $11.05 million (2015).

Biomass Scenario 8: Slow growth replacement of coal; high switchgrass yield per acre; high production costs (assumes use of added nitrogen).

1) Penetration of biomass energy: 1% of coal-generated electricity in 1995; 2% in 2000; 3% in 2005; 4% in 2010; 5% in 2015.

2) Utility generating production cost increases of $3.77 million (1995-1999); $7.54 million (2000-2004); $11.31 million (2005-2009); $15.08 million (2010-2014) and $18.85 million (2015).

3) Increased demand for switchgrass assumed to be met by Iowa agricultural sales increases of $6.09 million (1995-1999); $12.18 million (2000-2004); $18.27 million (2005-2009); $24.36 million (2010-2014) and $30.45 million (2015) Increased fertilizer demands of $1.13 million (1995-1999); $2.27 million (2000-2004); $3.40 million (2005-2009); $4.53 million (2010-2014) and $5.66 million (2015).

4.4 Biomass Scenario Results

Results for an aggressive scenario in which 1% of Iowa's electricity is generated from switchgrass -- represented by scenario 6 -- are shown in Table 20. These model results are based on an assumption that there is no up front capital spending, but only the added cost of purchasing and burning switchgrass in place of coal in existing power plants. The results indicate that the higher cost to Iowa business (causing a loss of jobs) is more than offset by the "import substitution" effect, which is the flow of money to create Iowa jobs supplying switchgrass in place of money previously flowing out of the state to purchase coal. (The corresponding loss of jobs in the coal industry is out-of-state and hence ignored here.)

Table 20: Economic Impact of Generating 1% of Electricity from Switchgrass

	Absolute Amount	Ratio: Per Million Dollars Spent	Percent Increase Over State Total
Change in Spending			
Total Over 10 yrs	$37.7 m	n.a.	n.a.
Average Year	$3.77 m	n.a.	n.a.
Peak Year	$3.77 m	n.a.	n.a.
Change in Jobs			
Total Over 10 yrs (Job-yrs)	3,150	84	0.02%
Average Year	315	84	0.02%
Peak Year	373	99	0.02%
Change in Disposable Income			
(millions of constant 1994 dollars)			
Total Over 10 yrs	$55m	1.4	0.02%
Average Year	$6m	1.4	0.02%
Peak Year	$7m	1.8	0.03%
Change in Gross State Product			
(millions of constant 1994 dollars)			
Total Over 10 yrs	$75m	2.1	0.01%
Average year	$8m	2.1	0.01%
Peak year	$ 9m	2.9	0.02%

The overall effect (as shown in the above table) is 315 jobs/year in Iowa, and an increase in personal income of $5.5 million. This represents 84 jobs per million dollars spent on biomass energy, and $1.46 of income to Iowa residents for every $1.00 spent on biomass energy.

Of course, all of the economic impacts shown here for switchgrass are contingent on assumed operating costs, use of existing combustion facilities with no additional capital costs, and an effective solution to overcome the "alkali slagging" problem now holding back switchgrass burning power plants. The estimate of job impacts for biomass is also believed to be an upside estimate, since the economic model lacks applicable data on the ultimate labor-intensiveness of large scale switchgrass production and harvesting in the state.

Estimates of economic impacts for all eight biomass scenarios are presented in Table 21 (a - h), on the pages which follow. Since the biomass scenarios have no concentration of capital spending or needs for short-term financing for capital costs (as was the case for energy efficiency programs), there are no dramatic differences between short-term and long-term results. Rather, the model predicts generally stable employment and income results with a trend of the job impacts slowly falling over time as labor markets and labor prices adjust to provide a new labor market equilibrium of supply and demand.

Overall, these scenarios show that estimates of the annual employment effects of biomass energy programs range from around 230 jobs/year (Scenario 3) to over 3000 jobs/year (Scenario 5). Over 2/3 of these jobs are in the farm and agriculture services sector. There is significant uncertainty concerning the labor requirements for a future large-scale switchgrass industry; so the current job estimates may be considered to be upside estimates. There is almost no effect on Gross State (Regional) Product in Scenario 3 but an increase of around $67 million in Gross State Product in Scenario 5. This range of results is not surprising as we use very different assumptions in each of the scenarios. In Scenario 3, we assume that switchgrass replaces 1% of coal. (To operationalize this assumption, we use heat content data for coal and switchgrass and assume the same conversion efficiency.) We also assume a high yield of switchgrass per acre and low production costs. In this scenario, we separate fertilizer purchases from the value of sales of switchgrass; this lowers estimates of economic impacts because Iowa has a very small chemical products sector so almost all of the spending on fertilizer leaves the state.

The assumptions in Scenario 5 are rather different. We assume very high substitution of switchgrass for coal by replacing 10% of current consumption of coal in electricity generation with switchgrass. We also assume low switchgrass yield per acre and low production costs. We do not separately model the costs of fertilizer but aggregate all spending on switchgrass in agricultural sales.

To provide perspective on the size of the estimated economic impacts, refer to the REMI control forecast for Iowa, shown earlier in Table 1 (end of Section 2). As the data show, Gross State Product for Iowa is over $82 billion dollars and employment in the state is almost 1,800,000. Thus, the low estimates suggest that replacement of coal with switchgrass for electricity generation will have essentially no effect on the state economy. The highest estimate suggests that use of switchgrass will increase GSP by around 0.1% and employment by 0.2%.

TABLE 21.
ECONOMIC IMPACT OF ALTERNATIVE SCENARIOS FOR ELECTRICITY FROM BIOMASS
(Gross State Product and disposable income in 1994 million dollars; employment in persons)

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Biomass Scenario 1: Low Level, Low Switchgrass Yield, Low Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$9	$9	$8	$8	$8	$7	$7	$7	$7	$7	$7
Real Disp Inc	$7	$7	$7	$6	$6	$6	$6	$5	$5	$5	$5
Employment	373	358	338	330	322	305	303	298	292	286	279
Employment by Sector											
Agriculture/Farm	264	255	244	239	234	226	225	224	223	221	219
Mining	0	0	0	0	0	0	0	0	0	0	0
Construction	17	16	15	15	14	13	13	12	12	11	10
Durable Goods	1	1	1	0	0	0	0	0	0	0	0
Non-Dur Goods	2	2	2	1	1	1	1	1	1	1	1
Tran & Util	5	5	5	5	5	4	4	4	4	4	4
Finan, Ins & RE	7	6	6	6	5	5	5	5	4	4	4
Wholesale	7	6	6	6	6	5	5	5	5	5	5
Retail	26	25	22	21	21	18	18	16	15	14	12
Services	40	38	35	34	33	29	29	27	25	24	22
State & Loc Govt	4	4	3	3	3	3	3	3	2	2	2
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	7	7	7	7	7	7	7	6	7	7	149
Real Disp Inc	5	5	5	5	5	5	5	4	4	4	111
Employment	282	284	284	282	280	281	282	279	280	281	6299
Employment by Sector											
Agriculture/Farm	221	222	224	225	226	226	226	226	227	227	4823
Mining	0	0	0	0	0	0	0	0	0	0	5
Construction	11	11	10	10	10	10	10	10	10	10	249
Durable Goods	0	0	0	0	0	0	0	0	0	0	7
Non-Dur Goods	1	1	1	1	1	1	1	1	1	1	23
Tran & Util	4	4	4	4	4	4	4	4	4	4	86
Finan, Ins & RE	4	4	4	3	3	3	3	3	3	3	89
Wholesale	5	5	5	5	4	4	5	4	4	4	105
Retail	13	13	12	12	11	11	11	10	10	10	323
Services	22	22	22	21	20	20	20	19	19	19	539
State & Loc Govt	2	2	2	2	2	2	2	2	2	2	49
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	**Sum of All Years**	**Net Present Value**
Gross Reg Prod	149.5	96.7
Real Disp Inc	110.9	73.1
Employment	6299	4057

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Biomass Scenario 2: Low Level, Low Switchgrass Yield, High Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$13	$12	$12	$11	$11	$10	$10	$10	$10	$9	$9
Real Disp Inc	$10	$10	$9	$9	$8	$7	$7	$7	$6	$6	$6
Employment	534	512	479	467	455	426	424	414	403	392	379
Employment by Sector											
Agriculture/Farm	389	375	360	352	344	333	331	330	328	326	323
Mining	1	1	1	1	1	1	1	1	1	1	1
Construction	23	22	20	19	19	16	16	15	14	13	11
Durable Goods	1	1	1	1	1	0	0	0	0	0	0
Non-Dur Goods	2	2	2	2	2	1	1	1	1	1	1
Tran & Util	8	8	8	8	7	7	7	6	6	6	6
Finan, Ins & RE	9	8	7	7	7	5	5	5	4	4	3
Wholesale	9	9	8	8	8	7	7	7	7	6	6
Retail	35	33	28	27	26	20	20	17	15	12	9
Services	51	48	42	40	39	32	32	28	25	21	18
State & Loc Govt	5	5	4	4	4	3	3	3	2	2	2
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	9	9	9	9	9	9	9	9	9	9	206
Real Disp Inc	6	6	5	5	5	5	5	5	5	5	136
Employment	383	386	384	380	374	376	377	371	372	373	8661
Employment by Sector											
Agriculture/Farm	325	328	330	331	332	332	332	333	334	335	7103
Mining	1	1	1	1	1	1	1	1	1	1	12
Construction	12	12	11	11	10	10	10	9	9	9	292
Durable Goods	0	0	0	0	-0	0	0	-0	-0	-0	6
Non-Dur Goods	1	1	1	1	0	0	1	0	0	0	21
Tran & Util	6	6	6	6	6	6	6	5	5	5	132
Finan, Ins & RE	3	3	3	2	2	2	2	2	2	2	86
Wholesale	6	6	6	6	6	6	6	5	6	6	140
Retail	10	10	9	7	5	6	6	4	4	4	305
Services	18	19	17	14	12	13	13	11	11	11	515
State & Loc Govt	2	2	2	1	1	1	1	1	1	1	48
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	205.8	134.4
Real Disp Inc	136.4	92.4
Employment	8661	5622

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Biomass Scenario 3: Low Level, High Switchgrass Yield, Low Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$7	$7	$6	$6	$6	$6	$6	$6	$6	$5	$5
Real Disp Inc	$6	$6	$5	$5	$5	$5	$5	$5	$5	$4	$4
Employment	287	276	263	256	250	240	238	236	233	230	226
Employment by Sector											
Agriculture/Farm	197	190	182	178	174	169	168	167	167	165	164
Mining	0	0	0	0	0	0	0	0	0	0	0
Construction	14	13	12	12	12	11	11	11	10	10	10
Durable Goods	0	0	0	0	0	0	0	0	0	0	0
Non-Dur Goods	2	1	1	1	1	1	1	1	1	1	1
Tran & Util	4	3	3	3	3	3	3	3	3	3	3
Finan, Ins & RE	6	6	5	5	5	5	5	4	4	4	4
Wholesale	5	5	5	4	4	4	4	4	4	4	4
Retail	22	21	19	19	18	17	16	16	15	15	14
Services	35	33	31	30	29	27	27	26	26	25	24
State & Loc Govt	3	3	3	3	3	2	2	2	2	2	2
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	5	5	5	5	5	5	5	5	5	5	119
Real Disp Inc	4	4	4	4	4	4	4	4	4	4	97
Employment	228	230	230	230	230	230	230	230	230	231	5035
Employment by Sector											
Agriculture/Farm	165	166	167	168	168	168	168	169	169	170	3602
Mining	0	0	0	0	0	0	0	0	0	0	1
Construction	10	10	10	10	10	10	10	10	10	10	226
Durable Goods	0	0	0	0	0	0	0	0	0	0	7
Non-Dur Goods	1	1	1	1	1	1	1	1	1	1	24
Tran & Util	3	3	3	3	3	3	3	3	3	3	62
Finan, Ins & RE	4	4	4	4	4	4	4	4	4	4	91
Wholesale	4	4	4	4	4	4	4	4	4	4	85
Retail	14	15	14	14	14	14	14	14	14	14	333
Services	24	24	24	24	24	24	24	23	23	24	552
State & Loc Govt	2	2	2	2	2	2	2	2	2	2	50
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	119.4	76.5
Real Disp Inc	97.2	62.8
Employment	5035	3220

