MATCHING INDUSTRIAL ENERGY EFFICIENCY R&D PROGRAMS TO THE NEEDS AND CAPABILITIES OF THE STATES

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Introduction

Our client, the U.S. Department of Energy's Office of Industrial Technologies (OIT), supports R&D on energy efficient industrial technologies. In the past, it has taken from five to thirty years for R&D on more energy efficient technologies to produce measurable energy savings. (Soderstrom 1984) Often the technologies that OIT supported have required considerable post-OIT investment before they produce substantial energy savings. Thus, evaluation of OIT's programs is more complex than evaluation of the energy efficiency programs that many papers in this conference address. This paper presents only one aspect of the success of OIT's programs.

OIT's R&D program is often only one of many factors in producing industrial energy savings[1]. OIT's strategic plan recognizes this issue. It includes language stating that OIT must "formulate, execute and evaluate a national program of technology, planning, research and development for industrial energy technologies . . . ensuring that industrial energy efficiency technologies make significant contributions . . . [OIT must] evaluate prospective domestic energy demands for defining specific program activities that reflect the scientific and technical potential for energy efficient technologies . . . and [the] economic interest of industrial energy users."

This paper describes a system developed to help OIT understand how well matched its industry projects and programs are to the needs of the states' energy intensive industries. Thus, this analysis is not a traditional energy program evaluation (Soderstrom 1981). Instead, it recognizes that the success of OIT's R&D program depends on both the location of the R&D performer and the economic needs and capabilities of the state's industries. It measures OIT's success at developing a portfolio of projects that are well matched to the state's needs and capabilities. In addition, because there is new data each year, longitudinal issues can be examined.

Background

History and Description of OIT

Since 1976, OIT has conducted a national program of technology, research, development, and deployment of industrial energy efficiency technologies. Recently, OIT has aligned its R&D efforts more closely with the industries (chemicals, petroleum refining, steel, aluminum, metal casting, glass, and forest products) that consume the most energy and produce the most waste. Figure 1 shows the percentage of energy used by these seven industries. They use more than 80% of all energy (especially electricity) consumed by US industry and produce more than 80% of all industrial waste. These seven industries also spend more than $150 billion per year on energy.

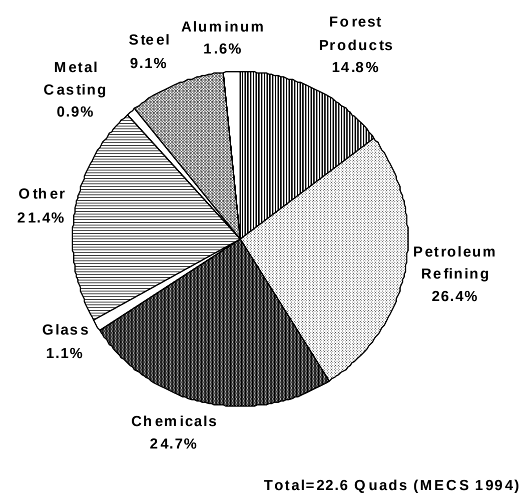


Figure 1: Energy Intensive Industries' Share of Manufacturing (End Use) Energy

The seven energy-intensive "vision" industries have been partnering with OIT and other stakeholders to achieve a consensus on their industry's future (called the industry's "vision"). The industry is typically represented by one or more trade associations as well as existing research consortia. OIT acts as a catalyst and an enabler of industry-led efforts to develop industry-wide technology road maps that implement the visions. All but the petroleum refining industry have signed compacts with DOE that outline their visions for the next century. OIT also has Technology Access programs focused on the needs of small and medium sized manufacturers. In addition to the industry-specific programs, OIT's Crosscut Technologies area works on technologies that address broader industry needs such as advanced materials and cogeneration.

[1]That is not to say that OIT program benefits are not measurable. A recent conservative estimate (DOE 1996b) is that OIT's program, between 1976-1994, returned more than $1.84 billion in net production cost savings on a $1.1 billion federal investment in R&D.

Why a State Focus?

Local, state and national policymakers are increasingly concerned with state and local economic development and quality of life issues. They would like to understand the energy intensive industries' presence in each state and what OIT R&D projects involve in state partners and/or reinforce that industry's efforts. The state information also helps OIT strengthen and build upon its existing relationships with state and local governments, universities, national laboratories and non-governmental organizations. It has also proved to be very successful in conveying the scope and direction of OIT programs and identifying its many partners. Finally, it provides a key communication tool for use by upper management and key stakeholders.

