Lessons learned by an international DSM database

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Synopsis

An international database on energy efficiency programs (INDEEP) has been developed. Data from 165 programs have been analysed for quantitative and qualitative key figures. Lessons learned about program management, evaluations, costs, savings, and marketing methods are presented.

Abstract

Experts from different countries, cooperating on a Task for the IEA DSM Implementing Agreement, have developed a framework to collect data on energy efficiency programs. This framework and the relevance of information was checked in two international workshops. Data for 165 Demand-Side Management programs in the USA, Europe and Korea were collected and stored in a database (INternational Database on Energy Efficiency Programs; INDEEP). The data contains information on program results and experiences, as well as the lessons learned during the design, implementation and evaluation of these programs.

Most (88%) of the programs were implemented by a utility and half of the programs (50%) offered rebates or a cash award.

In the analyses, emphasis is placed on program type, target groups, market delivery, technologies and energy savings related to costs. Any differences between expectations and final program results will be emphasised, as well as program evaluation information. In addition, qualitative information, so-called 'lessons learned' is analysed for practical suggestions. This provides experience about reasons for success or failure.

1. Introduction

Improving energy efficiency is a world-wide issue. Countries seek solutions to local and regional environmental problems, to reduce the prospect of global climate changes associated with the greenhouse effect. The main sources of CO2 emissions are energy sources such as coal, wood, oil and gas. Energy is a main input in the economic transformation process from raw material to products, for transport as well as for heating and cooling of buildings. There are several opportunities influencing this energy use. The most important one is to improve energy efficiency : to use less energy while maintaining the same degree of service. Other policies aim to increase the use of renewable energy sources or to improve the energy conversion processes. Increased energy efficiency by end-users is an objective for many organisations, governments, energy agencies, energy utilities, consulting groups, etc. Activities in this field are often described as Demand Side Management (DSM) programs. Utilities are involved in DSM programs for many reasons, one being environmental. Facing a more competitive future often with restructuring (in organisation, ownership and regulation) of the power industry and the energy distribution companies, utilities in Europe and USA are questioning the value and role of DSM. Program evaluations are already an important issue for improving cost efficiency and are expected to become even more important in the near future, as the performance and value of DSM programs is closely scrutinised due to this competitive environment. In this increasingly competitive future, continuing programs of this type are expected to be called Energy Efficiency Services (EES).

The International Energy Agency (IEA) encourages countries to bring relevant information together and to share experiences. In December 1993 an "Implementing Agreement on Demand Side Management Technologies and Programs" was signed. Fifteen IEA member countries are working together to clarify and promote opportunities for DSM. By definition, DSM programs include load management, strategic conservation and related activities. The European Commission and non-member countries (one via the World Bank) are participating, and each country participates in at least one of the working groups. Tasks under this Agreement deal with information/database, communications technologies, procurement of innovative technologies, integrating demand-side options into integrated resource planning (IRP), techniques for implementing DSM in the market and (recently) DSM in changing electricity business environments. The working group described in Annex 1 is given the task of collecting, analysing, and disseminating information on DSM programs. In order to facilitate this process and reduce the costs, the International Database on Energy Efficiency Programs (INDEEP) was developed. Austria, USA, Denmark, Republic of Korea, Spain, Sweden, the Netherlands and the European Commission decided to participate in this working group.

The development of an international database as well as its analysis is a time-consuming activity. In Section 2, we present important phases in this process. First, the common framework for data collection and analyses is shown. The selection of those variables that are essential for program evaluations is given next, and third, the data collection itself and development of the database software is presented. Section 3 starts with the lessons learned during this process and follows with the general analysis framework which was designed. Both quantitative aspects (e.g. key figures for costs, energy targets and results and participating rates) and qualitative aspects (lessons learned by program management, success and failure of marketing methods and human behaviour) are presented in Section 3.3. The last section discusses the overall conclusions for future international and national use of the evaluated data and key elements for developing and managing DSM and EES programs .

1.1 INDEEP database

The task of Annex 1 under the IEA Agreement is to establish an international database on DSM, analyse the data collected and disseminate the results. Underlying this task is the assumption that if all of this information is in one place (in the INternational Database on Energy Efficiency Programs; INDEEP), the cost of obtaining such information is considerably reduced and the potential for comparing programs and synthesising program experience is facilitated.

