FINAL REPORT:

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

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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 energy efficiency program scenarios 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 scenarios for renewable energy 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:

Energy Efficiency Programs

- 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

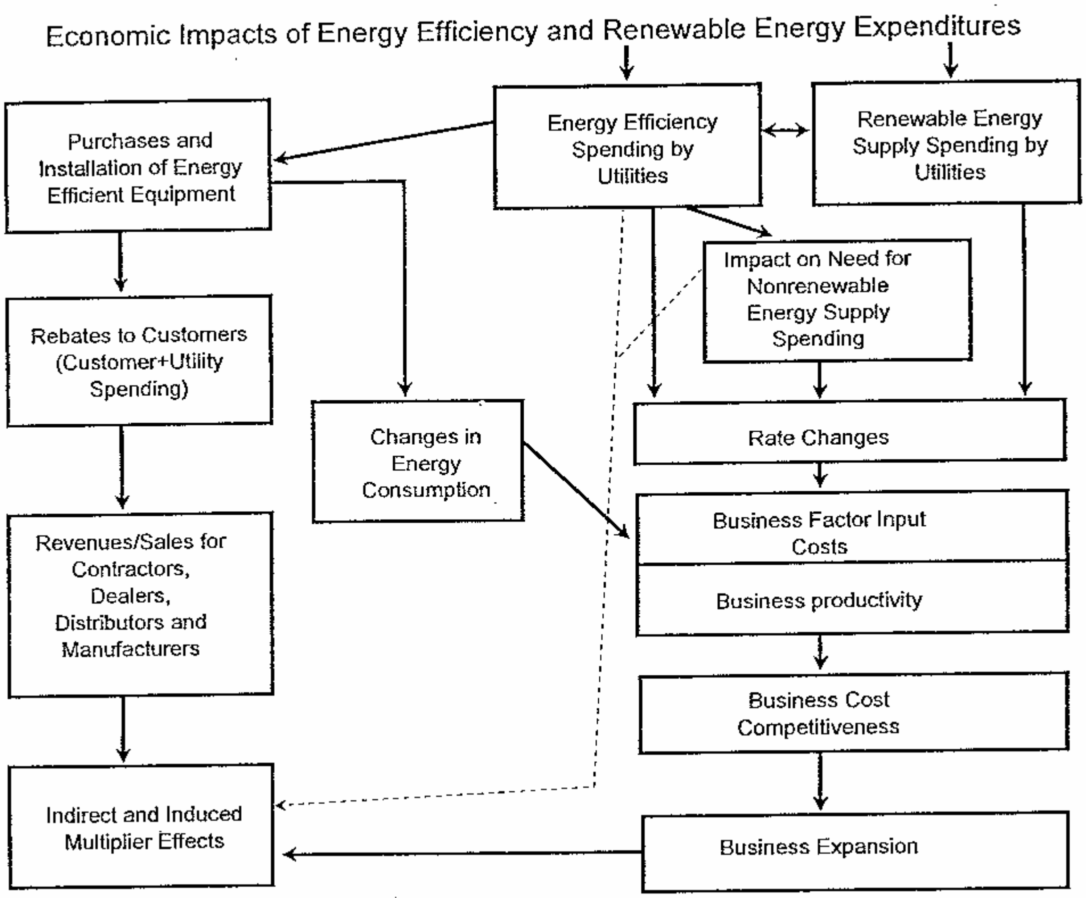
In general, energy policies and programs cause economic impacts through the following mechanisms:

- 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).


Economic Impacts of Energy Efficiency and Renewable Energy Expenditures
Purchases and Installation of Energy Efficient Equipment
Energy Efficiency Spending by Utilities
Renewable Energy Supply Spending by Utilities
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 <u>direct</u> impacts of energy-related expenditures are the purchases made to buy goods or services from specific industries. These, in turn, lead to <u>indirect</u> 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 <u>induced</u> 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 <u>leakage</u>. The percentage of overall purchases occurring within the state (i.e., not leakage) is known as the <u>regional purchase coefficient (RPC)</u>. 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?

