

## **APPENDIX B:**

### **FURTHER READING**



# CONTENTS

<b>EVALUATION AND DSM/EE INFORMATION SEARCH ON THE INTERNET .....</b>	<b>5</b>
GENERAL EVALUATION WEB-SITES .....	5
WEB-SITES WITH INFORMATION ON ENERGY EFFICIENCY AND DSM.....	6
<b>CONFERENCES AND PROCEEDINGS .....</b>	<b>8</b>
<b>BIBLIOGRAPHIC SUMMARIES .....</b>	<b>9</b>
REALISTIC EVALUATION .....	9
GUIDELINES FOR DEFINING AND DOCUMENTING DATA ON COSTS OF POSSIBLE ENVIRONMENTAL PROTECTION MEASURES.....	10
EVALUATION, VERIFICATION, AND PERFORMANCE MEASUREMENT OF ENERGY EFFICIENCY PROGRAMMES.....	12
BASIC IMPACT EVALUATION APPROACHES.....	20
EVALUATING ENERGY-EFFICIENCY PROGRAMMES IN A RESTRUCTURED INDUSTRY ENVIRONMENT: A HANDBOOK FOR PUC STAFF.....	23
MARKET TRANSFORMATION IN A CHANGING UTILITY ENVIRONMENT.....	37
EUROPEAN B/C ANALYSIS METHODOLOGY - A GUIDEBOOK FOR B/C EVALUATION OF DSM AND ENERGY EFFICIENCY SERVICES PROGRAMMES.....	47
THE INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL.....	50
EVALUATING MARKET TRANSFORMATION INITIATIVES: ISSUES, CHALLENGES, AND STATE OF THE ART.....	54
<b>LIST OF LITERATURE.....</b>	<b>56</b>



## EVALUATION AND DSM/EE INFORMATION SEARCH ON THE INTERNET

When searching for information, the Internet is a powerful tool, however, it is also indiscriminating on quality.

Below you find some short descriptions and URLs. It is by far not comprehensive and only included for inspiration. Due to the dynamic nature of the Internet, the sites might have moved, the content changed, or the address closed since the publication of this guidebook. The Guidebook takes no responsibility for the content of these external sites. The European Commission does not endorse or sponsor these sites, is not necessarily affiliated to the organisations, and does not attest to the accuracy of the information given on these sites. The CORDIS and the EUROSTAT areas are exceptions.

### GENERAL EVALUATION WEB-SITES

Over the last two decades, evaluation has become a major issue for academics, governmental and public organisations, and private businesses throughout the world. This has, however, resulted in a body of knowledge scattered across disciplines, professions, and countries. The following is a short presentation of evaluation bodies and journals.

A number of evaluation societies, associations and units exist on local, national international, and supra-national level. They encompass a variety of sectors, a.o. energy, but a lot of non-sector specific experiences can be drawn upon in general.

The **European Evaluation Society** (EES) was founded in the Hague in 1994. The first official board was elected in autumn 1995 and started its work in January 1996. The internet address for this society is <http://www.europeanevaluation.org/>.

The society's primary goal is to promote theory, practice and utilisation of high quality evaluation especially, but not exclusively, within the European countries. This goal is obtained by bringing together academics and practitioners from all over Europe and from any professional sector, thus creating a forum where all participants can benefit from the co-operation and bridge building.

Examples (some not available in English) of other evaluation societies are:

- American Evaluation Association <http://www.eval.org/>
- Canadian Evaluation Society <http://www.evaluationcanada.ca/>
- Danish Evaluation Society <http://www.danskevalueringsselskab.dk>
- German Evaluation Society <http://www.degeval.de/degeval.htm>
- Italian Evaluation Society <http://www.valutazione.it>
- French Evaluation Society <http://www.sfe.asso.fr>
- The UK Evaluation Society <http://www.evaluation.org.uk/> (where it is possible to post an evaluation-related question on their noticeboard)
- OECD - Public Management and Governance (PUMA) <http://www.oecd.org/puma/index.htm>
- The World Bank Operations Evaluations Department <http://wbln0018.worldbank.org/oed/oedevent.nsf/htmlmedia/Interhome.html>
- UNDP Evaluation Office <http://www.undp.org/eo/>

- Electronic Resources for Evaluators: <http://it.usu.edu/itrs/AEA/index.html>

A number of journals are devoted to evaluation, some are thematic others inter-disciplinary.

**Evaluation and Program Planning** <http://www.elsevier.com/inca/publications/store/5/9/3/> is based on the principle that the techniques and methods of evaluation and planning transcend the boundaries of specific fields and that relevant contributions to these areas come from people representing many different positions, intellectual traditions, and interests. In order to further the development of evaluation and planning, Elsevier Science publishes articles from the private and public sectors in a wide range of areas. The primary goals of the journal are to assist evaluators and planners in improving the practice of their professions, to develop their skills and to improve their knowledge base.

**Evaluation: The International Journal of Theory, Research and Practice** publishes original evaluation research, both theoretical and empirical, as well as reviews of relevant literature and overviews of developments in evaluation policy and practice. <http://www.sagepub.co.uk/frame.html?http://www.sagepub.co.uk/journals/details/j0137.html>

**New Directions for Evaluation**, <http://www.josseybass.com/JBJournals/nde.html>. A quarterly journal where each edition is a collection of articles focused on a topic of current interest to evaluators and their clients.

## WEB-SITES WITH INFORMATION ON ENERGY EFFICIENCY AND DSM

The **World Energy Council** (WEC) is a global multi-energy organisation. It has committees and activities in approximately 100 countries, including most of the largest energy producing and consuming countries in the world. The Mission of the WEC is to promote the sustainable supply and use of all forms of energy for the benefit of all. <http://www.worldenergy.org> is their URL address. The site contains technical papers on energy efficiency and a database on GHG reduction projects where a major category is energy efficiency. The publication Energy Efficiency Policies and Indicators (1998) can be found at <http://www.worldenergy.org/wec-geis/global/downloads/1998Report.pdf>.

The activities of the **International Energy Agency** (IEA) intended to assist member countries in monitoring and improving their present energy efficiency policies in identifying and exploiting new opportunities for improving energy efficiency. The energy efficiency work is initiated, discussed, and supported by the Energy Efficiency Working Party of the IEA, which can be found under <http://www.iea.org/> select Energy Efficiency. A major part of the energy efficiency activity of IEA is in the CADDET's sphere.

The International Energy Agency **Demand-Side Management Programme** - <http://dsm.iea.org> works to clarify and promote opportunities for DSM, including load management and strategic conservation. The objective is for DSM technologies to reach their full market potential; to stimulate energy systems to function more efficiently whilst adding value to the energy system investment for gas and electricity customers.

The activity of the **CADDET Energy Efficiency** <http://www.caddet-ee.org> is analysis and dissemination of information on demonstrated new energy efficiency technologies. Register database containing demonstrated energy efficiency projects, analysis reports, workshop reports, maxi brochures, technical brochures, and newsletters are available on-line. The Website also provides an electronic news service. The **link section** <http://www.caddet-ee.org/links/home.htm> of the website contains links to a total of 200 other relevant websites of organisations specialising in energy-efficiency technologies. To help you browse through the list, the links have been sorted according to energy supply/end-use technology, and include short descriptions.

The **Greenhouse Gas Technology** links section, [http://www.greentie.org/links/gr\\_links.htm](http://www.greentie.org/links/gr_links.htm) of the Greentie website contains links to a total of 200 other relevant websites of organisations specialising in greenhouse gas mitigating technologies. To help you browse through the list, the links have been sorted according to energy supply/end-use technology, and include short descriptions.