In the first year (May 1994-April 1995), a Data Collection Instrument (DCI) was developed, the availability of data was checked and the analysis was discussed with potential users. In the second year, the DCI was shortened, data from about 100 programs was collected and a prototype for the database was developed. By the third year, the number of programs increased to 165 and the first comprehensive analysis was carried out.

The INDEEP Database is unique because it focuses on program evaluation. Most databases typically focus on technologies(rather than programs), demonstration projects or renewable energy sources. The evaluation perspective is the key issue for data collection on targets as well as results.

1.2 DSM and Energy Efficiency Programs

Demand Side Management, by nature, changes the energy use wherever it is utilised. This change could concern the amount of energy consumption or its pattern of use. Load shifting, valley filling or peak clipping have almost immediate results, and activities that promote these changes suit the traditional electricity business organisation.

Decreasing electricity use by changing equipment is more difficult to implement because the benefits are reaped mostly by the consumer/user and only to some extent by the grid companies. Often governments support the improvement of energy efficiency, and energy utilities and other organisations can bid to develop and manage these kinds of programs. Today EES (Energy Efficiency Service) programs are turning increasingly towards market transformation; i.e. affecting the investment pattern in the market. The promotion of renewable energy sources also plays an increasing role in these EES programs. Many EES programs are managed by energy agencies, energy saving companies or by local and regional authorities, not electric utilities. Nevertheless, EES and DSM programs

will probably continue to be an important focus for utilities wanting to offer high quality service to their customers, as well as for energy efficiency and environmental reasons.

In the end, all DSM and EES programs rely on the use of market forces to improve efficiency and strengthen the market in terms of energy and economy. As a societal influence, they are strong instruments in the work for an improved environment. A kWh or a m^3 gas better used does not emit more substances and does not require more land for power plants, pumps or transmissions lines. Keeping the two oil crises in mind, it does not require specific security activities in times of crisis.

2. Data collection framework

In the early 1990s a national database on energy efficiency programs (DEEP) was set up in the USA, and a UNIPEDE working group compiled similar data from 12 countries in Europe. Two of the experts involved in developing the INDEEP database were involved in these previous projects. The experts from the countries participating in the INDEEP Task developed a data collection instrument (DCI) that was tested in a pilot and discussed with potential users in several national and two international workshops (Vienna, 1995 and Madrid, 1996).

The data is collected by national experts using the DCI. The data collecting framework is developed without initially building a database on a computer. In the first years of the project, a spreadsheet was used to store the collected data, and later on a database was developed.

2.1 Data Collection Instrument

The Data Collection Instrument (DCI), initially 20 pages long, requested very detailed program information. A field test of 14 programs gathered from the participating countries demonstrated that it was not realistic to expect to receive such detailed information. This was discussed at an international workshop with potential users who recommended the development of a four page DCI. This DCI includes:

a: Program information
Includes the implementing organisation, contacts, and a short program summary. The contact information includes a name, phone, and fax number for additional information.

b: Program type and status
Includes reasons for selecting the program (e.g. business opportunity, costs of service or reduction of global warming) and the type of program (e.g. audits, installation of conservation measure, alternative rate etc.) Furthermore, we wanted to know when the program started, if it was still ongoing or terminated, whether it has been (or will be) evaluated and the scale of the program (pilot, national or regional level).

c: Objectives
The objectives could relate to energy efficiency, load or fuel savings, and/or appliance sales.

d: Technologies
Technologies are organised in ten groups ranging from building envelope to electricity saving and within each group are more specific technologies, e.g. heat pumps, metering devices and efficient fluorescent lamps. For each technology, the payback time should also be reported.

e: Markets and marketing
The program market is related to technologies (new construction and replacement/retrofit) and, by this, a segment of customers (residential, commercial, industry and agricultural) as well as non-customers (e.g. builders, architects and retailers). Goals as well as yearly and cumulative results are collected for participant information.