State information can also help with program design and implementation. The federal government has begun to customize its R&D programs to the needs of particular regions or even states. Working both formally and informally with state governments is often key to the success of such programs. For their part, in recent decades, state governments have been leaders in trying innovative ways to apply R&D and technology programs to solve public problems and improve the quality of life. In the 1970s, states also began to realize the importance of energy efficiency and environmental programs. In the 1980s, when states with heavy industries were rapidly losing jobs and even entire industries, a few states became leaders in deploying technologies for economic development. In the 1990s, states are beginning to integrate their various technology (economic, environment and energy) programs to maximize their benefits. States' commitment to technology is not a fad. All 50 states now have cooperative technology programs. Even during the recession of the early 1990s, two-thirds of all state technology programs continued to grow. (Berneman 1995)

Description of State Sheet Project

The state sheet project began in 1995 when OIT management was made aware of various other publications that broke down R&D and energy programs by state. (Battelle 1995, SEBC 1995). We began by collecting and revising a set of state-by-state "highlights" that describe selected OIT successes and current projects. The highlights were selected to reflect the most significant industry and university projects for that particular state. Highlights describe the partner's role in the project and provide both measured and projected energy, environmental and economic benefits. To put these highlights in context, we also provided data on OIT programs in each state such as the number of partners and the OIT funding. To do this, we had to develop a system (the "state database") to show links between more than 200 projects from OIT's seven industry areas involving partners in all 50 states.

To put the OIT portfolio in context, we also collected state industrial energy, employment, sales and facility information. The data collected for the "state sheets" form the basis for the analysis described in this paper. See Appendix 1 for a complete description of OIT's state sheets.

State Data

Data Collection Challenges

Two types of data were collected for the state sheets: internal data, including comprehensive project, partner, geographical and budget data for OIT's portfolio for a given fiscal year and external data, including state-by-state industrial data from the most current (1992) Department of Commerce's Census of Manufactures (DOC 1996) and DOE's Energy Information Administration (DOE 1995).

Since there were many partners (e.g., DOE national laboratories) that participated in many OIT projects, we realized that complete state partner and funding breakouts required a database to accommodate the "many-to-many" (project-partner) relationships. As we continued in the project, it became clear that much of the internal data still needed to be collected--especially the geographic location of partners and their fraction of the funding. DOE Headquarters data reflected the needs of program managers (PMs) (e.g., partners' phone numbers, but not city and state location) rather than those of program analysts. Even OIT's new project database, OITIS[2], did not generally provide information on allocations to subcontractors or other partners. We also realized that there was no single method to get all the state data and that we needed to develop quality indicators for the varied sources of data. (Appendix 2)

Problems encountered with the external data included industry definition and sparse data. Industry definition problems resulted in some over counting of statistics in some industries. While four of the vision industries (chemicals, petroleum refining, forest products and steel) easily mapped into 2 and 3 digit Standard Industrial Classification (SIC) codes, the other three industries (aluminum, glass and metal casting) could only be accurately described at the 4 or even 5-digit SIC code level. However, the Census of Manufacturers only provided state breakout data down to the 3-digit SIC level. For example, we used SIC 333 (Primary nonferrous metals) +335 (Nonferrous rolling and drawing) for the state breakout of aluminum. In the highlights, we could correct for the fact that some states (e.g., Kentucky) that had no aluminum industry appeared to due to a strong copper or other nonferrous metal industry. DOC also does not provide data if there are fewer than three firms reporting in a given state/industry. For many small industries in small states, the data was "not available." Finally, while the number of facilities in a given state/industry was easily verifiable, the DOC data showed that there was often substantial under reporting of sales and employment figures. In the state

[2] During the first year of our analysis, OIT commissioned its own internal project database "OITIS"-- the information system to be used by program managers.

sheets, this was addressed by indicating in parenthesis the number of facilities that actually reported data. However, in this analysis, it is taken as an additional error source. We assumed this is a reason that both the correlation and the regression analysis worked best with facility rather than sales and employment data.

Internal Data Quality Indicators

Our data quality indicators (DQIs) help us understand the possible errors introduced by varied data sources. (See Appendix 2) This data tagging has also been quite useful when we were asked to provide analysis before our data collection and verification was complete. One DQI is the "source" flag. It provides information on how, where and when it was collected and a rough quality ranking. It has been quite useful for estimating the data accuracy for a given partner, state, project or program manager and for the overall data--especially when data collection was in progress. Another internal data quality challenge is the continuing change in OIT personnel and programs. For example, in the Spring of 1996, OIT was reorganized and the Inventions and Innovations (I&I) program was added. (Brown 1997). Since the I&I program had extensive partner data in a compatible format, this was easily added to our state database. We used a special 4-digit ID series to flag I&I projects and partners.