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);

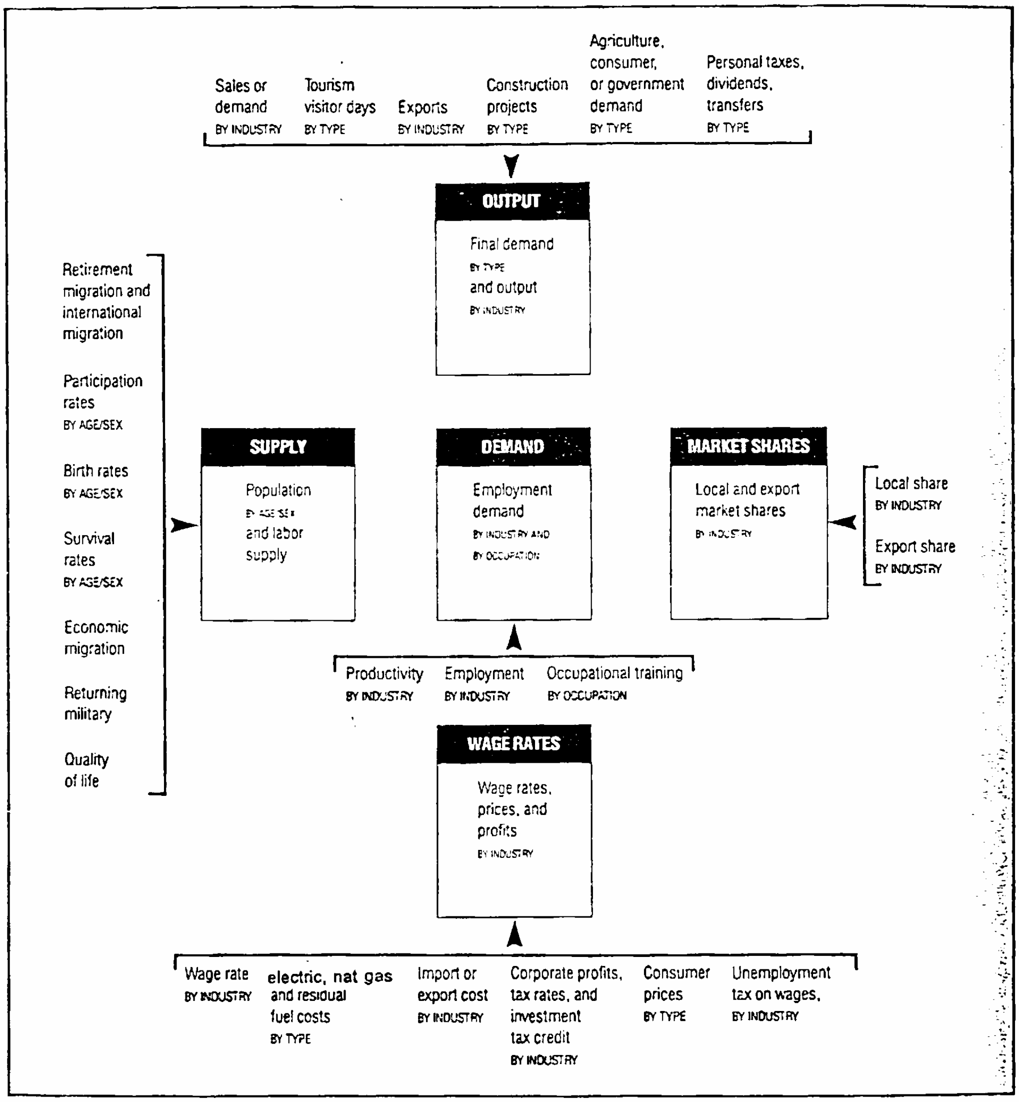
  relative differences in electrical, gas and oil fuel costs between the region and rest of the nation (and differences in fuel use by industry sector);

- 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

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.
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