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Biomass Scenario 4: Low Level, High Switchgrass Yield, High Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$7	$7	$7	$7	$6	$6	$6	$6	$6	$6	$6
Real Disp Inc	$6	$6	$6	$5	$5	$5	$5	$5	$5	$5	$4
Employment	308	296	281	274	267	255	254	250	247	243	239
Employment by Sector											
Agriculture/Farm	213	206	197	193	188	182	182	181	180	179	177
Mining	0	0	0	0	0	0	0	0	0	0	0
Construction	15	14	13	13	12	11	11	11	11	10	10
Durable Goods	1	0	0	0	0	0	0	0	0	0	0
Non-Dur Goods	2	2	1	1	1	1	1	1	1	1	1
Tran & Util	4	4	4	4	4	3	3	3	3	3	3
Finan, Ins & RE	6	6	5	5	5	5	5	4	4	4	4
Wholesale	5	5	5	5	5	4	4	4	4	4	4
Retail	23	22	20	19	19	17	17	16	15	15	14
Services	36	34	32	31	30	28	28	27	26	25	23
State & Loc Govt	3	3	3	3	3	3	3	2	2	2	2
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	6	6	6	6	6	6	6	6	6	6	127
Real Disp Inc	4	4	4	4	4	4	4	4	4	4	100
Employment	241	243	243	243	242	242	243	241	242	243	5335
Employment by Sector											
Agriculture/Farm	178	179	181	182	182	182	182	182	183	183	3893
Mining	0	0	0	0	0	0	0	0	0	0	2
Construction	10	10	10	10	10	10	10	10	10	10	231
Durable Goods	0	0	0	0	0	0	0	0	0	0	7
Non-Dur Goods	1	1	1	1	1	1	1	1	1	1	24
Tran & Util	3	3	3	3	3	3	3	3	3	3	67
Finan, Ins & RE	4	4	4	4	4	4	4	4	4	4	91
Wholesale	4	4	4	4	4	4	4	4	4	4	90
Retail	14	14	14	14	13	13	13	13	13	13	331
Services	24	24	24	23	23	23	23	22	22	22	549
State & Loc Govt	2	2	2	2	2	2	2	2	2	2	50
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	126.5	81.3
Real Disp Inc	100.5	65.3
Employment	5335	3419

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Biomass Scenario 5: High Level, Low Switchgrass Yield, Low Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$90	$87	$82	$80	$78	$73	$73	$71	$70	$68	$66
Real Disp Inc	$74	$71	$65	$64	$62	$57	$56	$54	$52	$50	$47
Employment	3732	3584	3382	3300	3218	3047	3031	2977	2924	2862	2792
Employment by Sector											
Agriculture/Farm	2643	2548	2441	2388	2335	2261	2250	2240	2229	2213	2192
Mining	2	2	2	2	2	2	2	2	2	2	2
Construction	170	163	150	146	141	129	128	122	117	111	105
Durable Goods	6	6	5	5	5	4	4	4	3	3	2
Non-Dur Goods	18	17	15	15	14	13	13	12	11	10	9
Tran & Util	53	51	48	47	46	43	43	41	40	39	38
Finan, Ins & RE	68	64	58	56	55	48	48	45	42	39	36
Wholesale	66	63	59	57	56	52	52	50	49	47	45
Retail	264	250	222	214	206	179	177	165	152	139	124
Services	404	384	348	337	326	290	288	271	254	237	218
State & Loc Govt	38	36	33	32	31	27	27	25	23	22	20
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	66	67	67	66	66	66	66	65	65	65	1495
Real Disp Inc	48	48	47	46	45	46	46	44	44	44	1109
Employment	2817	2842	2838	2825	2803	2812	2817	2788	2797	2806	62991
Employment by Sector											
Agriculture/Farm	2208	2224	2240	2250	2256	2256	2256	2261	2266	2272	48229
Mining	2	2	2	2	2	3	3	2	2	2	50
Construction	106	107	105	102	99	100	101	96	97	97	2490
Durable Goods	2	3	2	2	2	2	2	2	2	2	66
Non-Dur Goods	10	10	9	9	8	8	9	8	8	8	234
Tran & Util	38	38	38	38	37	38	38	36	36	36	863
Finan, Ins & RE	37	37	36	34	32	33	33	31	31	31	895
Wholesale	46	46	46	45	45	45	45	44	44	44	1045
Retail	127	130	124	117	109	111	112	102	104	105	3235
Services	221	225	216	207	196	199	201	189	190	191	5391
State & Loc Govt	20	20	19	18	17	18	18	17	17	17	493
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	1495.0	966.7
Real Disp Inc	1108.9	731.4
Employment	62991	40574

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO: Biomass Scenario 6: Slow Growth, Low Switchgrass Yield, Low Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$9	$10	$11	$13	$14	$15	$16	$17	$18	$19	$20
Real Disp Inc	$7	$8	$9	$10	$11	$11	$12	$13	$14	$14	$14
Employment	373	430	473	528	579	609	667	715	760	801	838
Employment by Sector											
Agriculture/Farm	264	306	342	382	420	452	495	538	580	620	658
Mining	0	0	0	0	0	0	1	1	1	1	1
Construction	17	20	21	23	25	26	28	29	30	31	31
Durable Goods	1	1	1	1	1	1	1	1	1	1	1
Non-Dur Goods	2	2	2	2	3	3	3	3	3	3	3
Tran & Util	5	6	7	8	8	9	9	10	10	11	11
Finan, Ins & RE	7	8	8	9	10	10	11	11	11	11	11
Wholesale	7	8	8	9	10	10	11	12	13	13	14
Retail	26	30	31	34	37	36	39	40	40	39	37
Services	40	46	49	54	59	58	63	65	66	66	65
State & Loc Govt	4	4	5	5	6	5	6	6	6	6	6
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	21	23	24	25	26	28	29	30	31	33	432
Real Disp Inc	15	16	17	18	18	19	20	20	21	22	312
Employment	901	966	1022	1073	1121	1181	1239	1282	1342	1403	18305
Employment by Sector											
Agriculture/Farm	707	756	806	855	902	947	993	1040	1088	1136	14286
Mining	1	1	1	1	1	1	1	1	1	1	15
Construction	34	36	38	39	40	42	44	44	46	49	694
Durable Goods	1	1	1	1	1	1	1	1	1	1	17
Non-Dur Goods	3	3	3	3	3	4	4	4	4	4	63
Tran & Util	12	13	14	14	15	16	17	17	17	18	247
Finan, Ins & RE	12	13	13	13	13	14	15	14	15	16	241
Wholesale	15	16	17	17	18	19	20	20	21	22	299
Retail	41	44	45	44	44	47	49	47	50	52	852
Services	71	76	78	78	78	83	88	87	91	96	1459
State & Loc Govt	6	7	7	7	7	7	8	8	8	8	132
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	432.1	243.1
Real Disp Inc	311.7	178.6
Employment	18305	10264

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO: Biomass Scenario 7: High Growth, Low Switchgrass Yield, Low Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$9	$13	$16	$19	$22	$24	$28	$30	$33	$35	$37
Real Disp Inc	$7	$10	$13	$16	$18	$20	$22	$24	$25	$27	$27
Employment	373	525	654	793	925	1025	1154	1269	1379	1480	1569
Employment by Sector											
Agriculture/Farm	264	369	464	561	654	735	832	929	1025	1117	1205
Mining	0	0	0	0	0	0	1	1	1	1	1
Construction	17	24	30	36	42	46	51	55	58	60	62
Durable Goods	1	1	1	1	1	1	2	2	2	2	2
Non-Dur Goods	2	3	3	4	5	5	5	6	6	6	6
Tran & Util	5	7	9	11	12	13	15	17	18	19	21
Finan, Ins & RE	7	10	12	15	17	18	20	21	22	22	22
Wholesale	7	9	11	14	16	18	20	22	23	25	26
Retail	26	38	45	55	64	68	75	78	80	80	78
Services	40	58	72	88	103	111	122	128	133	135	135
State & Loc Govt	4	5	7	8	10	10	11	12	12	12	12
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	40	44	46	49	51	54	57	59	62	65	795
Real Disp Inc	30	32	34	35	36	38	40	40	42	44	581
Employment	1707	1846	1969	2085	2192	2321	2448	2545	2674	2805	33738
Employment by Sector											
Agriculture/Farm	1313	1423	1534	1642	1748	1849	1951	2057	2164	2271	26107
Mining	1	1	1	2	2	2	2	2	2	2	24
Construction	67	72	75	77	79	84	89	89	93	97	1302
Durable Goods	2	2	2	2	2	2	2	2	2	2	32
Non-Dur Goods	6	7	7	7	7	7	8	7	8	8	122
Tran & Util	22	24	26	27	29	31	33	33	35	36	444
Finan, Ins & RE	24	26	26	27	26	28	30	29	30	31	464
Wholesale	28	30	32	34	35	37	39	40	42	44	551
Retail	84	91	92	92	90	96	100	96	100	105	1632
Services	145	156	159	161	161	170	179	176	183	191	2808
State & Loc Govt	13	14	14	14	14	15	16	15	16	17	253
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	795.1	432.3
Real Disp Inc	581.5	322.2
Employment	33738	18293

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Biomass Scenario 8: Slow Growth, High Switchgrass Yield, High Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	$9	$10	$11	$13	$14	$15	$16	$17	$18	$19	$20
Real Disp Inc	$7	$8	$9	$10	$11	$11	$12	$13	$14	$14	$14
Employment	373	430	473	528	579	609	667	715	760	801	838
Employment by Sector											
Agriculture/Farm	264	306	342	382	420	452	495	538	580	620	658
Mining	0	0	0	0	0	0	1	1	1	1	1
Construction	17	20	21	23	25	26	28	29	30	31	31
Durable Goods	1	1	1	1	1	1	1	1	1	1	1
Non-Dur Goods	2	2	2	2	3	3	3	3	3	3	3
Tran & Util	5	6	7	8	8	9	9	10	10	11	11
Finan, Ins & RE	7	8	8	9	10	10	11	11	11	11	11
Wholesale	7	8	8	9	10	10	11	12	13	13	14
Retail	26	30	31	34	37	36	39	40	40	39	37
Services	40	46	49	54	59	58	63	65	66	66	65
State & Loc Govt	4	4	5	5	6	5	6	6	6	6	6
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	21	23	24	25	26	28	29	30	31	33	432
Real Disp Inc	15	16	17	18	18	19	20	20	21	22	312
Employment	901	966	1022	1073	1121	1181	1239	1282	1342	1403	18305
Employment by Sector											
Agriculture/Farm	707	756	806	855	902	947	993	1040	1088	1136	14286
Mining	1	1	1	1	1	1	1	1	1	1	15
Construction	34	36	38	39	40	42	44	44	46	49	694
Durable Goods	1	1	1	1	1	1	1	1	1	1	17
Non-Dur Goods	3	3	3	3	3	4	4	4	4	4	63
Tran & Util	12	13	14	14	15	16	17	17	17	18	247
Finan, Ins & RE	12	13	13	13	13	14	15	14	15	16	241
Wholesale	15	16	17	17	18	19	20	20	21	22	299
Retail	41	44	45	44	44	47	49	47	50	52	852
Services	71	76	78	78	78	83	88	87	91	96	1459
State & Loc Govt	6	7	7	7	7	7	8	8	8	8	132
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	432.1	243.1
Real Disp Inc	311.7	178.6
Employment	18305	10264

4.5 Overview of Existing Wind Energy Technologies

As the demand for electricity increases and many of the existing fossil fuel and nuclear generating facilities are nearing the end of their life, additional sources of electricity are emerging. Wind energy offers one of the most promising sources for nonpolluting, low-cost energy generation. In order to study the possibility of wind energy use in Iowa, we have examined technological, economic, and environmental issues related to wind energy.