Program Manager Verification System

All internal data were subject to our "program manager verification system" (PMVS). The first step is to associate a DOE/OIT headquarters employee with every project (and every one of the 5,000 plus database records.) We then input all the readily available data into our database to ensure that the Program Managers (PMs) need only review and correct, not enter data. We then printed out the key project and partner information in a format that was familiar to program managers and asked them to verify and supplement it. (See Appendix 3) They were to examine these printouts and mark them with changes. We also asked the PMs to simultaneously review the highlights. This often provided additional database information. This method also provided a permanent record for the data source flag. If the data appeared in another form (other than by being marked on the printout)--it was also noted on the printout by us, along with the appropriate data source. This PM-focused method had several advantages including: 1) informing the PMs of the additional data we had collected, 2) getting "buy-in" from the persons (PMs) that would be responsible for responding to public inquiries that were a result of the state sheets. Updated versions were recirculated to assure accuracy and provide for any further updating. In the second year of this system, the PM review and verification package also included a checklist. (Appendix 3). In next year's guidance, we expect to include excerpts from this paper to aid PMs in ranking the highlights and understanding the importance of the partner and funding data.

Data Quality Results

The database used for the state sheets and this analysis passed several quality tests. First we required that more than 90% of all non-zero funding records have a source flag of five or greater. By our state sheet deadline, 93% of the non-zero funding records had a source flag of five or greater. Second, we required that more than 80% of all records have a source flag of five or greater. In fact, 80% of all records have a source flag of seven or eight. We also compared the state funding totals with OIT's budget. In both the FY95 and the FY96 state data, the OIT funding by state summed to within 8% of the total used by OIT's budget analyst (In FY95, we were 4% low, in FY96, we were 8% high).

Analysis

Examination of Correlations between Internal and External Data

In trying to measure the success of OIT's matching states' needs, we began with the idea that there should be a correlation between the external data and the internal data presented in OIT's state sheets. The quantitative measures from the internal data are 1) OIT funding, 2) number of OIT partners and 3) number of projects highlighted. The external data include: 1) industrial energy expenditure, 2) vision industries' sales, 3) employment and 4) number of facilities in each state. Table 1 shows the correlation between these items for FY96 data for all 50 states.

Table 1: Correlation between Internal and External Data From OIT's State Sheets

Correlations (FY96)	Industrial Energy$	Vision Employment	Vision # Facilities	Vision Sales
OIT $	.35	.51	.57	.37
# OIT highlights	.51	.76	.69	.58
# OIT partners	.71	.85	.91	.75

Although it is a good sign that all of the correlations are positive, these correlations should not be taken too literally. For example, it is not fair to say that OIT's funding is 22% better matched to the number of vision industry facilities (correlation of .57) than to the state's industrial energy usage (correlation of .35). There is often a substantial time lag between R&D and industrial energy savings, especially for the more capital intensive technologies. It is also not surprising that the correlation between OIT funding and the external data is generally not as good as the correlation between number of partners and the external data. As discussed in the next section, the R&D capability, including the university and government laboratories in the state, is reflected in the external data. While OIT's partners are drawn from across the industries, the partners that receive OIT R&D funding are only in locations that have substantial R&D capability. The weaker correlations between industrial energy expenditures and the internal data are also easy to understand since this data includes energy expenditures from industries other than the energy intensive vision industries. The vision industry employment, facilities and sales data also include some non-vision industry components, such as copper industry statistics. Finally, the employment and sales data are often under reported, with as many as half the facilities in a given industry in a few states declining to report data.

On the other hand, the especially strong correlation between partners and facilities appears to be a real effect. Unlike abstract correlations between energy and OIT funding, the connection between facilities and partners can be understood concretely. Each industrial "partner" is typically a particular facility of a company. For example, Dow Chemical in Michigan and Dow Chemical in Texas are counted as two separate partners. To understand the implications of the .91 correlation between the number of OIT-partners per state and the number of vision industries facilities in each state, assume that there are 100,000 vision industry facilities in the 50 states, and 1,000 total OIT partners (or OIT partners comprise 1% of all vision industry facilities). This correlation says that a heavily industrial state with 10,000 vision industry facilities (10% of the U.S. total) will have 100 OIT partners +/- nine.