The **Energy Efficiency Toolkit** of the CADDET Energy Efficiency website contains links to all sorts of energy efficiency related tools, such as databases, decision support tools, fact sheets, conversion tables, calculation programmes, analysis tools, etc. You can find the Toolkit at [http://www.caddet-ee.org/ee\\_tools.htm](http://www.caddet-ee.org/ee_tools.htm)

The **OECD** has, in co-operation with the **European Commission**, prepared a database on the use of **environmentally related taxes** in Member countries. The database provides detailed information on tax-bases, tax rates, exemptions to the taxes, refund mechanisms, the degree and purpose of earmarking of revenues, etc. More information: [www.oecd.org/env/policies/taxes/index.htm](http://www.oecd.org/env/policies/taxes/index.htm)

The **Intergovernmental Panel on Climate Change (IPCC)** - <http://www.ipcc.ch> has the role to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. The IPCC produces reports, technical papers, guidelines and methodologies, and supporting material. The reports are published commercially and are available from publishers or leading bookshops.

The **World Energy Efficiency Association (WEEA)** was founded in June 1993 as a private, non-profit organisation composed of developed and developing country institutions and individuals charged with increasing energy efficiency. WEEA has been formed to (1) serve as a clearinghouse for information on energy efficiency programs, technologies, and measures, (2) disseminate this information world-wide, and (3) publicise international co-operation efforts in energy efficiency. <http://www.weea.org> gives access to the Technical Library, a collection of reports made available to the World Energy Efficiency Association for electronic dissemination. The goal of this ongoing effort is to provide access to high-quality, full-text technical reports on energy efficiency in a variety of file formats. The site also contains international directories on energy efficiency institutions and energy service companies.

**EPRI** (Electrical Power Research Institute, USA) is a non-profit organisation, focusing on knowledge, tools, and expertise to help build competitive advantage and address environmental challenges. Participation in EPRI's program is open to all organisations involved in the energy industry throughout the world. EPRI has developed over 6,000 hardware, software, and information products that can be purchased individually. <http://www.epri.com/>

The **World Business Council for Sustainable Development (WBCSD)** is a coalition of some 140 international companies united by a shared commitment to sustainable development, i.e. environmental protection, social equity, and economic growth. One initiative of the WBCSD is in the electricity sector, see <http://www.wbcsd.org/sectoral/electricity/index.htm>

The following three British links contain useful information on energy efficiency and links to further web-sites: <http://www.est.org.uk>, <http://www.dti.gov.uk/energy/index.htm>, and <http://www.energy-efficiency.gov.uk>

## CONFERENCES AND PROCEEDINGS

When searching for inspiration and information about evaluation of DSM and energy efficiency programmes, conferences are evident sources. They provide state of the art information on their respective subjects as well as ideal circumstances for networking and establishing contacts with other experts to share experiences.

Most conferences offer documentation on the subjects in the form of conference papers or proceedings.

The following examples of conference proceedings are only intended to be illustrative of the vast information available.

- SAVE Conference *For An Energy Efficient Millennium* Proceedings Volume I & II, and Supplement Backgrounds & Results, Energieverwertungsagentur, Vienna, 2000.
- International Energy Program Conference. *Evaluation in Transition: Working in a Competitive Energy Industry Environment*. Proceedings 1999 (CD-ROM).
- International Energy Program Conference. *The Future of Energy Markets: Evaluation in a Changing Environment*. Proceedings 1997 (CD-ROM).
- Book of papers, ECEEE conference 1997, Spinleruv Mlyn 1997.
- Proceedings of the 1993 ECEEE Summer Study: The Energy Efficiency Challenge for Europe, Volume I & II, Oslo, 1993. R. Ling and H. Wilhite (eds.).
- DA/DSM 94 Europe. Distribution Automation & Demand Side Management Conference Papers Book I (Keynote session, Distribution Automation, Demand Side Management) & Book II (Information Technology, Special Issues, Case Studies), PenWell Conference & Exhibition.

Examples of recommended upcoming conferences:

- ECEEE Summer Study, June 11-16, 2001, Mandelieu, France – <http://www.eceee.org/Summer/summer.html>
- International Energy Program Evaluation Conference, August 21-24, 2001, Salt Lake City, Utah - <http://www.iepec.org>

## BIBLIOGRAPHIC SUMMARIES

### REALISTIC EVALUATION

Author(s):	Pawson, R. and N. Tilley
Time:	1997

- Programmes have an impact through the action of actors, which receive arguments and resources. Success happens when the context is favourable. Programmes are not things that work. It is people that have reasons to act. The individual choices are often rational or at least sensible. The resources can be individual (skills, possibilities, knowledge, money) or social (what is legitimate, culture, structure).
- “CMO”: Context + Mechanisms = Outcome. Description of CMO’s can be the starting point of an evaluation. The CMO’s can be refined throughout the process, e.g. with interviews with decision-makers and persons involved in the programme, as well as those who receive the results of the programme (e.g. audit, or information). The CMO’s can also be a central part of the final result. CMO’s can be regarded as “micro-theory”.
- The evaluation should not only focus on average (or aggregated) impact. A large amount of information (about mechanisms) exists in the details, the winners and losers. If we do not understand why the programme was successful in one situation and not so in another – then we do not understand the programme.

## GUIDELINES FOR DEFINING AND DOCUMENTING DATA ON COSTS OF POSSIBLE ENVIRONMENTAL PROTECTION MEASURES

Author(s):	I. Marlowe, K. King, R. Boyd, R. Bouscaren, and J. Pacyna
Time:	1999

These Guidelines are published by the **European Environment Agency** in order to promote good practice in the documenting and use of data on the costs of possible **environmental protection measures** in the context of international data comparisons.

Many users of such cost data have experienced problems when trying to compare data from different sources – in particular, data users do not always know whether comparisons are valid. For example, it is often not clear whether the data are comparable in term of:

- The *environmental protection measure(s)* described;
- The source(s) to which the measures are applied;
- The year(s) when data were valid;
- The method(s) by which data have been annualised, inflated or otherwise processed.

These Guidelines aim to establish a common framework and vocabulary for documenting and using data on the costs of possible *environmental protection measures*.

The Guidelines are divided into two parts:

**Part 1** contains a set of Guidelines on defining and documenting data for single *environmental protection measures*. These Guidelines aim to define a minimum set of information, which will enable data users to understand the contexts in which data comparisons are valid or not valid. These Guidelines are aimed at the following people:

- Managers of technology databases – to help them to design or improve their databases.
- Authors of reports and other studies, which draw on cost data – to help them to document the raw data prior to any data processing or modelling.
- Originators of cost data, such as industrial installations, equipment suppliers and engineering consultants – to help them to provide the context for cost data.

**Part 2** contains Guidelines on some key issues related to processing the raw data. These Guidelines are descriptions of various methods of data processing and contain suggestions for good practice for documentation in instances when these methods are used.

A number of previous guidelines from other organisations are reviewed in Appendix 2.

The following are minimal requirements. For further guidance and an extensive glossary please consult the report

**Guideline 1**

Pollutant definitions and assumptions regarding scope of pollutant categories should always be given wherever there is any possibility of ambiguity.

**Guideline 2**

Sufficient detail of the pollution source should be given to enable comparison with similar processes and to avoid ambiguity. It is recommended that published source sector classifications should be used wherever possible.

**Guideline 3**

Sufficient detail of the environmental protection measure should be given to avoid ambiguity, to define its performance characteristics, and to clarify any special circumstances limiting applicability of the measure.

**Guideline 4**

It is essential that reported costs are defined: what is included, what is excluded, how they have been attributed or apportioned. It is recommended that costs are also explained in physical terms such as quantity of materials, and as unit prices.

**Guideline 5**

As a minimum, all data should have a background discussion of the key uncertainties related to the data.

**Guideline 6**

The year in which the following data apply should always be given:

- Cost data;
- Currency exchange rates;
- Data describing control technologies (efficiency, applicability) and process technologies;
- Emissions to the environment.