There are a few critical technological issues that regulate wind energy use. Contrary to conventional wisdom, the wind energy output of a wind farm can be predicted with rather high confidence. If wind energy is ever to contribute a very large fraction of the electrical supply for a large region, then some form of storage or backup capacity will be needed to correct for the inevitable mismatches between wind-power output and demand. Sites of wind turbines need to be selected very carefully, because once turbines are installed, it is almost impossible to move them to other places to catch better wind resources. We have reviewed data regarding the mechanisms of wind-energy output, energy loss, reliability, and grid control.

The economic consideration of wind energy focuses on cost analysis. The overall production cost of wind energy, which is around 4-7¢ / kWh, is fairly competitive today and is down from about 25¢ / kWh in the early 1980's. Further efficiency improvements and cost reductions are possible. We have considered various estimates of construction and operation and maintenance (O&M) costs for the state of Iowa in order to provide a range of costs. Several analysts have conducted case studies to obtain a breakdown of costs for wind turbines of small (<50 kW), intermediate (50 to 200 kW), and large (>200 kW) sizes. Also, they have determined the costs of a 50-MW wind farm instead of single turbines, a form that is often advocated and that is in use in California and a number of foreign countries.

In Iowa, only biomass and wind are being seriously considered for renewable energy. The Iowa Energy Center is conducting a three-year project on wind energy in Iowa for the period of April 1993 - April 1996. Initial costs seem to be about $1,000/kW to install.

A total of 13 wind towers are being built in the state; several are now in operation. The unit which has the longest track record and the most operating data as a full production wind energy generator is the Waverly Light and Power unit. Following a preliminary feasibility study in 1991, and subsequent site evaluation and economic analysis, the Waverly wind-energy project was started in early in 1993 with plans for the installation of approximately 1 MW of wind capacity by 1996. The initial facility is an 80 kW wind turbine manufactured by Zond.

We spoke to Ben and Ken Hach at Zond and they said that the Zond equipment is being built and assembled in California, where Zond's headquarters is located. If a sufficient number of wind projects are started in Iowa, Zond may begin to assemble the parts in Iowa. Both for the wind-assessment projects (which use meteorology towers) and farms (which use generators), the equipment is built by the home company and then assembled and shipped to the site. In the case of generators, they are assembled from off-the-shelf parts. Presently there probably is no manufacturer and assembler of parts in Iowa.

A new 60 MW wind farm is also planned for Alta, Iowa. This will employ about 80 laborers during the construction period, which is expected to last for three to five months. The laborers will do masonry, hole digging, construction, electrical work, and build roads. Only four people will be brought in from California to consult on the project.

Zond leases land from farmers who get paid per acre as well as per tower constructed. In addition, the farmers owns "wind rights" that provide them with a percentage of energy based upon the amount of energy produced. If the land is sold or passed on to other family members, the contract will remain with the family.

From the Waverly final report (RLA Consulting, 1995), we find that the total cost of energy generation from the Waverly turbine, including turbine and tower, installation, land lease, and other related expenses, was $128,976, or $1,612/kW, which is somewhat higher than prevailing estimates. This seems to be within an acceptable cost range for the first turbine installed. With the plan for an eventual 1 MW capacity, they expect that economies of scale will lower the average cost. (Breakdown costs of Waverly turbine are listed at the end of this summary.) The overall energy cost of Waverly's current project (with a $25,000 grant) is about 11¢ / kWh. In the scenario with advanced technology, the electricity cost can be as low as 5.5¢ / kWh. To reach this cost level, much larger turbines (680 kW) will have to be used.

Because the Waverly turbine is located in a relatively low-speed wind area, the performance of the same wind turbine is expected to be higher and the energy cost would, then, be considerably lower (5¢ / kWh) in other sites in the north, where the wind resource are expected to be better.

The experience in wind-power output prediction obtained from the Waverly site shows that the actual monthly outputs are within a range from 83% to 117% of the predicted values. For the twelve months from October 1993 through September 1994, the actual output was five percent higher than the estimated output.

Waverly Turbine(80 kW)	**Costs($)**
Turbine & tower	71,750
Installation	19,950
Related materials	16,073
Fence & access road	5,552
Underground tie line	8,800
Land lease	2,200
Consultants/legal	4,651
Total	$128,976

Source: RLA Consulting, 1995

4.6 Construction of Scenarios for Wind-Generated Electricity

Modeling Approach

The statewide economic impacts of using wind energy plants, and the modeling of these impacts, occurs through three main channels:

1. Increased demand for purchases of wind power generation equipment, land and facility construction services.
2. Reduced demand for (imported) coal and existing coal-fired power plants in Iowa.
3. Electricity Cost Increases. Because electricity from wind is more costly than that from coal, electricity prices will have to be increased to finance the additional capital costs and operating costs.

Steps in Data Preparation and Development of Scenarios

The scenario and data inputs for REMI modeling are prepared in seven steps.

1. Obtain information on current total electric generation capacity (KW) and electricity production (KWh) in Iowa.
2. Obtain information on the percentage/amount of electricity generated from coal and its fuel requirement.
3. Assume a given percentage of coal (Btu) will be replaced by wind energy plants. We utilize several scenarios for a range of replacement percentages for period between 1995 and 2015.
4. Estimate capital and operating cost for wind power plants.

5. Estimate the impact of replacing coal-fired plants with wind energy, and calculate change in energy prices.

Construction of the resulting scenarios is summarized in Table 22 and text following it.

Table 22: Construction of Scenarios for Electricity from Wind energy

I. Wind energy Potential - Defining Scenarios

Percentage of kW generated by wind energy [1]	0.1%	0.3%	0.5%	1.0%
Million kWh	32.1	96.3	160.5	321

[1]Based on 1993 Iowa electricity generation estimate of 32.104 billion kWh. (Energy Information Agency, Electric Power Annual, 1993)

Wind Scenario	Replacement of Coal	Construction Cost	Operating Main. Cost	Financing
1	low	low	low	first year expense
2	high	low	low	first year expense
3	slow growth	low	low	continuing expense
4	high growth	low	low	continuing expense
5	high growth	mild	high	first year expense
6	high growth	high	high	first year expense
7	high growth	low	low	spread over 20 years as energy charge

II. Estimated Construction Costs (per kW Hour)

Source	**Type of System**	**Estimate (original)**	**Estimate (1994$)**
Wisconsin Energy Bureau (1994)	Wind Farm	$1000 (1992$)	$1059
Wisconsin Energy Bureau (1994)	Agricultural	$ 943 (1992$)	$999
Wisconsin Energy Bureau (1994)	Residential	$2700 (1992$)	$2965
Waverly Light & Power (1994)	80 kW	$1587 (1993$)	$1633
Carless (1993)	50-200 kW	$950-1100 (1990$)	$1095-1268
New York (1994)	Intermediate	$1073 (1992$)	$1136
General Estimate		$1200 (1992$)	$1271

III. Estimated Operation and Maintenance Costs (cents per kW Hour)

Source	Type	
Wis. Energy Bureau (1994)	30 MW Farm	1.0
Wis. Energy Bureau (1994)	Farm-scale Wind Machine	0.5
Wis. Energy Bureau (1994)	Resid.-scale Wind Machine	0.5
Brower (1992)	50-200 kW Turbine	1.5
Waverly Light & Power (1994)	80 kW Turbine	2.9
New York State (1994)	Wind Turbine	1.3

Additional Supporting Information:

Breakdown of Construction Costs of Wind energy Facilities (Percent of total spending in each category)

	30 MW Wind Farm	Large (200 kW) Turbine	Small Turbine
SIC 16	5%	----	14%
SIC 34	17%	21%	8%
SIC 35	44%	59%	35%
SIC 36	5%	4%	17%
Labor	29%	16%	26%

Sources: Wisconsin Energy Bureau, 1994; Johnson, 1985

Additional Estimates of Construction Cost Breakdown (Percent of total spending in each category)

	50 MW Wind Farm	500 kW Turbine	80 kW Turbine
Turbines	86.0%		
Turbine and Tower	n.a.	85.0%	56.5%
Installation	n.a.	15.7%	
Tie line	n.a.	6.9%	
Drilling and concrete	n.a.	4.5%	5.0%
Access Road	n.a.	n.a.	2.9%
Fence	n.a.	n.a.	1.5%
Consultants	n.a.	n.a.	3.7%
Other	n.a.	3.0%	7.6%
Leased land	n.a.	n.a.	0.2%
Connection to grid	n.a.	7.5%	n.a.
Substation	6.6%	n.a.	n.a.
Transmission	0.6%	n.a.	n.a.
Service Center	0.5%	n.a.	n.a.
Land	3.9%	n.a.	n.a.
Permitting	2.5%	n.a.	n.a.
	100%	100%	100%

Sources: Union of Concerned Scientists 1992; Waverly Lighting and Power, 1994; Wortman, 1983

Note: All inputs are in 1987 dollars

Definitions of Scenarios

Wind Energy Scenario 1: Low wind energy penetration; low construction costs; low O&M costs.

1) Penetration of wind energy: 0.1% of total electricity for all years 1995-2015 (Net spending decrease of $1.98 million dollars for traditional energy sources).

2) Construction and payment for facilities of $6.1 million assumed to take place in 1995. Construction costs modeled using following split: 33% in SICs 15-17 (construction); 56% in SIC 35 (non-electric machinery); 7% in SIC 36 (electrical equipment); 4% in SICs 81, 87, 89 (professional services).

3) Added wind operation and maintenance costs are $0.21 million per year for each year from 1995-2015.

4) The difference between increased spending on wind-generated electricity and fossil-fuel-generated electricity was modeled as a decrease in local purchasing power (on other goods) of $4.35 million in 1995 and an increase in purchasing power of $1.77 million for each year from 1996-2015.

Wind Energy Scenario 2: High wind energy penetration; low construction costs; low O&M costs.

1) Penetration of wind energy: 1.0% total electricity for all years 1995-2015. (Net spending decrease of $19.8 million dollars for traditional energy sources).

2) Construction and payment for facilities of $61.24 million taking place in 1995.

3) Operation and maintenance costs are $4.61 million per year for each year from 1995-2000; and $2.92 for each year from 2001-2015.

4) The difference between increased spending on wind-generated electricity and fossil-fuel-generated electricity represents an increase in purchasing power of $10 million in 1995 and $11.68 million for each year from 1996-2015

Wind Energy Scenario 3: Slow growth of wind energy penetration; low construction costs; low O&M costs.

1) Penetration of wind energy: 0.1% of total electricity in 1995-1999; 0.2% in 2000-2004; 0.3% in 2005-2009; 0.4% in 2010-2014; and 0.5% in 2015.

2) Demand for electricity decreased by 0.1% ($19.8 million) in 1995-1999; dropping to $9.9 million by 2015.

3) Construction for new facilities ($6.1 million) is assumed to take place every fifth year, with payment usually spread over 5 years.

4) Operation and maintenance costs are $0.46 million per year for each year from 1995-1999; rising to $3.62 by 2015.

5) The difference between increased spending on wind-generated electricity and fossil-fuel-generated electricity is modeled as a decrease in local purchasing power, ranging from an $0.25 million loss in 1995 to a gain of $4.51 million in 2015.

Wind Energy Scenario 4: High growth of wind energy penetration; low construction costs; low O&M costs.

1) Penetration of wind energy: 0.1% of total electricity in 1995-1999; 0.4% in 2000-2004; 0.6% in 2005-2009; 0.8% in 2010-2014; and 1.0% in 2015.

2) Demand for electricity decreased by 0.1% in 1995-1999; 0.4% in 2000-2004; 0.6% in 2005-2009; 0.8% in 2010-2014; and 1.0% in 2015. Electricity spending decrease of $1.98 million dollars in 1995 -1999 rising to $19.8 million in 2015.

3) Construction and payment for new facilities assumed to take place every fifth year, with $6.1 million in 1995, and$16.2 million in years 2000, 2005, 2010, and 2015.