The next step is to develop a model based on these correlations. Since all three vision industry statistics (sales, employees and facilities) provide essentially the same information, and since the facilities data is the highest quality, we take facilities as the variable to use to model the industries in state industrial presence. We use the energy expenditures to capture the state's industrial energy intensity. The equation below predicts the combined effect of these factors.

Regression Analysis

Based on the previous section, our hypothesis is that OIT internal data can be modeled as a function of state's industrial energy need and its vision industry capability. We use the two variables 1) industrial energy expenditures, and 2) vision industry facilities to predict the OIT partners and OIT funding in the state, subject to the constraint that the predicted number of partners and total funding adds up to the same amount as the actual partners and funding. Mathematically speaking, we did a multiple linear regression analysis (Excel 1996) of the form:

$$y = m_1x_1 + m_2x_2 + b$$

where input variables are

-x_1: each of the 50 states' 1993 industrial energy expenditure
-x_2: the number of vision industry facilities in each state
-y_i: actual number of OIT partners in each of the 50 states or the actual OIT funds to partners in each of the 50 states.

output variables are

-m_1: a calculated constant that reflects the relative importance of x_1
-m_2: a calculated constant that reflects the relative importance of x_2
-b: a calculated constant that normalizes the predicted y so that the total of the predicted y values equal the total actual y.
-y_p: the predicted y's based on x_1, x_2, m_1, m_2 and b.

Figure 2 shows one of the results of one of these regression analyses for y equals partners. The regression equation produces the result that more than 89% of the state by state variation in the numbers of partners can be explained by these two variables.

The result shows that OIT's recruitment of partners is well matched to the states' basic industries and energy needs. It is important to note that more than half of the partners are in voluntary technology assistance, deployment and information type programs where no funds flow to the state partners. This may partially explain why the "partner" fit is so much better than the funding fit. We ran the same

Figure 2: Actual and Predicted Number of OIT Partners by State (R2=.89)

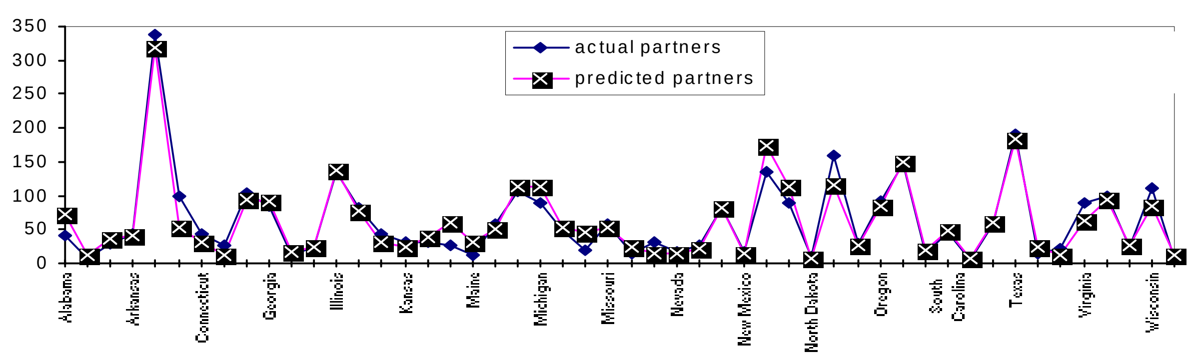
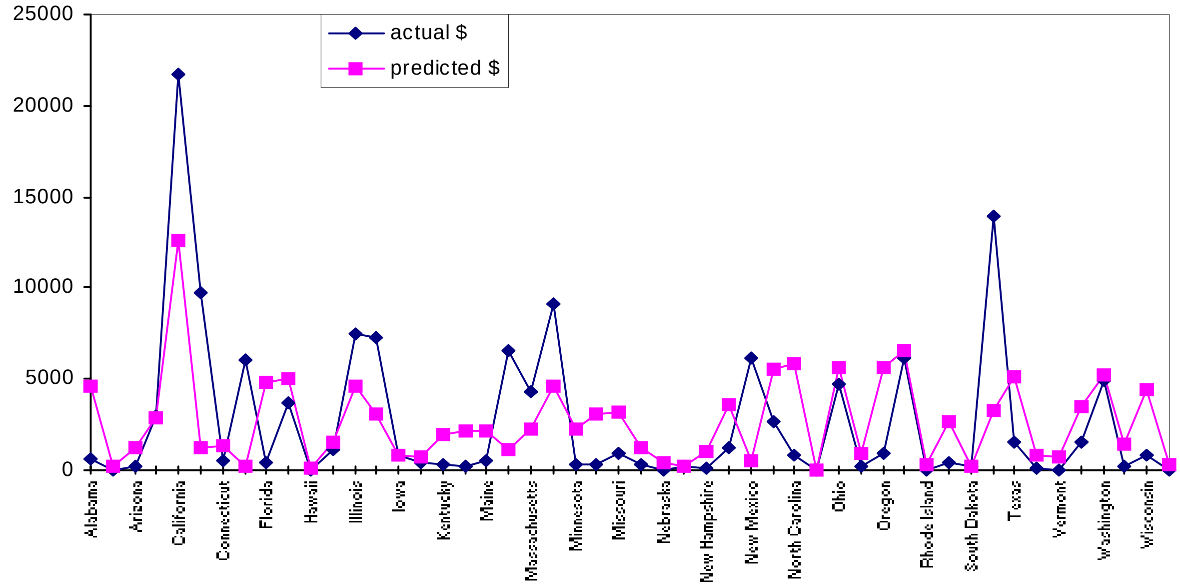