**Guideline 7**

The sources and origins of all data should be recorded as precisely as possible so that data may be traced at a later date if necessary.

**Guideline 8**

As a minimum, any discount/interest rates used should be recorded.

**Guideline 9**

If cost data are adjusted for inflation or changes in price through time, then the method used should be recorded and any index used should be recorded and referenced.

**Guideline 10**

If determining annual cost data, the approach, which has been used to derive the annual costs should be recorded, along with all underlying assumptions.

## EVALUATION, VERIFICATION, AND PERFORMANCE MEASUREMENT OF ENERGY EFFICIENCY PROGRAMMES

Author(s):	D. Violette
Time:	Prepared for the International Energy Agency, April 25, 1996

### RATIONALE FOR IMPLEMENTING AND EVALUATING ENERGY EFFICIENCY PROGRAMMES

The author presents several rationales for IEA members to implement energy efficiency programmes:

- Reduce energy costs and improve quality of life for customers.
- Improve the overall economic competitiveness of the country.
- Enhance export of energy efficiency services, skills and products to the international community, especially to those countries facing environmental problems and needing to address the economic competitiveness of their industries.
- Improve local environmental conditions.
- Implement plans developed through the Framework Convention on Global Climate Change.

The overall rationale for performing evaluation of energy efficiency programmes is to “provide the information required by energy planners and policy makers to make good decisions regarding investments in energy efficiency programmes.” More specifically, evaluations can:

- Ensure that expected energy efficiency improvements are actually attained.
- Provide management with feedback on specific assumptions regarding energy use, measure effectiveness, etc.
- Improve programme performance through enhanced accountability. Evaluation “sends the right message” internally, helps to focus implementors on cost effective use of their time, and offers them feedback on how to improve their performance.
- Help to profile and describe programme participants and non-participants, so that the cost effectiveness of programme expenditures can be improved (e.g., through better targeting or better understanding of who participates and why).
- Identify market barriers to programmes and the technologies/products they promote.

Drivers for increasing the rigor with which IEA member countries conduct evaluations include the increased scrutiny of all public expenditures for cost-effectiveness, and the intensified interest in energy efficiency programmes from the international community to the extent that these programmes are part of a country’s formal plans to reduce greenhouse gas emissions.

Objectives of energy efficiency programme evaluations may include the estimation or assessment of:

- Energy reductions.
- Changes in energy service quality or reliability.

- Cost, programme delivery effectiveness, and customer satisfaction.
- Relative cost effectiveness of the programme compared to other options for addressing the same objectives.
- Greenhouse gas emissions reductions.
- Non-energy benefits and costs.

### **KEY TRENDS IN EVALUATION**

For impact evaluation:

- An increased use of engineering estimation to lower the cost of estimating programme impacts
- A decline in the cost of metering and monitoring equipment
- Increased rigor in the performance of evaluations (better implementation)
- Increasing use of evaluation data collection during programme implementation.

For process evaluation:

- Increased integration of process evaluation with impact evaluation
- Increasingly *technical* process evaluations with regard to market assessment
- Increased emphasis on estimating market transformation and other indirect programme effects.

For evaluations in general:

- A shift in the types of methods employed as programmes mature.

The author presents general guidelines for conducting evaluations and then provides detailed case studies to illustrate the selection of methods, as summarised below.

### **GENERAL GUIDELINES FOR EVALUATION**

#### **Steps to an Evaluation**

- Assess the availability and quality of data resources.
- Define the evaluation method(s) to be used.
- Determine additional data that are required.
- Collect necessary data.
- Conduct data analyses.
- Compile and report study results.

#### **Planning**

Quality of data may be maximised and data collection costs minimised if evaluation needs are incorporated into programme design and key evaluation data are collected during programme implementation. For example, implementors can collect data on equipment replaced and on which meters are affected. They can inform metering

staff about the timing and location of measures that will soon be installed so that pre-installation meter readings can be taken. However, it is important to examine the incentives and goals of implementation staff, to ensure that these activities are consistent with their self-interest. Focusing incentives on verifiable savings (rather than number of measures installed or number of participants) can help align implementor self-interest with the goals of the evaluation and the overall programme.

Tracking systems for the programme should capture at least key parameters that can be used to estimate programme impacts, and it is preferable that they generate an impact estimate for each installation (which later evaluation would confirm or refine). Generating impact estimates from the tracking system can help to target programme implementation, by indicating market segments (business types, geographic areas, etc.) that are resulting in the largest per-installation impacts. Such estimates can also serve as inputs to statistical models (e.g., in statistically adjusted engineering estimation methods) and help improve the efficiency of evaluation sampling strategies.

## CASE STUDIES OF EVALUATION APPROACHES

### Case Study: Commercial Lighting Programme

*Programme description* — Replacement of inefficient lighting equipment with high-efficiency equipment at facilities of existing customers

*Tracking system* — Assume the tracking system is collecting data on:

- Number of each type of lighting equipment installed
- Installation data
- Location of installation, including account number (meter affected)
- Preliminary estimate of impact for each installation, based on the engineering algorithm: Estimate of kWh impacts =  $(\text{WATTS}_{\text{before}} - \text{WATTS}_{\text{after}}) \times (\text{operating hours}) \times (\text{number of fixtures})$ .

*Impact evaluation options:*

- Simple engineering methods using actual participant data — No on-site data are collected, but participant/installation-specific data (from programme application forms or the self-reports collected from participants in telephone/mail surveys) serve as inputs into the engineering algorithm. Provides an estimate of gross savings. This method is useful for programmes having a low number of participants, low savings, and/or in their start-up year — i.e., situations in which more rigorous evaluation methods would not be cost effective.
- Enhanced engineering estimates — On-site visits are used to gather detailed information on a random sample of participating customers, so that better estimates can be made for specific impact parameters (e.g., operating hours for affected lights, changes in lighting service levels, interactive effects of lighting modifications on heating and cooling system energy use). More sophisticated engineering algorithms/simulation models can then be used. The savings estimate of the rigorously analysed sample is then compared to the estimate produced by the tracking system (or simple engineering method above), so that a “realisation rate” (more sophisticated estimate as a percentage of the tracking system savings estimate) can be determined. This realisation rate is then applied to the entire population in the tracking system, to estimate programme savings.<sup>1</sup>
- Billing analysis — If impacts are expected to be larger than about 10% of the customers’ bills, these impacts should be observable in customers’ energy bills. Bills before and after the efficiency retrofit are compared and normalised to account for changes in weather. Bills of a sample of non-participants are similarly analysed and the results are compared to those of participants, to account for changes in consumption common to all customers.

<sup>1</sup> Issues of the randomness of the sample and heterogeneity of the participant population must be accounted for.

- **Multivariate billing analysis** — If bill savings are a substantial percentage of the energy bill, a more rigorous billing analysis approach can be applied. The multivariate billing analysis uses customer survey data to build statistical models with variables that account for non-programme factors affecting energy use (e.g., plant expansion, increases in production, changes in staffing or operations, building remodelling, or financial performance). Regression equations are developed so that the changes in energy use associated with the programme-induced retrofit can be isolated from other changes in energy use.
- **Metering and monitoring** — Metering and monitoring can provide excellent information about selected impact parameters, and also can be used in estimating changes in demand. Possible options include the metering of a sample of affected lighting circuits before and after installation of the efficient equipment, run-time metering to collect data on hours of use, and pre- and post-installation kW measurements to estimate demand the programme's impacts. The use of metering to estimate measure impacts is limited if no pre-installation metering is possible (e.g., if programme staff are not notified prior to measure installation).
- **Combination approaches and leveraged data approaches**
  - **Statistically adjusted engineering methods** —The outputs of engineering models can be used as inputs to statistical models in statistically adjusted engineering analyses. In a typical usage of this approach, a regression model is used to estimate changes in energy usage as a function of engineering model estimate of the impact, facility characteristics, and certain behavioural attributes. The regression model produces realisation rates that can be applied to the total tracking system population as a measure of the percentage of expected savings “that can be verified with a given degree of confidence.”
  - **Ratio estimation methods** — A ratio estimation method can leverage the use of costly but valuable site-specific data. In such an approach metered data for a small sample (e.g., 25 sites) is combined with both detailed engineering study results for a larger sample (e.g., 75 sites) and survey and billing data for large samples of participants and non-participants. (The author refers the reader to discussions of this technique in reports authored by Violette and Hanser (1991) and Buller, et al. (1993).<sup>2</sup>

#### **Case Study: Residential Informational Audit Programme**

*Programme description* — An on-site audit of a home reviews the customer's appliance holdings and energy usage and makes recommendations for cost-effective energy efficiency activities such as installation of efficient equipment or changes in energy-using behaviour.