Information on marketing methods (e.g. direct mailings, advertising, personal contact) and incentives (e.g. rebates, financing, gifts) is also collected.

f: Costs
Both incentive and non-incentive costs are dealt with, as well organiser and non-organiser costs. This data can be combined with participation rates and energy saving data for a measure of program cost effectiveness.

g: Savings
The yearly and cumulative electricity, demand, and/or fuel savings are given which can then be compared to saving goals. If the program is ongoing, it is the intention to update the data yearly based on new results.

h: Lessons learned
Program management are encouraged to write their experiences over the past year of the program. In particular, we were interested in successes and failures, as well as difficulties encountered in program design, financing, implementation and evaluation.

2.2 Data collection

The data collection began in 1994 by compiling information on 14 programs to be used for testing. In 1995, data was collected for about 100 programs using the 4-page DCI. The experts entered the information in spreadsheets and, after merging, began the first analysis.

To ease the data collection process, the DCI has been translated into several languages. In 1996, quality improvement in previously collected data was a main issue, apart from ongoing data collection for new programs resulting in a current total of 165 programs.

3. Results and lessons learned

3.1. Introduction

The INDEEP database forms a basis for the analysis of DSM programs, but the analysis depends on the availability of data. INDEEP should help people in their international information-seeking process in the design of new programs as well as the evaluation of existing programs. The focus of the analysis goes from a general analysis of issues for the success of marketing techniques to an in-depth analysis concerning a single technology.

3.2. General analysis framework

A framework for structuring the analysis was discussed during an international workshop with potential users such as representatives from utilities, government organisations and research institutes. In Table 3.2a this framework is presented. The first one is general background information per country on energy production, energy distribution and energy use. Information is given by country on the organisation of energy production, distribution, and use. This information is not stored in the INDEEP database, but is available in the country itself or in IEA reports.

Table 3.2a. General framework for analysis INDEEP

General information	Objectives	Program management	Impacts
Background information	Utility-specific Objectives	Type of program Implementor	Participation Rate
Information is given by country on the organisation of energy production, distribution, and use	Non-utility-specific Objectives	Energy Source Market Delivery Non-customer target group Customer target group	Energy savings Cost-effectiveness
This information is not stored in the database	Summary	Technologies	Lessons learned

In addition to this general framework, a list of organisational perspectives one could assume in analysing the data was developed:
Government: program designers, implementors, evaluators and planners
Utility companies: program designers, implementors, evaluators planners and system managers
Utility regulators: public utility commissions
Customers: residential, commercial, industrial and agricultural
Non-customer target groups: appliance manufacturers, retailers, building owners, architects and engineers, etc.
Environmental associations, consumer associations, trade unions, etc.

3.3 Results and Lessons Learned

The INDEEP Database can be used as a tool for designing and planning new DSM or EES programs as well as for evaluating existing programs by drawing comparisons to similar programs in the database. The following analysis presents the available INDEEP data including program status, evaluation status and technologies used. Marketing techniques and objectives of the programs are commented on as well as how the programs have been evaluated. Limitations of the analysis due to mixing of different technologies, marketing techniques, calculation methods, etc. are described. In Section 3.3.2, a more in-depth analysis is given of one technology group, High Efficiency Lighting Systems, comparing participation, participation rates, electricity savings, program costs, and cost-effectiveness as well as marketing techniques and lessons learned.

3.3.1 Analysis of all cases

In the beginning of 1997, 165 cases are included in the INDEEP database. Figure 3.3.1a shows 97 (59%) of the programs to be still ongoing, while 68 (41%) have been terminated. Figure 3.3.1b shows that over half of the cases have finished their evaluations, and just under a quarter are still being evaluated or have planned evaluations.