Figure 3: Actual and Predicted OIT Funding by State (R2=.38)



regression to fit y equals funding. The energy and economic data could only account for 38% of the state to state vacation. (Figure 3)

Clearly, the energy and economic data from state sheets do not fully explain the variation in OIT funding. We do know that there is a substantial error in the sales and employment data, with many facilities not reporting--or reporting in such small numbers that the Bureau of the Census is prohibited from releasing the data. However, the most likely explanation is the OIT funding reflects that the non-voluntary program (the R&D part of OIT) is where more funding flows to partners. The external data in the state sheets does not provide a good measure of the states' capabilities for R&D partnerships. Although this capability was implicit in the many highlights about OIT laboratory, university and industry R&D partners, it is not reflected in the data used in the correlations. In examining Figure 3, it is clear that all of the states for which the actual funding is substantially greater than predicted have some significant R&D capacity that is relevant to OIT. Table 2 shows the probable R&D capability factors for the 10 most anomalous states (those with the greatest absolute difference between actual and predicted funding). Under the R&D capability column, "FL" indicates that there are one or more federal laboratories in the state, "IL" indicates that there are one or more major industrial laboratories, and "UL" indicates that one or more major university laboratories that have OIT-relevant capabilities. The notes column gives the names of the largest such laboratories. The state rows that are italicized are those for which the actual funding is lower than predicted. Note that none of these appear to have federal laboratories, industrial laboratories or university laboratories with a long standing industry-orientation. However, these "underfunded" states are clearly opportunities for OIT partnerships. For example, North Carolina, in recent years, has dramatically increased both its R&D capability and its industrial activity.

Table 2: R&D Capability Factors for Top 10 Anomalous States.

State	R&D Factor	Notes
California	FL; UL	LBNL, LLNL; Stanford, UC-system, Caltech...
Colorado	FL	NREL, NIST
Delaware	IL	DuPont, Merck, Rhone- Poulnec...
Florida	--	*opportunity*
Massachu-setts	UL	MIT, Tufts, Umass...
Michigan	IL	Dow Corning&Chemical, Big Three automakers
New Mexico	FL	SNI, LANL
North Caroli-na	--	*opportunity*
Oregon	--	*opportunity*
Tennessee	FL	ORNL (and numerous industrial user centers)

Thus, when supplemented with information about R&D capability, our model provides a useful measure and ranking of OIT opportunities in the states.

Comparison with Other State Reports

State by state analysis of R&D programs, perhaps in response to concerns over cuts in R&D (especially energy and technology R&D) budgets, has become quite popular in the past few years. This section examines three different reports on R&D programs in the states. The first (Coburn 1995) focused on cooperative technology programs, especially those with federal partners mainly from DOC / NIST and DOD. The second (AAAS 1996) focuses on more basic R&D programs, especially at universities. The third (SEBC 1995) focused on energy-related R&D.

Battelle Compendium of State and Federal Cooperative Technology Programs (Coburn 1995)

In the Spring of 1993, The Office of Science and Technology Policy under the Executive Office of the President convened a conference on "Science and Technology in the States." One outcome of this effort was a comprehensive review of cooperative R&D programs in the 50 states. In addition to extensive program description and funding data, this compendium provided wide ranging industry, economic, R&D and cooperative technology program information. Of the three reports, this is by far the largest, comprising 641 pages.