*Tracking system* — Assume the tracking system is collecting data on:

- Customer identification (account number)
- Equipment holdings such as appliances, HVAC system type and size, efficiency of energy-using equipment, other energy-using devices, etc.)
- Behavioural characteristics, such as patterns of use (time and duration) for energy-using equipment, thermostat setpoints, number of people home and time periods when they are home
- Auditor recommendations (e.g., replacement of incandescent bulbs with CFLs, cleaning of furnace filter, weather-stripping, etc.)
- Customer reports on intended actions to be taken as a result of the audit

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<sup>2</sup> See (1) Daniel Violette and Philip Hanser, “Utilizing Information from Multiple Sources of DSM Impact Evaluation,” *Proceedings of the 5<sup>th</sup> National Demand-Side Conference*, Boston, MA, July 1991, EPRI CU-7394; and (2) Susan Buller et al., “Combining Monitoring, Engineering Analysis and Billing Analysis to Evaluate PG&E's Commercial/Industrial Retrofit Programme,” *Proceedings of the 1993 International Energy Programme Evaluation Conference*, Chicago, IL, August 25-27, 1993, CONF-930842.

- Estimate of impacts for each recommended measure

To determine what actions were actually taken by participants, a brief mail survey to a large sample of participants and on-site surveys with a smaller sample of participants can form the basis for a three-tiered nested sample analysis (on-site survey estimate, mail survey estimate, and tracking system estimate).

*Impact evaluation options:*

- Enhanced engineering methods of using actual participant data — Results of customer surveys are used to adjust engineering estimates from audit recommendations (details such as number and location of measures installed).
- Billing analysis — If substantial impacts relative to energy use (>about 10%) are expected, billing analysis can be useful in estimating energy impacts of the programme, using the same approach as with commercial lighting. Pre- and post-*installation* (time of audit recommendation being implemented, not time of audit) billing data are compared and normalised to account for weather-driven energy usage differences between the billing periods, for participants and (optionally) non-participants. Changes among non-participants in energy usage between the pre- and post-installation periods represent the natural change that would have happened to participants had they not participated in the programme.<sup>3</sup>
- Multivariate billing analysis — If additional data can be collected from participants (and, optionally, non-participants), regression billing analysis can be conducted, to control for confounding effects (e.g., changes in occupancy or usage of equipment).
- Metering and monitoring — As a supplement to the enhanced engineering methods described above, spot monitoring of selected measures can increase the accuracy of engineering estimates of measure impacts. Examples of monitoring targets include attachment of run-time monitors to affected lighting circuits, measuring water flow rates on faucets and showerheads, or conducting blower-door tests, to address lighting, low-flow faucet aerators/showerheads, and infiltration measures, respectively. On-site visits are required, at least for a sample of participants.

**Case Study: Government/Industry Partnership Programme**

*Programme description:* Government negotiates Long-Term Agreements (LTA) with industry to improve energy efficiency.

*Tracking system:* Data available may include audit results, such as an inventory of equipment, details of how energy is used, and identification of cost-effective energy efficiency measures.

*Impact evaluation options:*

- Detailed engineering analyses — Impacts estimates are based on engineering models and calculations, using site-specific data and spot monitoring of the loads of energy-using equipment. Annual or biannual updates take into account persistence of savings and process changes.
- End-use metering — If expected savings are very large and/or if the plant has existing submetering on specific processes, end-use metering may be a viable option. Estimates of savings associated with specific processes or end uses (motor drives, air handling, lighting, etc.) can be generated by measuring the changes in energy usage of these activities with end-use meters. It is very important, however, to adjust savings estimates for non-programme factors such as changes in environmental requirements leading to process changes, changes in the production process due to changes in market/marketing strategies, or other events.
- Use of an energy use metric — In negotiating the Long-Term Agreement, a reduction in energy use per unit of production or some other metric may be specified. Baseline values are measured/estimated (e.g., using metering

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<sup>3</sup> Author's Note: Self-selection bias would have to be accounted for.

and engineering calculations) and then recalculated periodically. Calculations are subject to review by the government.

The LTA negotiation generally includes the evaluation activities, so that the evaluation process is similar to verification protocols negotiated between energy service companies and their business clients.

### **Case Study: Market Transformation Programme**

*Programme description:* Inducements are provided to lighting equipment manufacturers to produce new products of higher quality. The government works with manufacturers to develop specifications for the product and with purchaser groups to ensure the existence of a market for the final product.

*Evaluation strategy:* Develop detailed information on customer groups and competitors, and use that information to make judgements about market response to the programme. Key to the analysis is identification of the aspect of the market targeted for change, including its baseline conditions and future baseline (without-programme) conditions.

*Impact evaluation options:*

➤ **Market baseline study** — This research, often conducted during the planning stages of the programme, sets the baseline for the programme and can determine where programme efforts might have the greatest leverage in moving the market. Therefore, an “exploration of the vertical market structure from manufacturer to end-user provides insight into which areas of the product distribution cycle are most receptive to programme efforts.” The research may include:

- “Characterisation of the product value chain
- Identification of the key actors along the product value chain
- Characterising the various market segments
- Documenting product efficiency and availability
- Studying manufacturer behaviour
- Assessing the quality and content of available industry sales data.”

Data sources for this information include:

- “Interviews with representatives of manufacturers, distributors, retailers, and contractors
  - Various statistical resources, including manufacturers sales reports, government reports, or private data series
  - Interviews with key customers
  - Review of trade, academic or professional literature, or
  - Review of business data sources such as product catalogues, price lists, and product reports.”
- **Trade ally interviews and focus groups** — The purpose of this method is to gain an understanding of common practice with regard to the targeted measure/product, as well as how the distribution process works. As with the market baseline study above, baseline perceptions/practices are documented and compared to later research with the same groups. Conducting similar research with trade allies in non-programme areas allows an assessment of the natural change occurring in the market (i.e., without the programme).

- Sales tracking studies — Tracking sales information provides the evaluator with accurate information on the distribution of various types and efficiencies of products at specific points in time. Comparison of these data with data from a non-programme area allows estimation of natural change occurring in the market. These non-programme area sales data can be obtained by negotiating with manufacturing associations, or “by tracking and integrating existing sales data from disparate source.”

Steps to obtaining sales data from manufacturers/trade associations include the following:

- “Assess the content, format and quality of data currently collected.”
- “Assess whether tabulations by efficiency *and* region are possible under current data collection procedures.”
- “Identify issues that would need to be negotiated with the association prior to release of further data.”
- “Formulate a work plan for developing the system.”

Key issues to address in building a sales tracking system through integrating existing sales data from multiple sources include the following:

- “Recruitment of participating retailers.”
  - “Appropriate sampling of retailers.”
  - “Standardisation of reporting format.”
- Customer equipment surveys — Periodic surveys with customers interested in purchasing lighting equipment can provide data on what equipment is being installed, how it is being used, what equipment is being replaced, and what equipment would have been installed had there been no programme. This research augments sales data studies, to provide a more comprehensive picture of how the market is responding to a programme.