4) Operation and maintenance costs are $0.46 million in 1995-1999; $1.67 for 2000-2004; $2.08 for 2005-2009; $2.67 for 2010-2014; and $3.62 for 2015.

5) The difference between increased spending on wind-generated electricity and fossil-fuel-generated electricity is modeled as a change in local purchasing power, ranging from an incremental loss of $4.6 million in l995 to a $14.0 million gain by the year 2015.

Wind Energy Scenario 5: High wind energy penetration; mid construction costs ($1250 per kW); high O&M costs.

1) Penetration of wind energy: 1.0% total electricity for all years 1995-2015

2) Demand for electricity decreased by 1.0% per year; decrease of $19.8 million.

3) Construction and payment for facilities of $75.41 million assumed in 1995.

4) Operation and maintenance costs are $5.41 million per year for each year from 1995-2000; and $2.92 million for each year from 2001-2015.

5) The difference between increased spending on wind-generated electricity and fossil-fuel-generated electricity is modeled as a decrease in purchasing power ranging of $61.02 million in 1995, rising to a gain of $16.88 million by the year 2005.

Wind Energy Scenario 6: High wind energy penetration; high construction costs ($1600 per kW); high O&M costs.

1) Penetration of wind energy: 1.0% total electricity for all years 1995-2015

2) Demand for electricity decreased by 1.0% per year; decrease of $19.8 million.

3) Construction and payment for facilities of $96.52 million assumed for 1995.

4) Operation and maintenance costs are $5.41 million per year for each year from 1995-2000; and $2.92 for each year from 2001-2015.

5) The difference between increased spending on wind-generated electricity and fossil-fuel-generated electricity represents a decrease in purchasing power of $82.13 million in 1995, rising to a gain in purchasing power of $26.88 of the period of 2001-2005.

Wind energy Scenario 7: High wind energy penetration; construction and O&M costs charged as a constant increment in price per kW hour of usage; costs calculated using Iowa electricity prices and assumed capacity factor of 20%; initial capital cost of $1032 per kW.

1) Penetration of wind energy: 1.0% total electricity for all years 1995-2015

2) Demand for fossil fuel-generated electricity decreased by 1.0% per year or 321.04 million kWh. To calculate the decrease in spending on utilities, subtract 6.17 cents per kWh of replacement (fossil-fuel fired costs, including both operating and fuel costs), but then add 0.77 cents for each kWh wind energy to cover line losses. This decreases net energy production operating cost by 16.79 million dollars per year.

3) Construction and payment for facilities spread over all years. ($5.6 million/year) Construction costs modeled using following split: 33% in SICs 15-17; 56% in SIC 35; 7% in SIC 36; 4% in SICs 81, 87, 89.

4) Operation and maintenance costs are $4.32 million per year for each year from 1995-2015 and are assumed to stimulate demand for construction services.

5) The difference between increased spending on wind-generated electricity and fossil-fuel-generated electricity were modeled as a decrease in purchasing power of. $7.41 million per year for each year from 1995-2015.

4.7 Wind Energy Scenario Results

The cost data indicates that (at least in the short-term) wind energy appears to be a more financially realistic and technically feasible power source for Iowa than switchgrass. This conclusion, that wind costs can be expected to be lower than biomass combustion, was also found by a comprehensive study of the costs of alternative electricity generation technologies conducted by the New York State Energy Office.

It is, however, also important to note that wind and biomass energy do in fact affect the economy of Iowa in very different ways. In Iowa, use of switchgrass in electricity generation has the effect of replacing an imported good (coal) with one that is locally produced (switchgrass), using the same basic power plant boilers for co-firing switchgrass with coal. Thus, the Iowa economy benefits from keeping more dollars flowing in the state (known as"import substitution") and does not have to invest in any additional new power plant facilities to do so.

In contrast, use of wind energy does not increase demand for any local product except wind, which of course escapes the price system. With wind, there is still a much smaller substitution effect insofar as imports of fossil fuels will decline and there will be a modest increase in demand for construction services to maintain wind facilities. The largest effect on the Iowa economy associated with wind energy, though, is the financing and construction of new generating facilities. Funding for new capital investment of this type can have a short-term negative effect on the economy, to the extent that the funding reduces disposable income which otherwise would have been spent on other goods and services within the state. Of course, the savings on importing of coal into the state can then lead to longer-term benefits for the state economy.

Results for an aggressive scenario in which 1% of Iowa's electricity is generated by wind energy is represented by scenario 2. Under this scenario of low operating and capital costs, there is a substantial first year loss of jobs associated with the loss of income to pay for new generating facilities (which more than offsets the temporary construction jobs generated at that time). After that, there is a generally growing number of jobs generated, averaging 80 - 135 jobs/year over the period of 2005 - 2015. Associated with it is a net increase in personal income to Iowa residents of $2 - 4 million/year. Excluding the first year loss of jobs, these results indicate represent 1.6 jobs annually per million dollars spent on wind energy and $1.03 of income to Iowa residents for every $1.00 spent on wind energy. Compared to biomass, there are significantly fewer jobs created (since there is no ongoing crop harvesting impact) but overall income effects are as large or larger (due to money remaining in the Iowa economy rather than flowing to out-of-state coal suppliers).

Table 23: Economic Impact of Generating 1% of Electricity from Wind Energy

	Absolute Amount	Ratio: Per Million Dollars Spent	Percent Increase Over State Total
Change in Net Spending			
Total Over 10 yrs	$116 m	n.a.	n.a.
Average Year	$12 m	n.a.	n.a.
Peak Year	$61 m	n.a.	n.a.
Change in Jobs (excl. 1st yr.)*			
Total 10 yrs (Job-yrs)	292	2.5	<0.01%
Average Year	29	2.5	<0.01%
Peak Year	135	11	<0.01%
Change in Disposable Income (excl. 1st yr.)*			
(millions of constant 1994 dollars)			
Total Over 10 yrs	$7m	0.1	<0.01%
Average Year	$0.7m	0.1	<0.01%
Peak Year	$4m	0.3	<0.01%
Change in Gross State Product (excl. 1st yr.)*			
(millions of constant 1994 dollars)			
Total Over 10 yrs	$6m	0.1	<0.01%
Average year	$0.6m	0.1	<0.01%
Peak year	$5m	0.4	0.04%

* Including the losses of jobs and income associated with financing construction of new facilities, and the subsequent gains of jobs and income associated with wind plant operations, the net 20-year impact is approximately break-even. The figures shown here represent the average of the first ten years and the second ten years of operation.

Estimates of economic impacts for seven wind scenarios are presented in Table 24 (a - g). For each of the alternative scenarios, estimates of the employment impacts of wind energy penetration range from a loss of over 100 jobs per year (Scenario 7) to a gain of 100 jobs per year (Scenario 2). In Scenario 7, high wind energy penetration is assumed and construction and operation and maintenance costs are distributed based on consumption of wind-powered electricity. This essentially assumes that for every year between 1995 and 2015, around 320 million kW hours of electricity is generated from wind energy. Because construction costs are spread through the lifetime of the equipment in the form of electricity prices, the effects are fairly stable over time. The average effect is a loss of around 160 jobs per year and a loss of around 7 million in Gross State Product each year. This is a minuscule portion of the total Iowa economy.

TABLE 24: ESTIMATES OF ECONOMIC IMPACTS FOR EIGHT WIND SCENARIOS

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Wind 1: Low Level, Low Construction Cost, Low O&M Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	-3	-0	-0	-0	-0	-0	-0	-0	-0	0	0
Real Disp Inc	-5	-0	-0	-0	-0	-0	-0	0	0	0	0
Employment	-108	1	-2	0	-1	3	3	5	6	8	10
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0
Construction	3	-0	-1	-0	-0	0	0	0	0	1	1
Durable Goods	1	-0	-0	-0	-0	-0	-0	-0	-0	0	0
Non-Dur Goods	-2	0	0	0	0	0	0	0	0	0	0
Tran & Util	-5	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
Finan, Ins & RE	-9	0	0	0	0	0	0	0	1	1	1
Wholesale	0	-0	-0	-0	-0	-0	-0	-0	-0	-0	0
Retail	-43	1	-0	0	0	1	1	2	2	3	3
Services	-47	2	1	2	1	3	2	3	4	5	5
State & Loc Govt	-5	-0	-0	-0	-0	0	0	0	0	0	0
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	0	0	0	0	0	0	0	0	0	0	-3
Real Disp Inc	0	0	0	0	0	0	0	1	1	1	-2
Employment	10	10	11	12	13	13	12	16	15	15	52
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-5
Construction	1	1	1	1	1	1	1	2	2	2	16
Durable Goods	0	0	0	0	0	0	0	0	0	0	1
Non-Dur Goods	0	0	0	0	0	0	0	0	0	0	2
Tran & Util	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-23
Finan, Ins & RE	1	1	1	1	1	1	1	1	1	1	5
Wholesale	0	0	0	0	0	0	0	0	0	0	0
Retail	3	3	4	4	4	4	4	5	5	5	12
Services	5	5	6	6	7	6	6	7	7	7	43
State & Loc Govt	0	0	0	0	0	0	0	1	1	1	-1
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	-3.2	-3.8
Real Disp Inc	-1.9	-4.1
Employment	52	-30

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO: Wind 2: High Level, Low Construction Cost, Low O&M Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	-33	-3	-4	-3	-4	-3	-2	-1	-1	-0	0
Real Disp Inc	-53	-3	-5	-4	-4	-2	-2	-0	0	1	2
Employment	-1097	-30	-52	-34	-43	-8	5	37	46	67	82
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Construction	24	-6	-9	-7	-8	-4	-2	2	3	5	7
Durable Goods	10	-1	-1	-1	-1	-1	-1	-0	-0	-0	0
Non-Dur Goods	-25	0	-0	0	0	1	1	1	2	2	2
Tran & Util	-46	-11	-12	-11	-12	-10	-11	-10	-10	-9	-9
Finan, Ins & RE	-87	-1	-2	-1	-1	1	2	4	5	6	7
Wholesale	4	-3	-4	-3	-4	-3	-2	-1	-1	-0	0
Retail	-439	-6	-12	-7	-9	1	5	14	17	24	28
Services	-481	2	-6	1	-2	10	16	28	32	40	46
State & Loc Govt	-55	-2	-3	-2	-3	-1	-1	1	1	2	2
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	0	0	0	1	1	1	1	2	2	2	-45
Real Disp Inc	2	2	2	3	3	3	3	5	4	4	-39
Employment	83	82	93	105	116	111	105	138	131	135	72
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-46
Construction	7	7	9	10	11	11	10	14	13	14	110
Durable Goods	0	0	0	0	0	0	0	1	0	1	7
Non-Dur Goods	2	2	2	3	3	3	3	3	3	3	12
Tran & Util	-8	-9	-8	-8	-8	-8	-9	-7	-7	-7	-230
Finan, Ins & RE	7	7	8	8	9	9	9	11	10	10	20
Wholesale	0	0	0	1	1	1	1	2	2	2	-10
Retail	28	28	32	35	39	37	36	45	43	44	-16
Services	46	46	50	55	59	57	55	67	65	66	251
State & Loc Govt	2	2	3	3	4	4	3	5	4	5	-25
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	**Sum of All Years**	**Net Present Value**
Gross Reg Prod	-44.8	-46.6
Real Disp Inc	-39.0	-54.7
Employment	72	-602