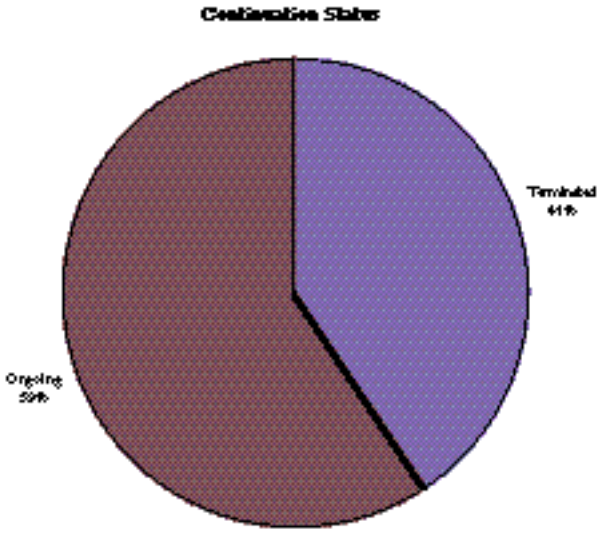

Figure 3.3.1a. Continuation Status.

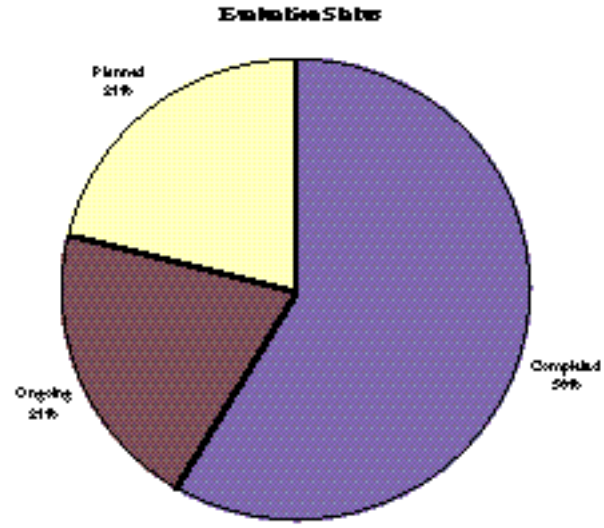

Figure 3.3.1b. Evaluation Status.

The number of programs within the database broken down by country is shown in Figure 3.3.1c.

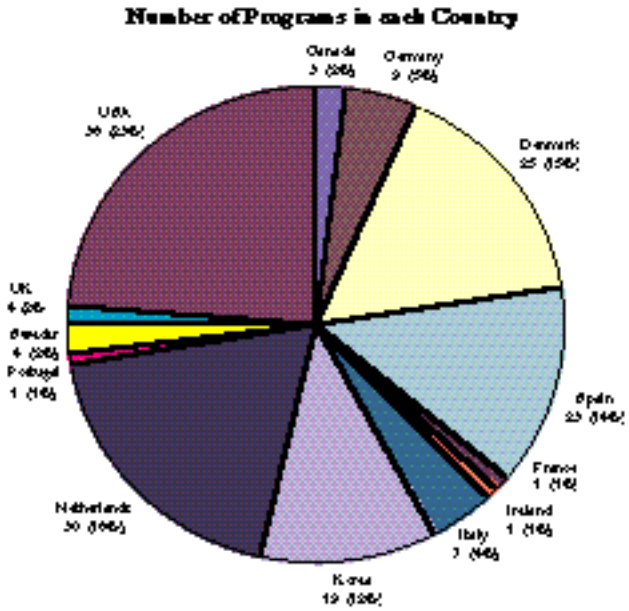

Figure 3.3.1c. Number of Programs by Country.

The majority of cases in the database were implemented by the Utility companies (88%); central governments supported 10%, and non-profit organisations, 2%. The primary object of most cases in the database (90%) is energy efficiency.

110 (67%) of the cases in the database are associated with one or more technologies. Figure 3.3.1d shows the number of cases of main technology groups in the database. Of the programs with technologies, 78 (71%) deal with electricity savings in general and 49 (45%) deal with high efficiency lighting systems. 46% (51) use a mixture of technology codes, and 14% (15) use a mixture of larger more diverse technology groups. This makes analysis difficult.