## MARKET VERSUS CONSUMER-SPECIFIC EVALUATIONS

Market-directed programmes (e.g., market transformation programmes) require a different focus than consumer-directed programmes (such as consumer rebates for specific products, audit programmes, facility retrofit programmes). One key difference is that consumer-directed programmes typically identify programme participants as part of the programme, while market-directed programmes may not (since they are focused on transforming an entire market rather than the purchase decision or practice of individual customers). Evaluation data required for these different programme types must also differ.

Examples of market evaluation data requirements:

- Changes among manufacturers with regard to:
  - Product lines, including design improvements, changes in the number of models offered, etc.) and manufacturer reports on attribution of these changes to the programme
  - Prices and product discounting
  - Labelling of energy efficiency characteristics
- Changes among dealers, distributors, and contractors with regard to stocking practices, pricing, promotion or enhanced services.
- Estimates of how the market would have evolved without the programme (future baseline):
  - Self reports of manufacturers, and other market actors

- Analysis of recent industry trends
- Understanding of industry structure and roles of various market actors in influencing the targeted purchase decision or practice
- Analysis of non-programme factors (e.g., health of the economy, technical innovations, etc.)

Methods for collecting these data, as mentioned above, include market baseline studies, annual interviews/focus groups with key market actors, and sales tracking and other market studies. Market evaluations can sometimes benefit from collection of consumer-specific data, to ensure that installation assumptions are accurate<sup>4</sup> and to address failings in available sales data.

Examples of consumer-specific data requirements:

- Billing data;
- End-use metered data;
- Site data (building and equipment characteristics);
- Survey data;
- Programme tracking data.

## **PROCESS EVALUATIONS**

The authors present a brief description of the purpose and research options associated with process evaluations.

The purpose of process evaluations is to assess the overall effectiveness of the programme, provide feedback on performance to decision-makers, and guide future programme refinements and development. Topics to address (for a lighting programme evaluation) might include:

- Delivery mechanisms
- Customer satisfaction with programme and programme components
- Barrier to programme penetration
- Effectiveness of marketing materials
- Market penetration levels
- Market segmentation profiles of participants and non-participants

Research options include a review of programme documentation, an analysis of the programme data base/tracking system, in-person interviews, focus groups, site visits, and customer surveys.

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<sup>4</sup> Targeted equipment might not actually be installed or may be installed in a different location than assumed. Manufacturer energy ratings may be inaccurate; assumptions about the efficiency of replaced equipment may be wrong.

## BASIC IMPACT EVALUATION APPROACHES

### General Observations

- “The programme tracking system is the foundation of the evaluation process.”
- “Common reasons to conduct on-site surveys are to provide the data inputs for building simulations for a site, to estimate measure persistence . . . or to estimate site-specific energy-usage behaviour.”
- Problems in using end-use metering to estimate programme impacts include the following:
  - It is expensive and sample sizes must therefore be small.
  - Improving the estimation of programme impacts generally requires both pre- and post-measurements, and it is often difficult to identify participants before they install programme measures.
  - Due to (1) the need to pre-identify participants, (2) the need to gain customer permission for metering, and (3) technical difficulties which make metering impractical at some sites, obtaining pre-/post-installation metering samples that are representative of the participant population can be difficult.

### Approaches

- Engineering methods are typically of two types — engineering algorithms and engineering simulations. Common uses for engineering methods include the following:
  - “Engineering estimates may be used to provide independent, stand-alone estimates of programme impacts. . . . As a primary evaluation methodology, however, [they must] be benchmarked against forecast and load research data and subjected to a regular and ongoing programme of verification and refinement using billing data analyses and end-use metering studies.”
  - “Engineering estimates may serve as a backup to and a means of verification of statistical methods.”
  - “Engineering methods are sometimes the most cost-effective method . . . when the value of information does not justify more expensive evaluation approaches.”
  - “Engineering methods can provide time differentiation of impacts.”
  - “Engineering approaches can estimate savings for all fuels, even if billing data is not available.”
  - “Engineering methods can offer measure-specific resolution of impacts . . . [allocating] savings to individual measures or groups of measures including interactive effects.”
- Statistical methods include:
  - Basic statistical methods (billing analysis), which may be misleading and can have hidden complexities, but which are typically inexpensive and use data that are usually readily available.
  - Multivariate statistical methods, which better isolate programme impacts from those of other non-programme factors. Typically, these approaches use regression methods (such as conditional demand analysis models and statistically adjusted engineering models) or discrete choice models (which control for systematic differences between participants and non-participants). One trend has been the use of two-equation models — one to model the decision to participate in the programme and one to estimate the change in energy use, holding constant those factors that influence participation.

## **PRACTICAL ISSUES TO ADDRESS WHEN PLANNING, IMPLEMENTING, AND REVIEWING PROGRAMME EVALUATIONS**

The author address several key practical issues associated with the actual practice of evaluation.

### **Tracking System Data Quality**

Typical problems are inaccurate account numbers (so that linkage to billing records is not possible), records that are missing key data, data entry errors, and omission of measure costs. These problems are caused by failure to collect needed information on programme application forms, poor or non-existent data quality procedures, and inadequate skills or training of staff collecting or entering programme data. The problems result in an inaccurate picture of the programme's success and programme impacts. They can be resolved by having programme data quality assurance plans and reporting on data quality control in evaluation reports.

### **Estimating Net Programme Impacts**

Net programme impacts are the difference between gross impacts (the measured/estimated change in participant energy use) and the programme baseline (what would have happened in the absence of the programme). There are two main methods of estimating programme impacts — comparing the change in energy use of participants with the change in energy use of a “control group” (e.g., consumers not aware of or not offered the programme), or estimating free ridership through surveys. However, finding a group that is similar to participating customers in every respect except for participation in the programme is very difficult, even more so as more and more DSM programmes are implemented. Also, if non-participants are used as the control group, there is a danger in over- or under-estimating savings because those who choose (or select themselves) to participate may be systematically different from those who do not (e.g., their attitudes/beliefs may be more favourable to taking conservation actions, even if no programme existed). This problem is addressed by estimating a discrete choice model of programme participation and a separate multivariate regression model of energy savings.

### **Impact Evaluation Accuracy**

Increasing precision in impact estimates usually increases evaluation costs, due to the need for more surveys and/or more observations in the sample. Two important questions related to accuracy are as follows:

- How does one provide information on accuracy? Typically, one can calculate levels of precision for specified confidence intervals and/or one can illustrate the robustness of impact results by showing how reasonable changes in impact model structure and approach change the impact estimate.
- What is a good target for accuracy? The accuracy target must vary depending on the expected level of savings. The bigger the expected percentage of savings the easier it will be to hit the target precision. However, the targets may not be achieved.<sup>5</sup> The U.S. Environmental Protection Agency guideline for impact evaluation accuracy is a minimum 75% confidence level. Because decisions about the level of accuracy affect the cost of evaluation, an option is to set the accuracy target for the lower bound estimate of savings. For example, the same results indicating that there is an 80% probability that actual impacts fall between 900 kWh and 1,100 kWh (80% plus or minus 10%) also means that there is a 90% probability that the actual impacts are greater than 900 kWh. “Targeting higher precision for high percentage savings programmes and lower precision for programmes with lower savings may be the most efficient approach.”