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Wind 3: Slow Growth, Low Construction Cost, Low O&M Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	-0	-2	-2	-2	-2	-0	-2	-2	-2	-2	0
Real Disp Inc	-0	-2	-3	-3	-3	-0	-3	-2	-2	-2	0
Employment	-10	-45	-47	-45	-46	-1	-45	-40	-36	-31	12
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-0	-0	-0	-0	-0	-0	-0	-1	-1	-1	-1
Construction	15	-6	-6	-6	-6	15	-6	-6	-5	-5	17
Durable Goods	2	-0	-1	-1	-1	2	-1	-1	-1	-0	2
Non-Dur Goods	-1	-1	-1	-1	-1	-0	-1	-1	-0	-0	-0
Tran & Util	-2	-2	-3	-3	-3	-3	-4	-4	-4	-4	-3
Finan, Ins & RE	-2	-3	-3	-3	-3	-1	-3	-2	-2	-2	-0
Wholesale	4	-2	-2	-2	-2	4	-2	-2	-2	-2	4
Retail	-14	-13	-14	-13	-13	-11	-13	-11	-10	-8	-7
Services	-10	-16	-16	-15	-15	-5	-14	-12	-10	-8	1
State & Loc Govt	-2	-2	-2	-2	-2	-1	-2	-2	-2	-1	-1
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	-2	-2	-2	-1	0	-2	-2	-1	-1	-0	-25
Real Disp Inc	-2	-2	-2	-2	1	-2	-2	-1	-1	-0	-31
Employment	-29	-25	-20	-14	28	-14	-12	6	7	14	-393
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
Construction	-4	-4	-4	-3	19	-3	-3	-1	-1	17	14
Durable Goods	-0	-0	-0	-0	2	-0	-0	-0	-0	2	3
Non-Dur Goods	-0	-0	-0	0	0	0	0	0	1	-0	-5
Tran & Util	-4	-4	-4	-5	-4	-5	-5	-5	-5	-5	-81
Finan, Ins & RE	-1	-1	-1	-0	1	-0	-0	1	1	0	-25
Wholesale	-2	-2	-2	-1	4	-2	-2	-1	-1	3	-8
Retail	-7	-6	-5	-3	-1	-3	-2	3	4	-6	-152
Services	-6	-5	-3	-0	9	1	2	9	10	4	-99
State & Loc Govt	-1	-1	-1	-1	-0	-1	-1	-0	-0	-1	-26
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	**Sum of All Years**	**Net Present Value**
Gross Reg Prod	-25.4	-16.6
Real Disp Inc	-31.2	-21.3
Employment	-393	-304

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO: Wind 4: High Growth, Low Construction Cost, Low O&M Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	-3	-0	-0	-0	-0	-9	-0	-1	-0	-0	-10
Real Disp Inc	-5	-0	-0	-0	-0	-15	0	-0	0	0	-16
Employment	-109	-3	-5	-3	-4	-301	15	10	21	24	-317
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-0	-0	-0	-0	-0	-1	-1	-1	-1	-1	-1
Construction	2	-1	-1	-1	-1	5	1	0	2	2	2
Durable Goods	1	-0	-0	-0	-0	3	-0	-0	-0	-0	2
Non-Dur Goods	-2	0	-0	0	0	-7	1	0	1	1	-7
Tran & Util	-5	-1	-1	-1	-1	-13	-3	-3	-3	-3	-16
Finan, Ins & RE	-9	-0	-0	-0	-0	-24	1	1	2	2	-24
Wholesale	0	-0	-0	-0	-0	1	-0	-1	-0	-0	-0
Retail	-44	-1	-1	-1	-1	-119	6	4	7	8	-123
Services	-48	0	-1	0	-0	-131	10	9	13	14	-134
State & Loc Govt	-5	-0	-0	-0	-0	-15	0	0	1	1	-16
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	1	0	1	1	-11	2	1	2	2	-10	-37
Real Disp Inc	2	1	2	2	-16	4	3	5	4	-16	-46
Employment	63	53	65	69	-312	114	98	130	122	-294	-566
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2	-22
Construction	6	5	6	7	2	12	10	14	13	4	89
Durable Goods	0	0	0	0	2	0	0	1	1	2	12
Non-Dur Goods	2	1	2	2	-6	3	2	3	3	-6	-9
Tran & Util	-4	-5	-4	-4	-19	-6	-7	-5	-5	-20	-130
Finan, Ins & RE	5	4	5	5	-24	9	8	10	9	-22	-41
Wholesale	1	0	1	1	-1	1	1	2	2	-1	5
Retail	21	18	22	23	-120	37	33	42	40	-115	-264
Services	32	28	33	35	-128	55	50	61	58	-119	-163
State & Loc Govt	2	2	2	2	-16	4	3	4	4	-15	-43
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

IOWA STATE IMPACT OF ENERGY POLICIES
SCENARIO: Wind 5: High Level, Mid Construction Cost, High O&M Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	-39	-4	-4	-4	-4	-3	-2	-1	-1	-0	0
Real Disp Inc	-64	-4	-5	-4	-5	-3	-2	-0	0	1	2
Employment	-1333	-43	-63	-45	-54	-21	1	38	45	67	82
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Construction	32	-8	-11	-8	-9	-5	-3	2	3	5	7
Durable Goods	13	-1	-1	-1	-1	-1	-1	-0	-0	-0	0
Non-Dur Goods	-30	-0	-0	-0	-0	0	1	1	2	2	2
Tran & Util	-53	-11	-12	-11	-12	-11	-11	-10	-10	-9	-9
Finan, Ins & RE	-106	-1	-3	-2	-2	0	2	4	4	6	7
Wholesale	6	-4	-4	-4	-4	-3	-3	-1	-1	-0	0
Retail	-536	-10	-15	-10	-13	-3	4	15	17	24	28
Services	-590	-3	-10	-4	-7	5	15	29	32	40	45
State & Loc Govt	-67	-2	-3	-3	-3	-2	-1	1	1	2	2
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	0	0	0	1	1	1	1	2	2	2	-53
Real Disp Inc	2	2	2	3	3	3	3	5	4	4	-53
Employment	83	82	93	105	116	111	105	138	131	135	-224
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-46
Construction	7	7	9	10	11	11	10	14	13	14	112
Durable Goods	0	0	0	0	0	0	0	1	0	1	9
Non-Dur Goods	2	2	2	3	3	3	3	3	3	3	5
Tran & Util	-8	-9	-8	-8	-8	-8	-9	-7	-7	-7	-238
Finan, Ins & RE	7	7	8	8	9	9	9	11	10	10	-3
Wholesale	0	0	0	1	1	1	1	2	2	2	-9
Retail	29	28	32	35	39	37	36	45	43	44	-132
Services	46	46	50	55	59	57	55	67	65	66	118
State & Loc Govt	2	2	3	3	4	4	3	5	4	5	-39
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	-52.8	-54.3
Real Disp Inc	-52.5	-67.8
Employment	-224	-889

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO: Wind 6: High Level, High Construction Cost, High O&M Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	-48	-4	-4	-4	-4	-3	-2	-1	-1	-0	0
Real Disp Inc	-79	-4	-5	-4	-5	-3	-2	-0	0	1	2
Employment	-1675	-43	-63	-45	-54	-21	1	38	45	67	82
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Construction	46	-8	-11	-8	-9	-5	-3	2	3	5	7
Durable Goods	17	-1	-1	-1	-1	-1	-1	-0	-0	-0	0
Non-Dur Goods	-38	-0	-0	-0	-0	0	1	1	2	2	2
Tran & Util	-64	-11	-12	-11	-12	-11	-11	-10	-10	-9	-9
Finan, Ins & RE	-134	-1	-3	-2	-2	0	2	4	4	6	7
Wholesale	10	-4	-4	-4	-4	-3	-3	-1	-1	-0	0
Retail	-678	-10	-15	-10	-13	-3	4	15	17	24	28
Services	-747	-3	-10	-4	-7	5	15	29	32	40	45
State & Loc Govt	-84	-2	-3	-3	-3	-2	-1	1	1	2	2
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	0	0	0	1	1	1	1	2	2	2	-62
Real Disp Inc	2	2	2	3	3	3	3	5	4	4	-68
Employment	83	82	93	105	116	111	105	138	131	135	-566
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-46
Construction	7	7	9	10	11	11	10	14	13	14	125
Durable Goods	0	0	0	0	0	0	0	1	0	1	13
Non-Dur Goods	2	2	2	3	3	3	3	3	3	3	-3
Tran & Util	-8	-9	-8	-8	-8	-8	-9	-7	-7	-7	-249
Finan, Ins & RE	7	7	8	8	9	9	9	11	10	10	-31
Wholesale	0	0	0	1	1	1	1	2	2	2	-6
Retail	29	28	32	35	39	37	36	45	43	44	-274
Services	46	46	50	55	59	57	55	67	65	66	-40
State & Loc Govt	2	2	3	3	4	4	3	5	4	5	-57
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	Sum of All Years	Net Present Value
Gross Reg Prod	-61.9	-63.5
Real Disp Inc	-68.2	-83.5
Employment	-566	-1231

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO: Wind 7: High Level, High Construction Cost, High O&M Cost

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Results (1995 $)											
Gross Reg Prod	-10	-7	-8	-8	-8	-7	-7	-7	-7	-7	-6
Real Disp Inc	-14	-10	-12	-11	-11	-10	-10	-10	-9	-9	-9
Employment	-250	-173	-204	-185	-194	-167	-172	-162	-156	-148	-141
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Construction	-19	-9	-13	-11	-12	-9	-9	-8	-7	-6	-5
Durable Goods	-1	-0	-1	-0	-1	-0	-0	-0	-0	-0	-0
Non-Dur Goods	-4	-3	-3	-3	-3	-3	-3	-3	-3	-2	-2
Tran & Util	-19	-15	-17	-16	-16	-15	-15	-15	-15	-15	-15
Finan, Ins & RE	-16	-12	-13	-12	-13	-11	-11	-11	-10	-10	-9
Wholesale	-7	-4	-5	-4	-5	-4	-4	-4	-3	-3	-3
Retail	-82	-59	-68	-63	-65	-57	-59	-56	-54	-51	-49
Services	-87	-60	-71	-64	-67	-58	-59	-56	-53	-50	-47
State & Loc Govt	-12	-9	-10	-9	-10	-8	-9	-8	-8	-8	-7
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
Results (1995 $)											
Gross Reg Prod	-6	-6	-6	-6	-6	-6	-7	-5	-6	-6	-144
Real Disp Inc	-9	-9	-9	-8	-8	-9	-9	-7	-8	-7	-197
Employment	-140	-140	-139	-136	-134	-140	-145	-114	-120	-117	-3279
Employment by Sector											
Agriculture/Farm	0	0	0	0	0	0	0	0	0	0	0
Mining	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-45
Construction	-5	-5	-5	-5	-5	-5	-6	-2	-3	-2	-153
Durable Goods	-0	-0	-0	0	0	-0	-0	0	0	0	-3
Non-Dur Goods	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-53
Tran & Util	-15	-15	-15	-15	-15	-15	-15	-14	-14	-14	-319
Finan, Ins & RE	-9	-9	-9	-9	-9	-9	-10	-8	-8	-8	-217
Wholesale	-3	-3	-3	-3	-3	-3	-3	-2	-2	-2	-75
Retail	-49	-49	-49	-48	-47	-49	-50	-41	-43	-42	-1132
Services	-47	-47	-47	-45	-45	-46	-48	-37	-39	-38	-1114
State & Loc Govt	-7	-7	-7	-7	-7	-7	-8	-6	-7	-6	-168
Federal Govt	0	0	0	0	0	0	0	0	0	0	0

TOTAL EFFECTS	**Sum of All Years**	**Net Present Value**
Gross Reg Prod	-143.7	-94.0
Real Disp Inc	-197.0	-129.4
Employment	-3279	-2176

Fuel Cost Results

One way to model the effects of a change from conventional to renewable energy is to estimate the effects on fuel costs and enter this into the model. However, the combination of relatively low potential penetration and small enough cost differences between conventional and renewable energy meant that even for the high penetration cases, there was little effect on electricity costs. However, we thought it would be worth exploring the effects of a radical change in electricity costs on the Iowa economy to get a sense of what would happen if a very ambitious or very costly renewable energy program were instituted. To test this, we ran two scenarios. In the first one, we model the effects of a 10% increase in the price of electricity to industrial consumers; in the second, the effects of a 10% increase to commercial consumers.