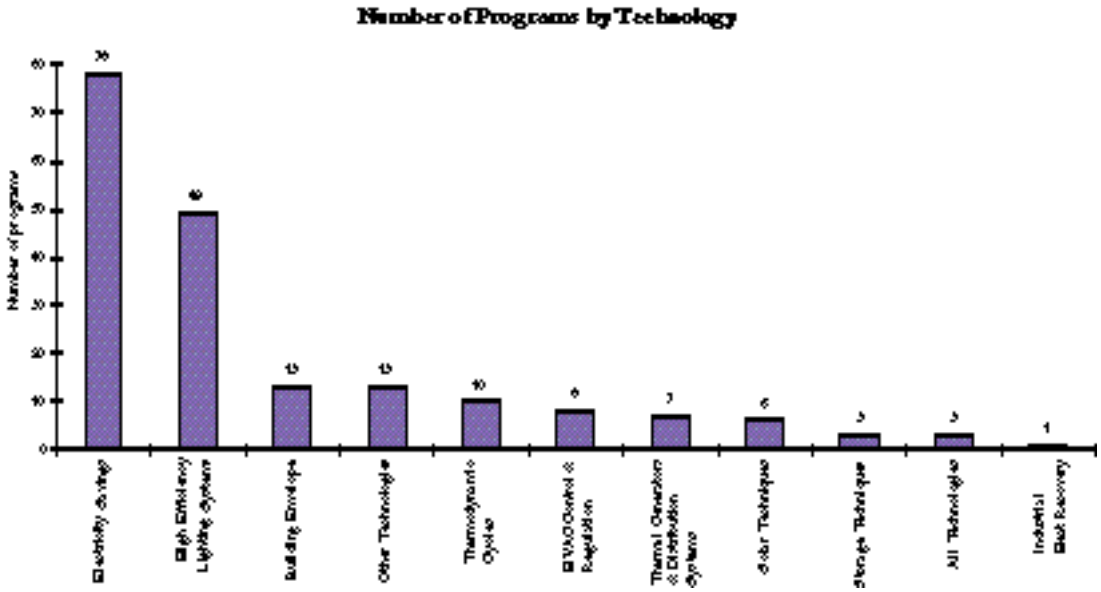

Figure 3.3.1d. Use of Technologies.

From Table 3.3.1a, it is clear that more than one marketing method is used in many of the INDEEP programs. 92% of all the programs in the database use some form of marketing method. They are often used together so participation is augmented, but it then becomes difficult to attribute increased participation to a single method.

Table 3.3.1a. Use of Marketing Methods.

Number of Marketing Methods Used	Number of Cases
0	14
1	43
2	65
3	21
4	17
5	5

According to Table 3.3.1b, usually only a single marketing incentive is used.

Table 3.3.1b. Use of Marketing Incentives.

Number of Marketing Incentives Used	Number of Cases
0	31
1	102
2	26
a3	6

Figure 3.3.1e shows the most widely used incentive in DSM programs to be rebates and cash rewards, over twice as often as any other incentive method