### **Persistence of Efficiency Impacts**

The author provides sample persistence estimates used by a U.S. utility company for several residential multi-family retrofit programme measures, to illustrate that persistence varies by measure and by sector. Persistence of savings

<sup>5</sup> The author provides the following example: “If impacts are expected to be 1,000 units per consumer, then a targeted precision of 20% means that the allowable tolerance is  $\pm 200$  units. If actual programme savings are less than 1,000 units, e.g., are 600 units per consumer, then even if the experimental design achieves the target tolerance of  $\pm 200$  units the resulting precision will be  $\pm 33\%$  instead of the expected  $\pm 20\%$ .”

can be expensive to measure. Decision must be made with regard to (1) the appropriate methodology to use (verification inspections, billing analysis, , and the frequency of the studies (annually, biannually, etc.). The author recommends that follow-up persistence studies “be carried out for at least 3 years, and probably for no more than 10 years . . . the time horizon . . . can vary by measure-type and programme, depending on such factors as the expected measure lifetimes.”

### **Separation of Programme Evaluation and Implementation Functions**

The author provides advantages and disadvantages of having implementors involved in evaluation. Blending the two functions (1) is likely to provide greater accuracy and lower evaluation costs, (2) suggests the use of an outside audit of the evaluation process, as a check against lack of objectivity, and (3) requires the implementor to identify with, accept responsibility for, and be an active participant in the evaluation.

### **Evaluation Reporting**

The author provides the following guidelines for reporting evaluation results:

- Provide the context for the evaluation — programme description (programme history, goals, significant design features, energy efficiency measures promoted, target markets, performance to date, issues from previous evaluations), and the objectives and scope of the evaluation
- Describe the sources of data and sample strategies/sizes, including the data collection instruments and protocols as appendices.
- Describe methods used and the rationale for selecting them, including:
  - assumptions, caveats, and limitations of results
  - selection criteria
  - major steps in the analysis, including the type of analysis and the calculations
- Indicate programme performance relating to each objective of the evaluation, the accuracy of the estimate (at least subjective, if not a statistical measure of confidence), biases or limitations that should be considered in using the results
- Present conclusions.

The author presents a detailed discussion on accuracy calculations as an appendix.

## EVALUATING ENERGY-EFFICIENCY PROGRAMMES IN A RESTRUCTURED INDUSTRY ENVIRONMENT: A HANDBOOK FOR PUC STAFF

Author(s):	J. Schlegel, M. Goldberg, J. Raab, R. Prah, M. Keneipp, and D. Violette
Time:	Prepared for the National Association of Regulatory Utility Commissioners, April 1997.

**Purpose:** “To assist state regulators and staff in their oversight and review of energy-efficiency programme evaluation activities and reports” and “to assist regulators in planning for evaluation of energy-efficiency programmes in an environment of ongoing utility industry restructuring.”

**Scope:** Addresses three types of energy efficiency efforts likely to exist in “the new industry environment” which will be regulated to some degree and for at least some period of time:

- Public purpose wires charge (systems benefits) energy efficiency activities;
- Least-cost distribution system investments;
- Least-cost transmission system investments.

“The role of programme evaluation will be determined only when the role of energy efficiency is decided.”

The authors provide historical information about the U.S. utility industry and conjectures about the future of DSM. The future, they say, is likely to focus increasingly on “the need to try and intervene in markets only where necessary to reduce market barriers and correct market failures — with the need for a clear goal and strategy to turn those market segments over to the market as soon as possible.” This implies information and market transformation programmes, as well as programmes to reach low-income populations. Funding: non-bypassable systems benefits charge, typically a few mills or less (per kWh sold). Three main options exist for who would administer and deliver the programmes: regulated utility (most likely a distribution utility); a non-profit or private, state-wide entity; or allowing distribution companies to bid against energy service companies.

If distribution utilities engage in DSM to defer distribution capacity investments, emphasis could be more on estimating gross rather than net savings. If they offer DSM as a customer service, there is probably no need for regulatory oversight at all.

Long-term effect of restructuring: Evaluations every two to three years, rather than every year; if performance incentives, lost revenues recovery mechanisms or both are abandoned, evaluation standards can be relaxed from the regulators’ point of view.

The authors suggest methods for evaluating information and market transformation programmes.

### EVALUATION OF INFORMATION PROGRAMMES

Issues:

- What must be documented?
  - Information had the desired effect on knowledge/attitudes
  - The changes led to increased adoption of energy efficiency measures or practices

- The measures/practices resulted in energy savings

The greatest uncertainty surrounds the first two items.

Methodological challenges:

- Difficult to identify “participants” (recipients of the information, and the intensity/duration of their exposure)
- Relationship between attitude and behaviour is complex; need to document knowledge/attitudes effects AND effects on behaviour.
- Information programmes may have very long lag times, making attribution very difficult (6 months to three years is most appropriate time frame).
- May be very difficult to sort out “other” influences.

Three approaches for evaluating information programmes:

- Direct analysis of consumption data — useful when participants can be easily identified, when savings are a substantial portion of consumption, and when there is not a long lag time before savings are apparent
- Self-reports from participants and market actors — useful when participants can be easily identified, survey respondents can reliably indicate whether they saw, heard, or read the information, when survey respondents can remember what action they took, and when respondents can state why they took action the degree to which it was because of the programme.
- Rigorous analysis of changes in attitudes and behaviours:

- Major stages of the process:

- \* Identify recipients of information and establish an experimental design. Use a comparison group (e.g., for audit programme). “Note that it is generally not appropriate to construct a comparison group based primarily on self-reports from market actors saying they haven’t been exposed to the programme information . . . due to limitations on people’s ability to recall their exposure to information, as well as the likelihood of systematic differences in this ability across sub-groups. If it is not possible to identify a non-participant group (e.g., for mass media advertising campaign), conduct repeated measures of the target population to assess the correlation of changes in attitudes/behaviour with changes in the level of programme effort.
- \* Measure changes in attitudes and behaviour. It is important to comprehensively and reliably measure the baseline levels of key variables, “both those attitudes and behaviours that are the explicit focus of programme efforts, and other attitudes and behaviours that are relevant to energy efficiency but are not directly targeted by the programme.” It may be advisable, for broad-based programmes targeting a wide range of attitudes/behaviours, to construct and validate indices to characterise the overall baseline.
- \* Control for self-selection effects. “. . . people who are more aware of or more interested in energy efficiency issues (e.g., people who are already intending to install energy-efficiency measures) . . . [will be more likely] to more readily pursue the information being offered than the average recipient. For example, it is probably inappropriate to evaluate the impacts of an energy-efficiency hotline simply by comparing adoption rates and changes in consumption between those customers who called in and those who did not. Many customers who call in may already be planning to install an energy-efficiency measure, and only want either specific guidance or confirmation.”
- \* Develop ancillary evidence of energy and demand reductions. Examples of such evidence include the following:

- a) “Hard evidence is presented, based on market research, that a programme addresses a specific market barrier to energy efficiency associated with either the knowledge or attitudes of market actors.
  - b) Market indicators change in the predicted order.
  - c) A correlation can be demonstrated between the intensity of a recipient’s exposure to the offered information and changes in his or her behaviour.
  - d) Targeted market actors demonstrate behavioural changes of the specific type advocated by the programme, but not of other types.”
- \* Document potential indirect programme effects and market transformation benefits. To address participant spill-over, analysts must take care to control for self-selection effects and may need to deal with spill-over effects that “may occur beyond the time frame covered by the analysis of direct impacts.” In estimating non-participant spill-over, it may be difficult to isolate those information recipients who have received programme information from those who have not, and to also isolate market actors who have had significant contact with information recipients from those who have not. Documenting market transformation effects is more difficult for mass information programmes than for direct information programmes, due to difficulty in identifying information recipients and the nature, intensity and duration of their exposure to the information. For each of these types of effects, identifying suitable comparison groups can be very difficult task.

## EVALUATION OF MARKET TRANSFORMATION PROGRAMMES

Challenges associated with evaluating market transformation programmes:

- “Markets are interactive.
- Markets are dynamic — e.g., they are constantly changing and evolving.
- For the most part, markets are regional and national in nature, rather than being organised at the level of utility service territories.
- Fundamental changes in the structure and functioning of markets may occur only slowly.”