Like the OIT state sheets, this report compares federal government in the state R&D expenditures to state economic characteristics. It is also designed to help program designers and stakeholders learn about the state context for its programs. The economic metrics used are more general than those used in our OIT analysis. For example, each state profile includes information on the Gross State Product (GSP) (1990) and nonagricultural Employment (October 1993). These are broken out by sectors: Agriculture, Mining, Construction, Manufacturing, Transportation, Trade, Finance, Services and Government. Each state profile also includes statistics on population (1992), Per Capita Money Income (1989), Patents (1991), Number of SBIR Grants (FY83-FY91), and University and College R&D expenditures (1991). Most states also have information such as "Institutions in the Top 100 R&D Expenditures for 1991." Since there is no one-to-one match between this external data and the program data, no correlation or regression analysis can be done. It does, however, provide useful state ranking in each of these external economic measures.

Like the other two reports (and unlike OIT) there is substantial information in addition to the state-by-state profiles. There is a lengthy foreword, a preface, an overview of all federal technology programs and several appendices. Like the AAAS, (but unlike OIT and SEBC) there is a narrative for each state that qualitatively connects the external economic data to the R&D program descriptions.

AAAS: State and Regional R&D Reports (AAAS 1996)

In January 1996, the American Association for the Advancement of Science's (AAAS) Center for Science, Technology, and Congress, undertook to produce a series of reports to provide information on the state and regional impacts of federal R&D spending. AAAS's goal is to help the industrial and academic research communities, state and federal lawmakers, and local opinion leaders to better understand the effects of current trends in public and private sector R&D spending in key regions of the U.S. AAAS is also responding to Congress and the public about the role of science and technology, including federal, state and industrial R&D, in the economies of various states. Starting in August 1996, AAAS has prepared six state and regional reports on Alaska, California, Georgia, the Midwest, New England (3/97) and the Pacific Northwest (2/97) and is in the midst of preparing a report on Florida. These reports can be found on the Center's Web site at: http:\\www.aaas.org/spp/dspp.

For the state R&D funding, AAAS used the 1993 National Science Foundation data (NSF 1996). This is the most recent data available that is broken down by state. AAAS augmented the NSF data with additional research and with projections of future government spending based on out year funding data from the President's budget request and the congressional budget resolution. The report provides a statistical portrait of the state's R&D activity; it examines the distribution of federal R&D funding in the state; it discusses university-based research and state R&D and technology development initiatives; and it assesses the potential future impacts of trends in federal, state and private sector R&D spending.

The only non-R&D number presented is the Gross State Product (GSP) which is used to normalize the state's spending on R&D for comparison with other states. For example, AAAS's Alaska report notes that only 0.5 percent of Alaska's GSP is spent on R&D compared with 2.5 percent for the nation as a whole. The overview has substantial descriptive information about the economic base of the state, but no non-R&D statistics. The bulk of the AAAS report comprises project and budget detail on research conducted in the state by industrial firms, colleges and universities, federal laboratories, the state government and other organizations. Each report has at least five tables and at least 10 charts on sources of funds, R&D performers, and R&D trends in the state. Nowhere are state specific benefits listed. AAAS concludes that the state's future will be heavily influenced by the contributions of science and engineering R&D. It cites many state-specific problems and then states: "all of these and more require the generation and application of new knowledge through research and development."

Sustainable Energy Budget Coalition (SEBC 1995)

On June 1, 1995, the SEBC released its report, "Congressional Energy Budget Proposals: Penny Wise, Pound Fuelish -- A State-by State Analysis." It included 50 state profiles of energy efficiency and renewable energy (EERE) programs in each state, EERE relevant facts, (e.g. wind capacity if relevant, notable ranking in energy use etc.) and EERE funding compared with nuclear and fossil spending. It is important to note that the SEBC is a non-profit coalition founded to promote a shift in federal energy priorities from fossil fuels and nuclear power to improved energy efficiency and renewable energy technologies. SEBC realized that EERE state-by-state funding information could be used to promote its cause to Congress. The report points out that "three quarters of the states would fare better if cuts were made in [fossil fuel, nuclear fission, and nuclear fusion program]. Organizations in every state receive DOE funding for energy efficiency and renewable energy R&D."