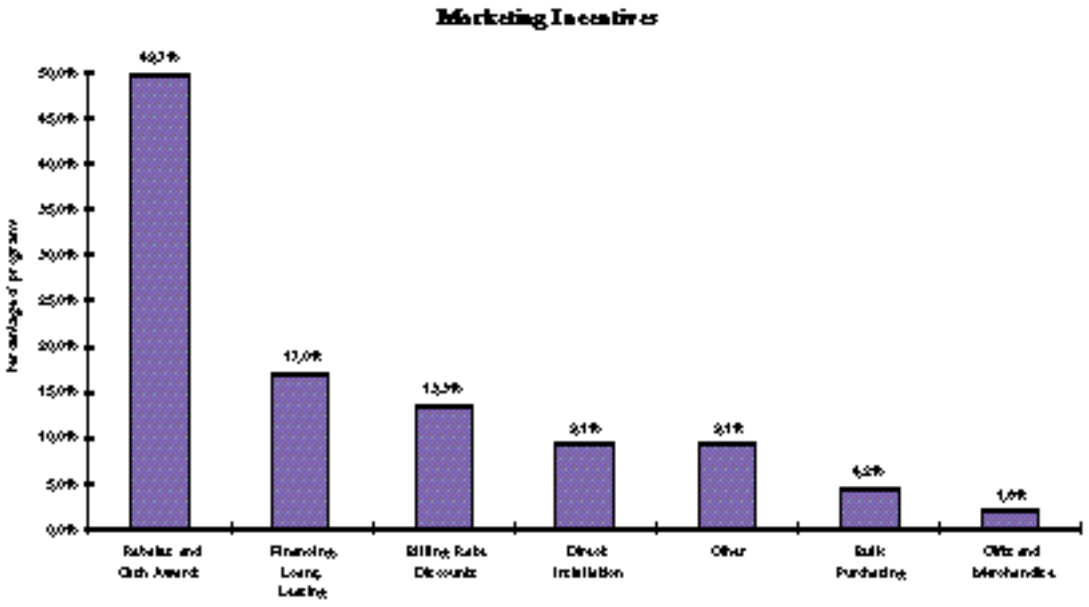

Figure 3.3.1e. Percentage of Cases vs. Marketing Incentives

No single marketing method stands out above the rest as shown by Figure 3.3.1f, but over 50% of the INDEEP cases use direct mailings or advertising to promote their programs. Personal contact is another popular marketing method which is used in 45% of the cases.

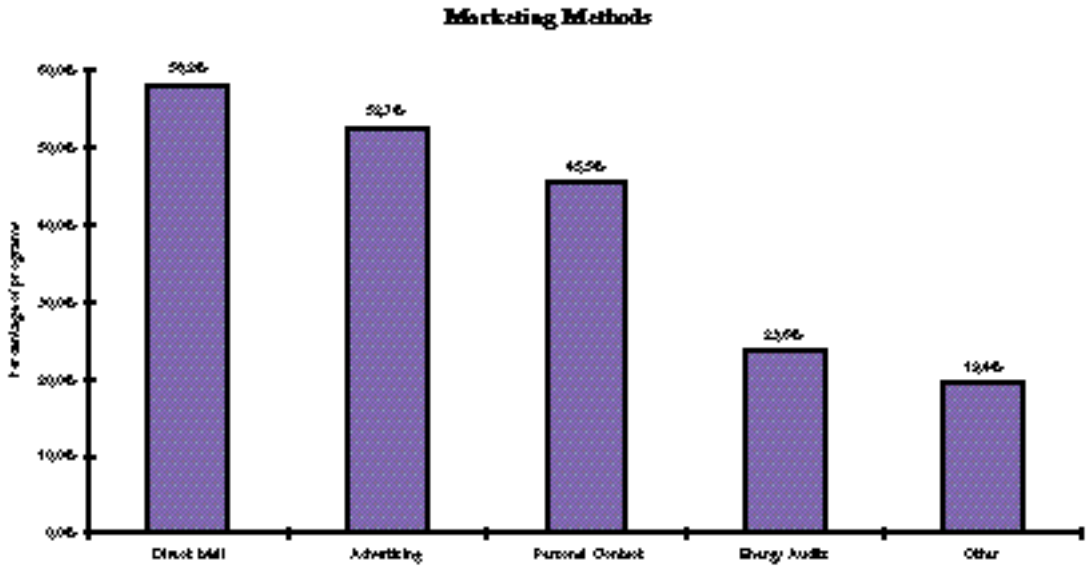

Figure 3.3.1f. Percentage of Cases vs. Marketing Methods.

An important aspect of the INDEEP database is the reliability of the energy savings data. Figure 3.3.1g shows how many cases used each type of evaluation. The most common evaluation method (46%) is using engineering data. The program evaluations often use several sources of measured data such as site-specific data (16%), equipment specifications (16%), and utility billing data (21%) in their calculations.