To claim that a market has been transformed, utilities must demonstrate the following:

- “There has been a change in the market that resulted in increases in the adoption and penetration of energy-efficient technologies and/or practices.
- That this change was due at least partially to a utility programme or initiative (based both on data and a logical explanation of the programme’s strategic intervention and influence).
- That this change is lasting, or at least that it will last after the utility programme is scaled back or discontinued.”

Establishing causality is a major challenge. There are two primary approaches to addressing this issue:

- Give up and focus on measuring the level of gross change in a market (rather than net change).
- Relax evidentiary standards regarding causality somewhat and provide at least qualitative evidence of causality, through quasi-experimental design and tracking of relevant market indicators, and using data collected from several different types of market actors. A causal relationship would be suggested “by the occurrence of predicted differences in market indicators between test and comparison areas, and by the fact that various market indicators showed changes in the order that would be predicted given the stated intent of the programme.”

Meeting the challenges of market transformation evaluation:

- Define performance using several different metrics:
  - “Ultimate outcomes (energy and demand savings, product sales as a proxy for energy and demand savings, or market penetration)
  - Indicators of effects (indicators of lasting market effects and/or reductions in market barriers)
  - Effective and efficient performance of planned activities (good-faith implementation).”
- Define evaluation broadly. Evaluation of market transformation can have several purposes:
  - “Supporting the planning and design of the programmes and initiatives, including providing up-front market studies and baseline analyses
  - Providing corrective and constructive guidance regarding the implementation of market transformation initiatives
  - Providing indicators of the effectiveness of specific market transformation strategies and activities (e.g., by evaluating indicators of market effects and reductions in market barriers)
  - Assessing the overall level of performance and success of market transformation initiatives (both mid- and long-term)
  - Informing decisions regarding performance incentives provided to administrators (e.g., state-wide entities or distribution utilities) for market transformation activities.”
- Focus on evaluating and assessing indicators of market effects. “Market effects are timely and observable, the utility has the ability to impact and observe them, the information collected can help improve the initiative in a timely manner, and often they can be used to develop or forecast estimates of market penetration and load impacts (for purposes of assessing ultimate outcomes).” For example, indicators that might be relevant to track for a commercial lighting remodelling initiative might include the following:
  - “Increased knowledge or awareness among specifiers, designers, and decision-makers
  - Existence and deployment of decision-making tools and structures which are likely to lead to efficient design and equipment installation, and which are being used on more jobs
  - More frequent recommendation or specification of efficient equipment and design
  - Increased application of efficient equipment or design
  - Attendance at and intent to implement training
  - Changes in the costs of efficient technologies and practices.”

Methods to collect these data might include interviews with vendors, contractors, and managers of targeted large firms, and walk-through surveys or plan reviews of samples of remodelled buildings.<sup>6</sup> This approach “can provide valuable interim directional guidance to initiative efforts between larger impact studies. In some cases, it may be easier to track impacts on specific markets through this type of approach rather than using aggregate sales data tracking.”

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<sup>6</sup> Based on *Opportunities for Market Transformation for Commercial Lighting Remodeling*, by F. Gordon and L. Tumidaj. Prepared for the Boston Edison DSM Settlement Board. Pacific Energy Associates, Portland, OR.

The authors speculate that “a utility claim of market effects is more likely to receive regulatory approval if it is supported by an assessment of the market, a description of key market barriers on which it focused its efforts, an evaluation of market effects that are likely to result of those barriers are reduced, and other links between observed market effects and reductions in market barriers. In contrast [the authors] believe regulators are less likely to approve a claim that consists solely of observed market effects.”

- “Use an iterative process to document and provide support for estimates of market effects . . .
  - Begin with a hypothesis or logical basis for the market effect . . .
  - Assess whether the hypothesis is reasonable by collecting preliminary supporting evidence . . .
  - Design the evaluation to build on the preliminary information and supporting evidence . . .
  - Conduct the evaluation, focusing on the strongest hypotheses of market effects and reductions in market barriers . . .
  - Use the supporting evidence to corroborate the evaluation findings.”

Types of data to be collected:

“The best strategy to follow in trying to evaluate market transformation effects is to develop predictions about which specific market indicators will change if the programme is successful, and then to track those indicators, using a quasi-experimental design, if feasible.” It is also important to collect data from a variety of sources, including consumers, dealers, contractors, distributors and manufacturers.

The need for up-front market research:

“In order to learn how to transform energy efficiency markets, it is necessary to first develop a detailed understanding of how these markets currently function . . . [including] a specific theory about what market barriers are currently preventing customers from adopting cost-effective energy-efficiency measures on their own, as well as a testable hypothesis about how utility intervention can overcome these barriers. Second, to be able to later document the possible effects of utility intervention, it is necessary to first establish baseline conditions for those market indicators that are expected to be affected by the programme.”

Documenting number of induced measures rather than unit savings:

“Regardless of the precision with which [per unit savings] is measured, in order to produce an overall estimate of programme savings, it must be multiplied by a more uncertain estimate of the number of induced measures.” Therefore, compared to evaluations of other types of programmes, evaluation of market transformation programmes should allocate significantly more resources to establishing causal effects of the programme, and less to rigorously measure the average gross savings associated with each measure (e.g., through end-use metering or detailed building simulations).

Evaluation Spending:

Regarding evaluation spending, the authors argue that the level of spending, “as a percentage of total DSM spending,” may need to increase, compared to evaluations of traditional DSM programmes. They also suggest shifting resources away from evaluation of traditional DSM programmes and toward market evaluations, especially where utility tracking system savings estimates for specific programmes/technologies have been shown to be more reliable. The timing of spending, they argue, should be shifted toward the front of the programme period to (1) develop market intelligence for programme targeting, (2) estimate baseline market conditions, (3) establish tracking systems and procedure for monitoring the conditions, and (4) develop new methods for integrating and analysing the data that is collected.

The authors suggest the use of market influence diagrams, to provide an overall understanding of market transformation initiatives, from planning through evaluation. They show one such tool developed by Eto et al, as

shown in **Error! Unknown switch argument.**<sup>7</sup>. Exhibit **Error! Unknown switch argument.** presents a market influence diagram for commercial and industrial lighting incentive and information programme.

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<sup>7</sup> *A Scoping Study on Energy Efficiency Market Transformation by California utility DSM Programmes*, by J. Eto, R. Pahl, and J. Schlegel.. Prepared for the California DSM Measurement Advisory Committee (CADMAC), 1996.. LBNL-39058. Lawrence Berkeley National Laboratory. Berkeley, CA.



## ADVICE TO REGULATORS

Report authors Schlegel and Prahel make a number of general recommendations to regulators who are reviewing evaluation results and final reports. They discuss shortcomings of billing analysis impact evaluations, which they have reviewed, including problems regarding:

- Criteria for selecting billing analysis instead of other approaches.
- Poor experimental designs, “including treatment of self-selection effects and of both programme-related factors and exogenous effects”.
- Degree to which participant and non-participant samples are matched.
- Improper methods for screening out specific data records.
- Failure to justify modelling choices (“including the logical and theoretical basis of the models chosen, the history of the modelling effort, and compliance with basic assumptions underlying regression modelling”).
- “Misinterpretation of billing analysis results, including both the inappropriate use of hypothesis-testing approaches and the misapplication of realisation rates” (e.g., extrapolation of billing analysis realisation rates to broader population).
- Poor documentation of the evaluation effort.

They also offer advice to regulators on what to look for in the evaluations they receive, with regard to these issues, and suggest criteria for acceptability related to each issue.

The authors present a list of situations in which end-use metering is most useful:

- “Evaluation of gross savings . . .
- Estimation of coincident peak demand savings . . .
- Focused evaluation of large-impact facilities that are not well suited to statistical analysis
- Providing data for statistical analyses and combination approaches
- Technology evaluation . . .
- Addressing specific research issues, such as determining operating hours (hour loggers) or estimating interactive effects
- Joint utility projects where the relatively high costs can be spread across utilities.”