The results show that if electricity costs to commercial consumers were to increase by 10%, there would be a job loss of around 1,500 per year and a decline in Gross State Product (GSP) of $30 million to $180 million. A similar increase to industrial users would decrease jobs by 500/year and GSP by $5 million to $75 million. We can reasonably say, then, that an increase in electricity costs of 10% to commercial and industrial consumers together would decrease the number of jobs in the state by roughly 2000 / year and GSP by roughly $150 million per year.

4.8 References

Beck, S.R., and H.W. Parker. 1979. Assessment of Energy from Biological Processes. Draft report to Office of Technology Assessment, United States Congress. Washington, D.C.: OTA

Blyth, J.E., J. Tibeen, and W.B. Smith. 1984. Primary Forest Products Industry and Timber Use, Iowa 1980. USDA Forest Service, North Central Forest Experiment Station. NC-82.

Brower, Michael C. et al. 1993. Powering the Midwest. Union of Concerned Scientists

Brower, M. 1992, Cool Energy: Renewable Solutions to Environmental Problems. Cambridge, MA: The MIT Press.

Brown Robert C. et al. 1994. The Potential for Biomass Production and Conversion in Iowa. Ames, Iowa: University of Iowa.

Budtz, Lars. Vestas. 1991. V39-500 kW: The Cost Effective Turbine Design, in The Proceedings of Windpower '91. Palm Springs, CA.

Carless, Jennifer. 1993. Renewable Energy: A Concise Guide to Green Alternatives. New York: Walker Publishing Company.

Cifuentes, L.A., and L.B. Lave. 1993. "Economic Valuation of Air Pollution Abatement: Benefits from Health Effects," Annual Review of Energy and the Environment, Vol. 18, pp. 319-342.

Clark, II, E.H., J.A. Haverkamp, and W. Chapman. 1995 Eroding Soils: The Off-Farm Impacts. Washington D.C.: The Conservation Foundation. Commission of the European Communities. 1990. European Community Wind Energy Conference.

Bedford, England: H.S. Stephens & Associates. Edison Electric Institution. 1992. Statistical Yearbook of the Electric Utility Industry.

Energy Information Agency. 1994. Cost and Quality of Fuels for Electricity Utilities Plants.

Energy Information Agency. 1994. Electricity Power Annual.

Ferris, Leon L., et al. 1990. Wind Energy Conversion System. London: Prentice-Hall International(UK), Ltd.

Hamrin, Jan and Nancy Rader. 1993. Investing in the Future: A Regulator's Guide to Renewable. Washington DC The National Association of Regulatory Utility Commissioners.

Hiler, Edward A. and Bill A. Stout. 1985. Biomass Energy: A Monograph. College Station, Texas: Texas A&M University System.

Hunter, Ray and George Elliot, et al. 1994. Wind-Diesel System: A Guide to the Technology and Its Implementation. Cambridge, UK: Cambridge University press.

International Energy Agency. 1991. Guidelines for the Economic Analysis of Renewable Energy Technology Applications. Paris: OECD/IEA. Jarass, L., L.

Hoffmann, A. Jarass, and G. Obermair. 1981. Wind Energy: An Assessment of the Technical and Economic Potential. Berlin, Germany: Springer-Verlag.

Johnson, Gary L. 1985. Wind Energy Systems. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Katzman, Martin T. 1984. Solar and Wind energy: An Economic Evaluation of Current and Future Technologies. Totowa, New Jersey: Rowman & Allan held.

Lynette, Robert. 1988. "Status of the Wind Power Industry", in Advances in Windfarming, edited by G.G. Piepers. Amsterdam, The Netherlands: Elsevier Science Publishers B.V.

Miles, Thomas R., Richard W. Rryers, Larry L. Baxter, Bryan M. Jenkins, and Laurance

L. Oden. 1994. "Alkalis in Alternative Fuels," in, Combustion Modeling, Scaling and Air Toxins. American Society of Mechanical Engineering.

Moore, D.S., R.D. Lacewell, C.B. Parnell, 1982. Economic Implications of Pelleting Cotton Gin Trash as An Alternative Energy Source. TAES B- 1382. College Station, Texas: Texas Agricultural Experiment Station, Texas A&M University.

National Association of Regulatory Utility Commissioners. 1993. Proceedings of the National Regulatory Conference on Renewable Energy. Savannah, Georgia.

National Befalls Roundtable. 1994. Biomass Energy: Environment Consideration." In Principals and Guidelines for the Development of Biomass Energy Systems, n.p.

Office of Technology Assessment, U.S. Congress. 1993. Potential Environmental Impacts of Bioenergy Crop Production-Background paper. OTA-BP-E-118. Washington, DC: U.S. Government Printing Office.

Pimentel, D., C. Fried, L. Olson, S. Schmidt, K. Wagner-Johnson, A. Wesman, A. Whelan, K. Foglia, P. Poole, T. Klein, R. Sobin, and A. Bochner. 1984. "Environmental and Social Costs of Biomass Energy," BioScience, Vol, 34(February), pp.89-94.

Ramsay, William 1985. Bioenergy and Economic Development: Planning for Biomass Energy Programs in the Third World. Boulder, Colorado: Westview Press.

Risser, J. 1985. "The Other Farm Crisis," Sierra, Vol, 70(May/June), pp. 40-47.

RLA Consulting. 1995. Demonstration of Wind Turbine Operation for Utility Electricity Production in Midwest Wind regimes. Bothell, Washington.

Schiffman, Yale M. and Gregory J. D'Alessio. 1993. Limits to Solar and Biomass Energy Growth. Lexington: D.C. Heath and Company.

Wortman, Andrze J. 1983. Introduction to Wind Turbine Engineering. Woburn, MA: Butterworth Publishes.

Wright, L.L., J.H. Cushman, and P.A. Layton, 1989. "Expending the Market by Improving the Resource." Biologue, Vol 6 (June/August), pp. 12-19.

Wrixon, Gerard T., Ann-Marie E. Rooney, and Wolfgang Palz. 1993. Renewable Energy-2000. Berlin, Germany: Springer-Verlag.

Section 5: Template

5.1 Overview

There are two spreadsheet templates which have been developed for the estimation of impacts associated with alternative scenarios. These are: (1) Energy Efficiency Program Template and (2) Renewable Energy Template.

5.2 Data Entry and Analysis Steps -- Energy Efficiency

The Energy Efficiency Program Template has five basic steps, as shown below. These are accessed through separate sheets on the three-dimensional spreadsheet. Note that, on each sheet, only the shaded items are to be filled in. All other numbers and words are automatically calculated or reprinted.

(Sheet 1)-- SPENDING

Input Step 1 -- Enter the Annual Spending on energy efficiency spending stream, in constant 1995 dollars.

(Sheet 2) -- DSM PROGRAM

Input Step 2 -- Enter the mix of program spending by economic sector and end use technology. Note that this mix is set to be the same for all years. The current Iowa mix is shown here as the default values. Note that all of the figures in the Step 2 entry box together must add up to 100%.

Input Step 3 -- Enter the incentive share of total costs, for purchase and installation of each type of program measure, for each type of end use technology and each type of economic sector. The estimated current Iowa values based on valuable data for a subset of all programs, indicate that rebates cover roughly 40% of the total cost for most programs; the remaining 60% is paid by the program participants.

Input Step 4 -- Enter the average ratio of participant energy savings to annual program cost, for each type of end use technology and each type of economic sector. The estimated current Iowa values, based on available data for a subset of all programs indicates that lifetime benefits generally run at 1.5 to 3 times total lifetime program costs.

Input Step 5 -- Other Data. The "Net Benefit Lifetime" is the number of years that the energy savings will continue to accrue from any installed energy-saving measures (set at 10 yrs for this analysis). The "Benefit Loss Rate" is the proportion of accumulated energy savings which is lost annually due to failure, removal or degradation of function over time for the installed measures (set at 2% annually for this analysis). The "Cost Recovery Period" is the number of years over which the program cost is to be recovered, through higher rates paid by customers. (currently 4 years, for Iowa utility programs). The cost for each sector -- residential, commercial and industrial -- is allocated separately to that economic sector. The "Rate Impact" is to be input by the user. In addition, the box marked "cross check" shows a calculated value of rate impact estimated by the template model based on the assumption of allocating actual costs over the specified cost recovery period. (This is only a rough estimate, and does not fully account for factors such as a return on DSM investments, shared savings rewards, generation loss recovery, interest cost, etc.

(Sheet 3) -- DEFAULT ASSUMPTIONS

Optional Input Step 6 -- Profile of DSM Program Spending. This table indicates the breakdown of costs for each type of program, separately by end use and custom sector. The defaults values come from the Survey of Iowa Utilities.

The remainder of this spreadsheet are intermediate calculations of costs and savings for the residential, commercial, industrial and agricultural sectors, as well as for utilities.

(Sheet 4) -- RESULTS

The results include estimated changes in Gross State Product (labeled as Gross Regional Product for the State of Iowa), Net Disposable Personal Income and Employment, year from 1995 to 2015. Employment impacts are also broken down by Standard Industrial Classification group.

5.3 Data Entry and Analysis Steps - Renewable Power

The Renewable Energy Template has three basic input steps, as shown below.

(Sheet 1) -- CAPITAL COSTS

Input step 1 -- Enter the capital costs, timing and total payment cost (including financing)associated with the purchase of equipment and construction of facilities.

(Sheet 2) -- OPERATING & MAINTENANCE COSTS

Input step 2 -- Enter the factors in annual spending on fuels, in constant 1995 dollars.

Input step 3 -- Enter the factors in annual spending on facility operating and maintenance, in constant 1995 dollars.

(Sheet 3) -- DEFAULT ASSUMPTIONS

Optional Input Step 4: The data on in-state vs. out-of-state flows of spending on renewable power fuels, materials and facilities is input here.

(Sheet 4) -- RESULTS

The results include estimated changes in Gross State Product (labeled as "Gross Regional Product" for the state), Net Disposable Personal Income and Employment, year from 1995 to 2015. Employment impacts are also broken down by Standard Industrial Classification group.

5.3 Sample

A sample of the spreadsheets, showing input and output fields, is shown on the pages which follow:

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO 1. Full DSM Mix -- $80m/yr for One Yr.

Input Step 1. Energy Spending by Year (millions of 1995 $)

	DSM Spending		
	Utility	State	Total
1995	72	8	$80
1996	0	0	$0
1997	0	0	$0
1998	0	0	$0
1999	0	0	$0
2000	0	0	$0
2001	0	0	$0
2002	0	0	$0
2003	0	0	$0
2004	0	0	$0
2005	0	0	$0
2006	0	0	$0
2007	0	0	$0
2008	0	0	$0
2009	0	0	$0
2010	0	0	$0
2011	0	0	$0
2012	0	0	$0
2013	0	0	$0
2014	0	0	$0
2015	0	0	$0

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO 1. Full DSM Mix -- $80m/yr for One Yr.