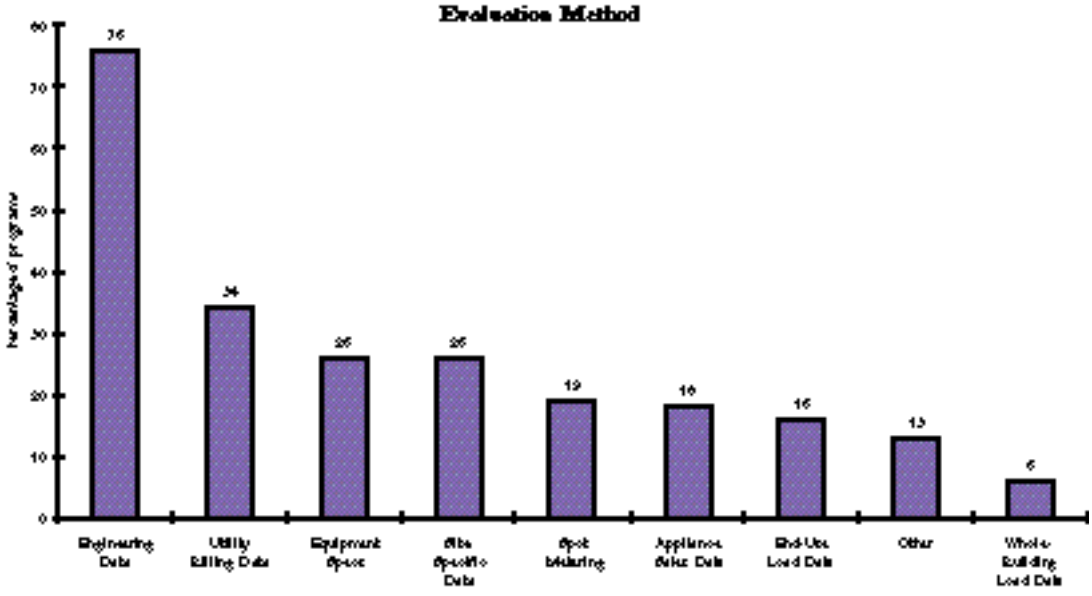

Figure 3.3.1g. Evaluation Method.

Many types of analysis could be done based on the INDEEP data. Some of these are exemplified by a more in-depth analysis of the technology group High Efficiency Lighting Systems.

3.3.2 High Efficiency Lighting Systems

High Efficiency Lighting Systems is the most common technology in the entire INDEEP database. Over 25% of all cases in INDEEP affect high efficiency lighting systems. Figure 3.3.2a shows data for individual programs within this technology. Only those programs with enough information to calculate the total resource cost are included.

Annual participation data in Figure 3.3.2a gives the volume of customers involved in the DSM program for the most recent year. The Danish program 'Campaigns for Energy Saving Lamps' (DK-3) has the most participants by far of any other program in this group, 520.000 customers. 'Licht Light' (DE-9) is second with 42.000 participants. According to the program summary, 'Licht Light' installed one 15 W CFL in nearly every household in Jena giving a 95% participation rate. And 46% of the households in Denmark contain CFLs. The other programs have participation that ranges from several thousand customers to well under one hundred. The annual participation rate chart gives an indication of the success of the marketing techniques used to promote the program. Again, the Danish and German CFL programs out perform all other programs with more than double the participation rate of any other case. The average participation is 6,5% of the eligible customers.

The annual total program costs in ECUs and the annual electricity savings in MWh/year are shown. The average program cost is in excess of 10 million ECUs and the average electricity savings is over 40.000 MWh/year.

The total resource cost takes energy savings, program costs, and average measure lifetime to calculate a measure of cost effectiveness of the program. The two Danish programs in this technology are the most cost effective with total resource costs of 0,0017 ECUs/kWh for DK-3 and 0,0044 ECUs/kWh for DK-6. The least cost effective program is another CFL program which comes from Spain, ESP-23, and has a total resource cost of 0,382 ECUs/kWh. The first two USA programs, the NYSE Star Program and the Comfort Home Program also have high total resource costs showing very poor cost effectiveness. There is no clear explanation of why these three programs did so poorly. The average total resource cost for this technology is 0,078 ECUs/kWh.

Overall, from the information given in the lessons learned category of the INDEEP database, giving monetary incentives, free installation of equipment or materials, or rebates and using aggressive marketing techniques seems to increase the participation and participation rate, and from that, increase the energy savings in high efficiency lighting system DSM programs. This is very expensive, so programs geared towards cost effectiveness concentrate on educating targeted customers and non-customers on energy efficiency techniques and limiting monetary incentives.