Like the other reports, the SEBC report comprised far more than just "state sheets." It also included a press release, an extensive list of "local co-releasers," SEBC membership list, an 8-page "summary of findings" nine pages of summary tables from the state sheets, eight pages illustrating and decrying proposed Congressional budget cuts, two pages of program description and two pages describing the study methodology. The sheets themselves are similar in structure to (and in fact were the inspiration for) the OIT state sheets. Instead of a Vision Box, there are state-specific "Energy Facts." Instead of a Partner and Total Funding Box, there is a box showing three EERE programs, the EERE total and Fossil and Nuclear R&D expenditures in the state. Instead of highlights, there are project titles and funding amounts. Unlike OIT highlights, these do not have comprehensive partner information nor do they typically present quantitative energy, environmental or economic benefits.

Conclusion and Future Efforts

We have shown that OIT's data is very well matched to the state's according to the external data chosen to put OIT's state efforts in context. The economic data presented is well aligned with OIT's portfolio, permitting the type of statistical analysis presented in this paper. We have shown that OIT's state sheets are unique in that external and internal data can be compared quantitatively. OIT's state sheets are also unique in that they link funding data to project descriptions that include estimates of specific energy, environmental and economic data.

OIT is likely to request another edition of the state sheets with FY97 data. Given that our data collection and assembly procedures are in place, the FY97 data should be available starting in late summer. Possible future improvements for the data collection include making state data collection and verification a routine year-round activity--rather than a last minute rush. Other improvements would be to integrate the partner and funding data with project data on energy, environmental and economic benefits. Doing a more traditional evaluation of OIT's success in the states would then be possible. Based on the other state analyses examined, it appears that OIT's state sheets would benefit from additional introductory narrative and state R&D and economic data. In particular, the trend analysis undertaken in the AAAS report might be useful. Finally, there will be new editions of the external data from DOC, DOE/EIA and NSF that will be included as soon as they become available.

References

AAAS, *State Reports*, http:\\www.aaas.org/spp/dspp/rd/states.html. Center for Science, Technology, and Congress. Via E-mail: congress_center@aaas.org, Washington D.C. 1996 and 1997.

Berneman, L.P., *Licencing University Research Results as an Economic Growth Springboard*, p. 164 in Technology Transfer Society Proceedings of Conference on Technology Commercialization and Economic Growth, Washington, D.C. July 16-19, 1995.

Brown, M.B., *Evaluating the Economic, Energy and Environmental Impacts of a Technology Commercialization Program.* This proceedings, August 1997.

Coburn, Christopher and Dan Berglund, *Partnerships, A Compendium of State and Federal Cooperative Technology Programs*, Battelle Press, 1995.

Excel Reference Manual, Chapter 31 "Statistical Analysis of Data"

OIT Technology Partnerships, produced for the U.S. Department of Energy by the National Renewable Energy Laboratory, February 1997.

National Science Foundation, *NSF/SRS, Survey of Federal Support to Universities, Colleges, and Nonprofit Institutions: FY 1994*, May 31, 1996 Table B-9. Federal obligations for science and engineering to universities and colleges, by geographic division, state, and agency.

Soderstrom, E.J. et al, *Evaluation of Conservation Programs: A Primer*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, July 1981, contract. No. W-7405-eng-26, ORNL/CON-76.

Soderstrom, J., E. Hirst, D. Greene, and D.L. Trimble. 1984. *Have DOE Conservation Programs Saved Money?* Eval. Rev. 8. p. 93-112.

Sustainable Energy Budget Coalition, *Penny Wise, Pound Fuelish*, June 1, 1995, Takoma Park, MD.

U.S. Department of Commerce, Bureau of the Census, 1992 Census of Manufacturers'. 1996.

U.S. Department of Energy, Energy Information Administration, "State Energy Date Report 1993", December 1995.

U.S. Department of Energy. 1996a. *Energy Conservation Trends: Understanding the Factors Affecting Energy Conservation Gains and Their Implication for Policy Development*, DOE/PO-0034, Washington, D.C.

U.S. Department of Energy, Office of Industrial Technologies, *Impacts--Summary of Results from Programs.* Washington D.C. December 1996b.

Appendix 1: State Sheet Description

There are three or four pages for each state.