Input Step 2. Program Spending by Type & Sector (% of Total DSMSpending

	Resid Sector	Comm Sector	Industrial Sector	Agric Sector	Instit./Govt Sector	Total
Bldg Shell	3	0	0	0	2	5 %
Lighting	12	4	2	1	4	23 %
Hot Water	14	0	0	0	0	14 %
HVAC	30	11	2	1	4	48 %
Appliance	0	0	0	0	0	0 %
Refrigeratio	0	1	0	0	0	1 %
Motors	0	0	4	0	0	4 %
Process	0	1	1	0	0	2 %
New Const	3	0	0	0	0	3 %
Total	62	17	9	2	10	100 %

Input Step 3. Incentive Share of Total (Incentive + Copayment by Partic)

	Resid Sector	Comm Sector	Industrial Sector	Agric Sector	Instit./Govt Sector
Bldg Shell	42	40	40	40	40
Lighting	45	36	36	36	36
Hot Water	45	36	36	36	36
HVAC	45	47	47	47	47
Appliance	45	38	38	38	38
Refrigeratio	45	28	28	28	28
Motors	38	38	38	38	38
Process	28	28	28	28	28
New Const	45	30	30	30	30
Wght Avg.	45	42	38	41	41

Input Step 4. Ratio of Energy Savings to Program Cost

	Resid	Comm	Industrial	Agric	Instit./Govt	Wght Avg
Bldg Shell	2.1	2.1	2.1	2.1	2.1	2.1
Lighting	1.8	4.6	4.6	4.6	4.6	3.1
Hot Water	1.9	2.5	2.5	2.5	2.5	1.9
HVAC	1.7	2.4	2.4	2.4	2.4	2.0
Appliance	1.7	3.2	3.2	3.2	3.2	0.0
Refrig	1.7	2.1	2.1	2.1	2.1	2.1
Motors	4.7	4.7	4.7	4.7	4.7	4.7
Process	4.9	6.7	6.7	6.7	6.7	6.7
New Constr	1.8	2.4	2.4	2.4	2.4	1.8
Wght Avg.	1.8	3.2	4.4	3.5	3.2	2.4

2-4 yrs. payback

Input Step 5. Other Data

			Cross-check Calc. c/kWh Rate Impact If Expensed for yr 1995
Net Benefit Lifetime ----	10	years	
Discount Rate ------------	5	percent annually	
Cost Recovery Period->	4	years	
Persistence Loss Rate-	2	percent annually	
Current Cost of Energy-	9	cents per kWh (equivalent)	
Given Rate Impact -----	0.105	cents per kWh (residential)	0.211
	0.085	cents per kWh (commercial)	0.141

IOWA STATE IMPACT OF ENERGY POLICIES

SCENARIO: 1. Full DSM Mix -- $80m/yr for One Yr.

Input Step 6. Given Profile of Program Spending (percent in each row total)

	Admin	Marketing	M & E	Incentives	Total (sb 100)
Residential					
Bldg Shell	8	3	8	81	100 %
Lighting	13	33	5	49	100 %
Hot Water	12	25	6	57	100 %
HVAC	10	12	6	72	100 %
Appliance	12	20	6	62	100 %
Refrig	12	20	6	62	100 %
Motors					0 %
Process					0 %
New Constr.	23	6	18	53	100 %

Business (Comm., Ind., Agric., Instit/Govt)

	Admin	Marketing	M & E	Incentives	Total (sb 100)
Bldg Shell	28	7	15	50	100 %
Lighting	15	6	12	67	100 %
Hot Water	18	7	15	60	100 %
HVAC	21	8	18	53	100 %
Appliance					0 %
Refrig	16	10	12	62	100 %
Motors	43	9	17	31	100 %

ENERGY EFFICIENCY SCENARIO **1. Full DSM Mix -- $80m/yr for One Yr.**

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
GRP	32	-10	-10	-10	12	13	12	13	13	14	0
Disposable Income	19	0	0	-0	20	21	20	21	21	21	0
Total Employment	498	-60	-62	-68	272	286	280	287	294	301	0
Employment by Sector											
Agriculture	128	0	0	0	9	10	9	9	10	10	0
Mining	6	4	3	3	16	17	16	16	16	16	0
Construction	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	0
Durable goods	15	-28	-27	-27	-7	-5	-5	-4	-3	-3	0
Non-durable goods	-13	-43	-43	-42	-30	-28	-27	-26	-25	-24	0
Transport	18	1	1	0	20	21	20	21	21	21	0
FIRE	62	-5	-6	-7	67	70	69	70	72	73	0
Wholesale	13	-8	-8	-8	3	4	4	4	4	5	0
Retail	233	6	5	2	127	130	128	130	132	134	0
Services	0	0	0	0	2	2	2	2	2	2	0
State & Loc Gov't	38	15	14	13	67	68	66	67	68	68	0
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL
GRP	0	0	0	0	0	0	0	0	0	0	80
Disposable Income	0	0	0	0	0	0	0	0	0	0	144
Total Employment	0	0	0	0	0	0	0	0	0	0	2029
Employment by Sector											
Agriculture	0	0	0	0	0	0	0	0	0	0	186
Mining	0	0	0	0	0	0	0	0	0	0	113
Construction	0	0	0	0	0	0	0	0	0	0	-19
Durable goods	0	0	0	0	0	0	0	0	0	0	-96
Non-durable goods	0	0	0	0	0	0	0	0	0	0	-303
Transport	0	0	0	0	0	0	0	0	0	0	146
FIRE	0	0	0	0	0	0	0	0	0	0	466
Wholesale	0	0	0	0	0	0	0	0	0	0	14
Retail	0	0	0	0	0	0	0	0	0	0	1026
Services	0	0	0	0	0	0	0	0	0	0	13
State & Loc Gov't	0	0	0	0	0	0	0	0	0	0	483
Federal Gov't	0	0	0	0	0	0	0	0	0	0	0
Farm Emp	0	0	0	0	0	0	0	0	0	0	0

APPENDIX A

INVENTORY OF IOWA DSM PROGRAMS

By Hagler Bailly Consulting

For the Iowa Dept. of Natural Resources

December, 1995

Inventory of Iowa DSM Programs

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
IES INDUSTRIES									
	ACTIVE AUDIT	AEHLW	3,809	0	0		2,694,000	673,000	1,537,000
	EQUIPMENT REBATE	AHLW	7,000	0	0	0	1,970,000	1,056,000	2,651,000
	LOW INCOME WEATHERIZATION	AEHLW	402	0	0	0	608,000	90,000	713,000
	A/C CYCLING	U	3,334	0	0	0	2,500	0	1,302,000
	NEW CONSTRUCTION	AEH	337	0	0	0	122,000	6,000	248,000
	TIME OF DAY PRICING	U	420	0	0	0	0	0	600,000
	C/I EQUIPMENT REBATE	AHM	0	2,060	516	0	40,040,000	100,000	3,496,000
	INDUSTRIAL PROCESS	P	0	6	17	0	4,500,000	0	717,000
	TIME OF DAY PRICING	U	0	1,340	340	0	0	0	595,000
	INTERRUPTIBLE PRICING	U	0	2	3	0	0	0	121,000
	TREE PLANTING		0	0	0	0	0	0	395,000
			15,302	**3,408**	**876**	**0**	**49,936,500**	**1,925,000**	**12,375,000**
INTERSTATE POWER COMPANY									
I	SECURITY LIGHT CHANGEOUT.	L	98	99	0	0	68,000	0	16,316
I	STREET LIGHTING. THE	L	0	0	0	270	127,000	0	517
I	INDUSTRIAL/ AGRICULTURAL	O	4	249	1		3,293,000		900,172
I	HIGH EFFFICENCY AC & ASHP.	A	1,516	114	0	1,624	90,000	0	524,009
I	WATER HEATER WRAP/	LW	1,310	0	0	0	112,000	0	107,353
I	C/I EFFIC LIGHTING/ SWITCH &	L	0	520	0	0	10,868,000	0	1,079,586
I	GROUND COUPLED HEAT PUMP.	AH	20	7	1	0	(235,000)	0	216,459
I	LOW INCOME WEATHERIZATION.	E	49	0	0	0	0	0	51,019
I	TIME OF USE PRICING.	U	0	27	7	3	0	0	0
I	HIGH EFFIC GAS FURNACE	H	845	89	0	0		918,999	629,206
I	INTERRUPTIBLE PRICING	U	0	0	27	0	0	0	18,806
	LOW INCOME ENERGY	LW	95	0	0	5	23,000		23,687

Inventory of Iowa DSM Programs

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
	A/C AND WH CYCLING (DLC)	AW	23,46						3,349,167
	BULBS COMPONENT (DLC)	L	6,474				589,000		
	GRANT			64			5,633,000	61,184	0
			33,874	**1,169**	**36**	**1,902**	**20,568,000**	**980,183**	**6,916,297**

IOWA DNR

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
	ENERGY BANK PROGRAM -State	AWHLO				390	1,609,000		8,924,000
			0	**0**	**0**	**390**	**1,609,000**	**0**	**8,924,000**

IOWA-ILLINOIS GAS & ELECTRIC COMPANY

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
I	RESIDENTIAL WEATHERIZATION	EWL	1,058				671,019		1,647,968
I	RESIDENTIAL HIGH EFF. EQUIP	AHW	1,832				634,001		2,544,610
I	RESIDENTIAL LOW INCOME	ELW	79				40,285		294,056
I	RESIDENTIAL	AHW	441				152,374		869,737
I	NON-RES. SHOPPING LIST	AHLMR		270			4,798,803		915,956
I	NON-RES. CUSTOMIZED	AHLMRP		126			502,772		583,139
I	NON-RES. INDUSTRIAL	P			18		2,030,785		297,976
I	NON-RES. NEW BUILDING	AEHLRW					39,286		191,154
I	GAS: RES. WEATHERIZATION	EW	4,231					422,268	
I	GAS: RES. HIGH EFF. EQUIP	HW	7,329					713,827	
I	GAS: RES. LOW INCOME	ER	317					40,145	
I	GAS: RES. NEW CONSTRUCTION	HW	1,762					198,788	
I	GAS: NON-RES. SHOPPING LIST	EHMW		67				58,422	
I	GAS: NON-RES. CUSTOMIZED	EHWP		31				57,017	
I	GAS: NON-RES. INDUSTRIAL	PW			5			9,443	

Inventory of Iowa DSM Programs

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
I	GAS: NON-RES. NEW BUILDING	EHW							
			17,049	494	23	0	8,869,325	1,499,910	7,344,596
	MIDWEST GAS								
	EFFICIENT EQUIPMENT		2,852					293,865	1,062,978
	EFFICIENT CONSTRUCTION			4				28,790	139,987
	BUILDING SYSTEMS DIRECT			209				3,187,768	852,651
	BUILDING SYSTEMS CUSTOM			47				428,321	473,282
	CUSTOM PROCESS				9			1,115,376	193,824
	INTERRUPTIBLE RATE			3				0	2,065,518
	TREES FOR TOMORROW							0	165,863
	MISCELANEOUS							0	86,046
	HOUSE CALL PROGRAM		2,902					361,554	680,249
	LOW INCOME WEATHERIZATION		654					335,004	248,932
	ROCK VALLEY PROJECT							0	63,021
	ASSESSMENTS							0	328,428
			6,408	263	9	0	0	5,750,678	6,360,779
	MIDWEST POWER								
I	APPLIANCE EFFICIENCY -	AHW	9,981	0	0	0	8,050,279		2,269,665
I	EFFICIENT ENERGY MOTORS -	M	0	0	25	0	293,984		106,281
I	TOU COST RECOVERY -	U	4,000	0	0	0	1,195,493		2,213,450
I	DLC OF AIR CONDITIONERS -	A	6,500	0	0	0	63		1,596,060
I	SMALL C/I SERVICES - Small	AHRWL	0	0	0	0	12,156		22,250
I	COMMERCIAL COOLING - C/I	A	0	340	81	0	1,018,707		384,902
I	TREE PLANTING - Shade trees to	E	0	0	0	0	0		176,860
I	COMMERCIAL LIGHTING -	L	0	1,492	0	0	18,436,691		2,057,285

Inventory of Iowa DSM Programs

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
I	HVAC OPTIONS - Promotion of	AEHRW	0	22	5	0	661,960		273,220
I	INTERRUPTIBLE/CURTAILMENT -	U	0	6	24	0	418,020		4,649,510
I	GUARANTEED SAVINGS -	LWAMEH	0	28	0	0	988,401		188,413
I	EFFICIENT COMM. CONSTR -	EALWHR	0	7	0	0	0		75,252
I	CUSTOM PROCESS - Promotion of	P	0	0	0	0	207,574		44,490
I	LOW INCOME	AEHLRW					413,773		269,120
I	COGENERATION ASSIST.	U					0		38,830
I	STREETLIGHT REPLACEMENT	L					7,177,506		866,004
I	ASSESSMENTS - COSTS	U					0		30,780
I	ASSESSMENTS - IA NRG &	U					0		318,990
	RESIDENTIAL AIR CONDITIONER		2,650				0		912,207
	RESIDENTIAL APPLIANCE		1,330				748,594		370,034
	ENERGY FITNESS PROGRAM		17,43				2,669,756		332,241
	LOW INCOME WEATHERIZATION		1,233				3,099,074		231,242
	COMMERCIAL LIGHTING			324			16,433,750		754,265
	INTERRUPTIBLE/CURTAILMENT				4		0		542,145
	ENERGY EFFICIENT MOTORS			34			1,054,907		103,082
	COMMERCIAL CHILLERS			8			431,741		131,326
	COMMERCIAL AIR			188			533,904		108,512
	COMMERCIAL HVAC OPTIONS			16			407,160		133,641
	CUSTOM PROCESS				3		5,700,000		130,724
	STREETLIGHT REPLACEMENT					1,808	3,527,152		445,839
	TREES FOR TOMORROW						0		184,731
	MISCELANEOUS						0		90,564
	ROCK VALLEY PROJECT						0		61,024