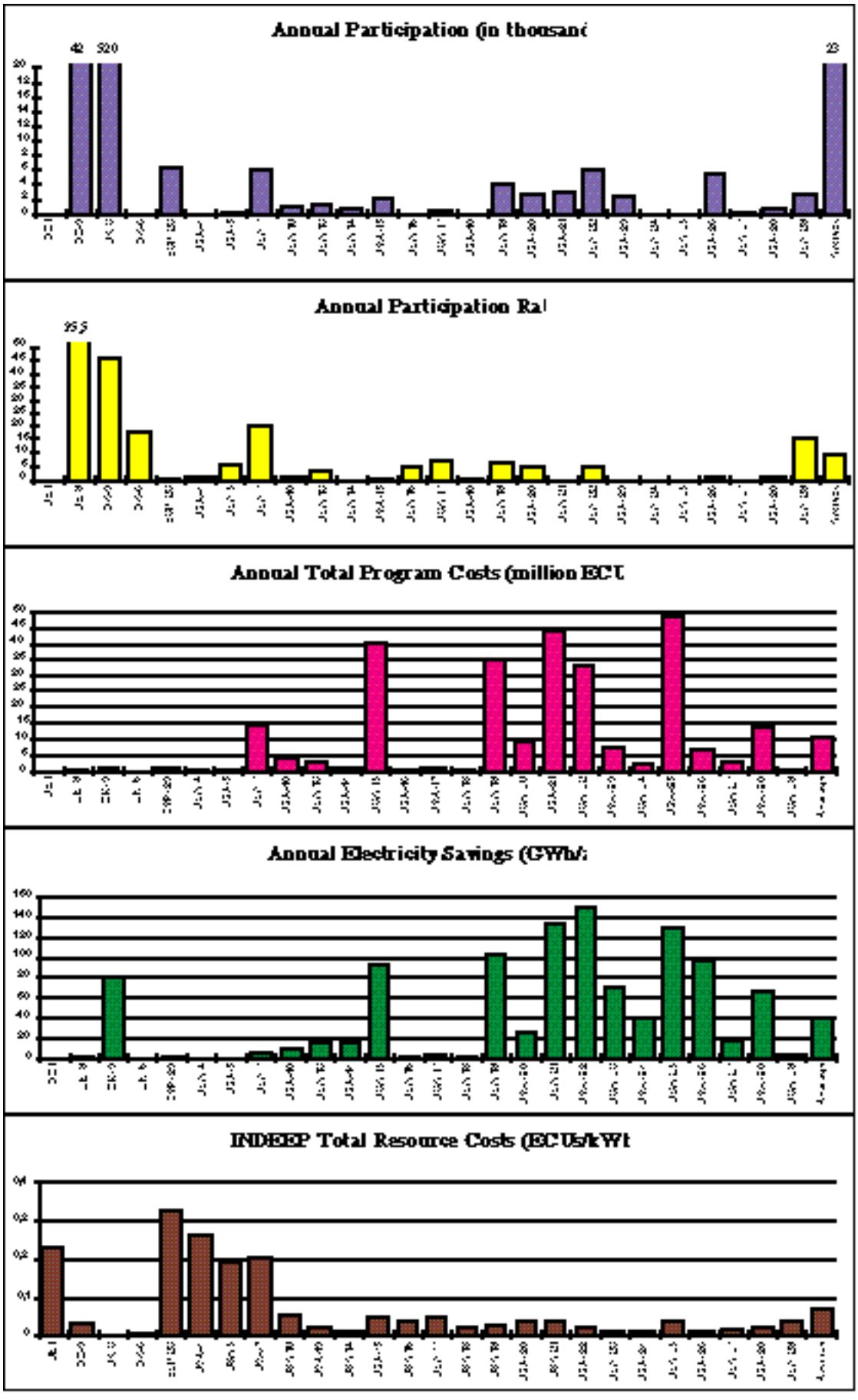

Figure 3.3.2a. Individual Programs using High Efficiency Lighting Systems.

4. Conclusions

Overall, the INDEEP Database is a tool that can be used to both design and evaluate DSM programs all over the world. Basic valuable information is contained within the database including contact agents and fax numbers that can be used to obtain more detailed information on specific programs.

It is not only important to collect data but also to give feedback to the data providers about what is done with the information. To continue the use of the database it has to have added value for the users. To improve the communication process with all users, the key information in INDEEP is summarised for different types of programs. The database itself is restricted to the countries participating in Annex 1 of the IEA-DSM Agreement because these countries support the work.

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