Page 1 (and optional second page)

- *Industry Table:* shows the number of employees, number of facilities and sales for each OIT focus industry and totals for that state. Source: [1992 Economic Census.*]*
- *State's Industrial Sector Energy Expenditure for 1993*: the money spent by all industries in that state in 1993. [Source: Energy Information Agency].
- *OIT Partner Box:* a comprehensive list of companies, universities, non-governmental organizations, and state and local agencies that receive (or have received) OIT funding, receive services, or share tasks with OIT on projects. At the bottom of the box are sections that show:
  - the *total number of current project partners*,
  - the *OIT fiscal year 1996 funding* for that state.
- *Highlights:* descriptions of projects that match the most significant vision industry areas (either by highest amount of sales or by number of employees) for that particular state. Not all of OIT's projects in each particular state are highlighted due to space constraints. Highlights also describe OIT Crosscut programs including Continuous Fiber Ceramic Composites and Advanced Turbine Systems are two of the largest programs in this area. Other programs include: catalysts, combustion (including municipal solid waste), co-generation, bioprocessing, alternative feedstock, remanufacturing and recycling, materials and welding, and heat treatment. OIT currently has more than 350 projects. In cases where OIT did not have project partners in the state from the state's major vision industries, project descriptions were still included but labeled as opportunities. This was intended to generate interest among potential partners in that state and new project ideas.

The partner box is just a snapshot of OIT's portfolio for fiscal year 1996. The highlights are a better way to understand the relative contributions of OIT and its partners fully.

Technology Access Page

This page is divided into five sections. Each explains the in-state partners' role in the program (or providing a general description if there are no in state partners.)

1. Climate Wise,
2. Industrial Assessment Centers,
3. Motor Challenge,
4. National Industrial Competitiveness through Energy, Environment, and Economics (NICE[3]), and
5. Inventions and Innovations Program.

This area is used by OIT to: a) encourage industry to deploy underutilized energy efficient technologies or to help industry overcome the financial hurdles that prevent technologies from moving into the deployment phase (National Industrial Competitiveness through Energy, Environment, and Economics and Motor Challenge), b) address national priorities (Climate Wise), c) educate and train the nation's next generation of industry engineers and help small businesses (Industrial Assessment Centers), and d) encourage independent technological breakthroughs (Inventions and Innovations).

Contacts Page

This displays the contacts for each OIT vision industry team and technology access program leader as well as the appropriate DOE regional point of contact for the state.

The "state sheets," showing the results for each state, were published as a booklet in May 1996 (first edition) and February 1997 (second edition).

Appendix 2: Data Quality Indicators Used in the State Database

Funding Table Flags

Source Flag In general, the higher the number, the greater the reliability of the data. But all source=5+ sources are considered fairly reliable.

1 1995 Program Manager Interviews: Project dollars for all primes and subs in the target states (CO, CA, PA, TN, IL) were obtained from interviews of 16 program managers.

2 OIT budget spreadsheet

3 OITIS: OITIS is the most comprehensive source of OIT project data at this time. However, we input most of the other partner information (e.g. zip, city, state phone).

4 Public Information: DOE publications such as "Missions in the Marketplace," OIT EXPO folders, NREL's one pagers, and internal semipublic information such as weekly reports, trip reports, AOPs etc.

5 Electronic Files Technology Access and other programs with great numbers of projects and partners gave us electronic (usually Excel) files.

6 Verbal Input. PM-provided information in a meeting, over the phone, on voice mail

7 1995 PMVS verified: These are projects for which the database printout of FY95 partners and funding was returned (approved) by the designated person.

8 1996 PMVS verified: These are projects for which the database printout of FY96 partners and funding was returned (approved) by the designated person.

Status flag: Mainly used to determine if project could be a highlight and if so, what tense to use. Also for excluding projects from state totals.

1 **Active**
2 **Inactive**
3 **Terminated**
4 **Declined**
5 **Completed**
6 **Success**
7 **Planned**

Partner Table Flags

The only "flag" is the **Active** (Yes/No) flag set to no for partners that had no active or success projects. The partner ID (OrgID) also contained substantial quality information since more than 80% of the partners were input by us, we used various 4-digit series to tag the organizations. For example, I&I program partners are 7000 series, success story partners are 8000 series and so on.

All entries had a "**Last Update**" field that greatly helped quality control.

Appendix 3: OIT State Database Program Manager Review Check List

- Your project? (If a project is not yours, Please cross it out in the database printout and cross out any associated highlights)
- Verify Project ID #
- Verify Project Title
- Cross out duplicates (even those with different title)
- Correct and complete Geographical information (city, state, phone, zip, CD)
- Correct and complete partners & subs
- Verify and revise Total FY 1996 Project Funding as necessary
- Break out funding for each partner/subcontractor