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
	ASSESSMENTS						0		276,640
			43,133	2,465	142	1,808	73,480,645	0	20,389,579
MUNICIPAL UTILITIES									
	COMMERCIAL HEAT PUMP	H							3,250
	DENSIFIED REFUSE DERIVED	O					0		69,526
	DUAL FUEL	H					876,000		49,000
	EFFICIENT LIGHTING PROGRAM	L					1,311,476		69,438
	HEAT PUMP REBATES & HEAT	H					1,800		5,800
	INDUSTRIAL GENERAL	P							14,000
	INDUSTRIAL CF LIGHTING	L					60,000		78,000
	INDUSTRIAL AUDITS	E					570,000		860
	INFRARED	E					118,699		12,654
	INSULATION	E					10,000		51,962
	LOAD CONTROL	AHW	6,799	461	0	0	32,052		334,642
	LOW FLOW	W					9,000		8,876
	LOW INCOME HOUSING	E					665,000		134,724
	RESIDENTIAL CENTRAL AIR	A					2,115		500
	RESIDENTIAL ELEC. WATER	W					19,850		541
	RESIDENTIAL ENERGY AUDIT	E	105	7	0	0	126,000		33,241
	RESIDENTIAL GAS WATER	W					0		0
	RESIDENTIAL HEAT PUMP	H					22,666		1,275
	RESIDENTIAL LOW FLOW	W					12,000		5,200
	RESIDENTIAL ROOM AIR	A					1,600		200
	RESIDENTIAL WATER HEATER	W					119,000		18,000
	STREET LIGHT RETROFIT	L					17,623,505		1,154,127
	TIME OF USE	U					275,000		25,495

Inventory of Iowa DSM Programs

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
	OTHER	HMP					5,996,554		1,619,979
	OTHER APPLIANCE REBATES	A					95,496		16,576
	SYSTEM UPGRADES	H					12,348,916		3,146,830
	OTHER MUNICIPAL PROGRAMS	AEHLMPRU					3,206,256		1,499,089
			6,904	**468**	**0**	**0**	**43,502,985**	**0**	**8,353,785**
PEOPLE'S NATURAL GAS									
I	DOMESTIC HOT WATER	W	3,331					319,776	500,994
I	CLOCK THERMOSTAT PROGRAM	HW	1,567					235,050	167,888
I	WEATHERIZATION ASSISTANCE	E	192					50,688	548,367
I	CLARKE COLLEGE	O		1					0
I	COMMERCIAL FIRM AUDIT/	HWM		28				42,588	94,859
I	INTERRUPTIBLE AUDITS	U			5				47,444
I	ENERGY CENTER	O							100,500
I	TREE PLANTING	E							77,972
I	HEATING SYSTEM REBATE	H						17,716	264,561
			5,090	**29**	**5**	**0**	**0**	**665,818**	**1,802,585**
RURAL ELECTRIC COOPERATIVES									
	DUAL-FUEL SPACE HEATING	H	6,281						373,787
	LOAD CONTROL SPACE	H	3,604				0		138,912
	DUAL-FUEL/ ELEC. THERMAL	H	208						100,301
	WATER HEATER LOAD CONTROL	W	15,61						355,207
	CROP DRYING AND IRRIGATION	OW				915	0		13,144
	INDUSTRIAL INTERRUPTIBLE	U			8		0		3,248
	GROUND SOURCE HEAT PUMP	AH	1,144				11,898,024		350,383
	AIR SOURCE HEAT PUMP	AH	1,038				3,709,878		262,290

TYPE	PROGRAM	End Uses	# Res	# Comm	# Ind	# Ag/ Other	KWh Savings	Therm Savings	Funding - 1994
	AIR QUALITY REBATE PROGRAM	AH	105				80,995		7,359
	HIGH EFFICIENCY AIR	A	2,956				3,045,908		70,384
	HIGH EFFICIENCY WATER	W	18,36				8,338,608		716,105
	HIGH EFFICIENCY ELECTRIC	H	1,105				2,466,250		42,164
	TRIPLE "E" REBATE		26				260,760		24,000
	APPLIANCES PROGRAM	ALO	5,456				0		126,269
	HIGH EFFICIENCY SECURITY	L				1,291	4,302,759		467,038
	HIGH EFFICIENCY COMMERCIAL	L		386			192,266		18,164
	MODEL HOUSING FINANCE	E	52				0		62,100
	HEATING & COOLING	AH				3,859	0		64,813
	ENERGY AUDIT SERVICES	EAHLW	8,673				0		133,596
	DOMESTIC WATER HEATERS	W	1,498				0		34,361
	ERC AND OTHER LOANS	U	1,047				0		23,601
	TIME OF USE COMMERCIAL	U		104					38,108
	TIME-OF-USE RESIDENTIAL		3				0		265
			67,173	**490**	**8**	**6,065**	**34,295,448**	**0**	**3,425,599**
UNITED CITIES GAS									
	RESIDENTIAL	W	250			250		25,440	86,750
	LOW INCOME	W	10			250		0	9,077
			260	**0**	**0**	**500**	**0**	**25,440**	**95,827**
WAVERLY LIGHT & POWER									
	ALL PROGRAMS	AEHLMOPR					2,209,136		158,000
			0	**0**	**0**	**0**	**2,209,136**	**0**	**158,000**

APPENDIX B

SURVEY OF IOWA MANUFACTURERS, DISTRIBUTORS & SERVICE PROVIDERS OF ELECTRIC, GAS & ENERGY SAVINGS PRODUCTS

By Hagler Bailly Consulting

For the Iowa Dept. of Natural Resources

December, 1995

SURVEY OF IOWA MANUFACTURERS, DISTRIBUTORS & SERVICE PROVIDERS OF ELECTRIC, GAS & ENERGY SAVING PRODUCTS

1. What types of products do you manufacture, distribute or service <u>from this location</u>? *(CIRCLE ALL THAT APPLY)*

	Manufacture	Wholesale Distribute	Design/Install Repair Service
Lamps/Ballasts	1	2	3
Stoves/Ovens	1	2	3
Refrigerators/ Freezers	1	2	3
Clothes Washers/Dryers	1	2	3
Space Heating Equipment	1	2	3
Humidifiers	1	2	3
Air Conditioning /Heat Pumps	1	2	3
Hot Water Heaters	1	2	3
Motors or Generators	1	2	3
Transformers	1	2	3
Controls	1	2	3
Insulation Materials	1	2	3
Windows and Doors	1	2	3
Other Specialized Elec. Equip.	1	2	3
(SPECIFY ______________________)			
Other Energy Saving Materials	1	2	3
(SPECIFY ______________________)			

2. What portion of the products that you manufacture, distribute or service at this location are high efficiency (i.e., energy-saving) as opposed to standard efficiency products? *(FILL IN PERCENTAGE OR CIRCLE IF NOT APPLICABLE)*

	Percentage that is <u>High Efficiency</u>	Circle if <u>not applicable</u>
Lamps/Ballasts	_____ %	1
Stoves/Ovens	_____ %	1
Refrigerators/ Freezers	_____ %	1
Clothes Washers/Dryers	_____ %	1
Space Heating Equipment	_____ %	1
Humidifiers	_____ %	1
Air Conditioning /Heat Pumps	_____ %	1
Hot Water Heaters	_____ %	1
Motors or Generators	_____ %	1
Transformers	_____ %	1
Controls	_____ %	1
Insulation Materials	_____ %	1
Windows and Doors	_____ %	1
Other Specialized Elec. Equip.	_____ %	1
(SPECIFY ______________________)		
Other Energy Saving Materials	_____ %	1
(SPECIFY ______________________)		

3. What percentage of the revenue of this facility is attributable to customers in the state of Iowa? *(FILL IN APPROXIMATE PERCENTAGE)*

_______________% *(IF YOU CANNOT ESTIMATE PERCENTAGE, CIRCLE ONE NUMBER)*

1 Nearly All
2 More Than Half
3 Roughly Half
4 Less Than Half
5 Relatively Little
6 Don't Know

4. What portion of your ***Iowa*** business revenue deals with high efficiency (i.e., energy-saving) products? *(FILL IN PERCENTAGE OR CIRCLE IF NOT APPLICABLE)*

_______________% **1 Don't Know**

What portion of your ***non-Iowa*** business revenue deals with high efficiency (i.e., energy-saving) products? *(FILL IN PERCENTAGE OR CIRCLE IF NOT APPLICABLE)*

_______________% **1 Don't Know**

5. What percentage of your sales are in the following group? *(FILL IN PERCENTAGE OR CIRCLE IF UNKNOWN)*

Sales to retail consumers	_______%	**1 Don't Know**
Sales to contractors/ installers	_______%	**1 Don't Know**
Sales to wholesale distributors	_______%	**1 Don't Know**
Sales to other resellers	_______%	**1 Don't Know**
Sales to others (TO WHOM: _______________)	_______%	**1 Don't Know**

6. What percentage of the materials and equipment you purchase come from suppliers located in Iowa? *(FILL IN APPROXIMATE PERCENTAGE)*

_______________% *(IF YOU CANNOT ESTIMATE PERCENTAGE, CIRCLE ONE NUMBER)*

1 Nearly All
2 More Than Half
3 Roughly Half
4 Less Than Half
5 Relatively Little
6 Don't Know

7. Have you heard of rebate, grant and subsidy programs which are being offered by Iowa utilities and state agencies to encourage purchases of energy-saving appliances, equipment and materials? *(CIRCLE ONE NUMBER)*

1 **Yes - definitely know about them and understand how they work**
2 **Yes - have heard that they exist but don't know much about them** — *(SKIP TO QUESTION 9)*
3 **No - have not heard specifically about them** — *(SKIP TO QUESTION 9)*
4 **Not Sure - might have heard something about them** — *(SKIP TO QUESTION 9)*

8. Has knowledge of these energy programs affected your firm's products and services? *(CIRCLE ALL NUMBERS THAT APPLY)*

1 **We are now supplying special energy-saving products & services intended for these programs.**

2 **We have normally been supplying some energy-saving products & services which may also be used for these programs.**

3 **We have been considering offering some energy-savings products & services in the future.**

4 **We have not changed our product and service offerings because of these programs.**

9. Are there any changes which you would like to see the Iowa utilities and/or state agencies make in their policies and programs regarding energy efficiency and conservation? *(CIRCLE ONE NUMBER)*

1 No
2 Yes ------------------------> What are they? *(FILL IN BLANK)* ____________________

____

____

10. Business Characteristics: *(PLEASE VERIFY OR CORRECT THE INFORMATION WHICH APPEARS ON THE LABEL)*

[AFFIX LABEL HERE]

Business Name: *(CIRCLE ONE NUMBER)*

1 **Correct**
2 **Incorrect (Correct name is:** *(FILL IN BLANK)* ____________________

Employees at this location: *(CIRCLE ONE NUMBER)*

1 **Correct**
2 **Incorrect (Correct number is:** *(FILL IN BLANK)* ____________________

Sales at this location: *(CIRCLE ONE NUMBER)*

1 **Correct**
2 **Incorrect (Correct number is:** *(FILL IN BLANK)* ____________________

Please return this form to: HBRS, Inc., 20 Park Plaza, Suite 1220, Boston MA 02116