The limitations and disadvantages of end-use metering are then also presented:

- Higher cost
- Smaller sample sizes and increased concern about sample attrition
- Need for customer permission/cooperation
- Possibility that customers will behave (i.e., use energy) differently if they know energy use is being monitored
- Due to long lead times typically needed, increased potential for difficulty in ensuring that sample is representative of population

- Difficulty in collecting pre-participation data
- Insufficient amounts of data
- Difficulty and expense of obtaining similar data for non-participant customers
- Seasonality of energy use relative to short duration metering efforts
- Interactions between measure installations and other energy-using systems they may affect (e.g., lighting and HVAC equipment)
- Adjusting for free-ridership and making other net-to-gross adjustments
- Decreased ability to show that it is the measures that are responsible for changes in energy use, due to lack of data on the behavioural and market impacts of programmes or technologies

### **SUGGESTIONS FOR EVALUATING CERTAIN TYPES OF TRADITIONAL DSM PROGRAMMES AND MEASURES**

The authors offer general guidelines for applying evaluation strategies:

- “In general, billing analysis is most appropriate to programmes where the participant and measure characteristics follow normal statistical distributions (e.g., higher volume programmes with homogenous populations)
- A further general requirement for billing analysis is that the measure effect [be] large enough in relation to overall energy consumption to be discernible and not ‘lost in the noise.’
- Billing analyses typically address only energy impacts.
- Engineering methods can be accurate, but the accuracy of the method is a very strong function of the quality of the data used to produce the inputs to the methods.
- Except in certain case study applications, end-use metering is not an evaluation method; it is a data collection strategy [to supplement econometric or engineering methods].”

Other guidelines refer to the types of measures being evaluated:

- “As measures move from constant efficiency/constant load to variable efficiency/variable load, the analytic approach and data requirements become more challenging.
- For variable efficiency and/or variable load applications the preferred approach may be simulation modelling or pre-/post-installation metering.
- Envelope measures can be deceptively difficult to analyse and simple algorithmic methods are typically inadequate for these measures [due to the impact of these measures on HVAC systems operation].
- Some measures can be difficult to classify or may fall into one of several categories.”

The primary strategies for data collection include field inspections, surveys, spot measurements (one-time measurements of instantaneous power draw), metering and monitoring, and billing data.

The primary analytical approaches include simple engineering methods, billing analysis, multivariate billing analysis, enhanced engineering estimates, metering and monitoring, and combination and leveraged data approaches.

## Guidelines for Evaluating Common Programme Types

### *Retrofit and Equipment Replacement Programmes*

(Standardised and customised rebates for efficient equipment and systems; financing programmes for efficiency improvement projects)

#### 1. Energy-efficient lighting equipment programmes

Preferred approach is enhanced engineering estimates. Simple engineering algorithms are supplemented by simulation models (that account for the interaction between measures and energy-using systems) and on-site data collection (site-specific operating hours based on run-time hour monitoring). Segmentation by building type accounts for variations in operating schedules. Key evaluation issues:

- Number and type of equipment replaced
- Baseline wattages
- Interactive effects with HVAC systems (especially for commercial programmes)
- Seasonality of lighting energy use

Alternate approaches include simple engineering algorithms (with *assumed* wattages and operating hours) or billing analysis (if lighting is large fraction of total electricity usage and model can address customer variations such as size and business type).

#### 2. Energy-efficient lighting controls programme

Preferred approach is to use simple engineering algorithms, supplemented by simulation models (such as DOE-2 to model daylighting controls) and on-site data collection (metering — e.g., for daylighting controls — and/or site-specific operating hours data by type of space use, to determine load patterns and variations). Load bin methods account for load variations. Segmentation by building type accounts for variations in operating schedules. Key evaluation issues:

- Variation in lighting equipment load (typically based on “engineering judgement”)
- Accurate data on wattage of controlled lights
- Interactive effects with HVAC systems (especially for commercial programmes)
- Seasonality of lighting energy use

Alternate approaches include simple engineering algorithms with estimated “savings factors” (with *assumed* percent savings) for controls or billing analysis (if lighting is large fraction of total electricity usage and model can address customer variations such as size and business type).

#### 3. Energy-efficient motors programmes

Preferred approach is enhanced engineering estimates. Simple engineering algorithms are supplemented as needed by simulation models and on-site data collection (site-specific operating hours, end-use metering, and possibly other). On-site data needs for motors with constant efficiency/constant load include operating houses based on run-time monitoring; for variable efficiency and/or variable load motors, end-use metering is needed. Key evaluation issues:

- Assessing whether motor application is constant versus variable efficiency and load
- Operating hours and profiles

- Rated load factors
- Baseline efficiency
- Large installations may justify expense of on-site inspections and metering/monitoring.

Alternate approach is simple engineering algorithms (with *assumed* efficiencies, load characteristics and operating hours).

#### 4. Energy-efficient motor controls programmes

Preferred approach is enhanced engineering estimates:

Engineering algorithms and load bin calculation supplemented as needed by metering/monitoring (to assess patterns and load variation), simulation modelling (such as DOE-2 to model system changes resulting in variable controls — e.g., conversion of air-handling systems to variable-air volume) and on-site data collection. Key evaluation issues:

- Assessing variation of motor load
- Accounting for efficiency variations among different motor loads

Alternate approach is simple engineering algorithms and estimated “savings factors” for controls.

#### 5. High-efficiency air conditioning and heat pump programmes

Preferred approach is multivariate billing records analysis. Customer surveys are used to develop econometric models, with billing data normalised for weather. Statistically adjusted engineering estimate approaches can be used to leverage prior engineering estimates of impacts. Key evaluation issues:

- Performance characteristics of baseline equipment
- On-site inspections typically required, regardless of method
- Engineering analyses required to estimate demand impacts, when billing analysis approach is used.

Alternate approach is enhanced engineering estimates based on hourly building energy simulation models. This approach requires high-quality site-specific data on construction, operational, occupancy, and equipment characteristics.

#### 6. Building envelope and weatherization programmes

Preferred approach is multivariate billing records analysis. Customer surveys are used to develop econometric models, with billing data normalised for weather. Statistically adjusted engineering estimate approaches can be used to leverage prior engineering estimates of impacts. Key evaluation issues:

- Magnitude of impacts may not be large enough to discern using billing records analysis.
- On-site inspections typically required, regardless of method
- Engineering analyses required to estimate demand impacts, when billing analysis approach is used.

Alternate approach is enhanced engineering estimates based on hourly building energy simulation models. This approach requires high-quality site-specific data on construction, operational, occupancy, and equipment characteristics.

*New Construction, Renovation, and Remodelling Programmes* (e.g., new home information, information and incentive, C/I information and design assistance, C/I design assistance and incentive, and C/I design awards programmes)

### 1. New construction programmes

Preferred approach is combination (hybrid) and leveraged data approaches. Hybrid approaches typically use a mix of statistical methods, engineering, end-use metering supplemented with on-site data collection. Billing records are used to calibrate engineering estimates using post-participation data. Supplemental engineering analyses and metering are leveraged through combination approaches. Key evaluation issues:

- Estimating baseline design characteristics
- Collecting detailed on-site facility and systems data

Alternate approach is enhanced engineering estimates based on hourly building energy simulation models (such as DOE-2). This approach requires high-quality site-specific data on construction, operational, occupancy, and equipment characteristics.

### 2. Information and Education Programmes (seminars, training sessions, publications, technical assistance programmes)

Preferred approach is simple engineering methods — except where measure adoption is systematic (the same across numerous participants), or where large-scale or high-impact measures are adopted — using simple engineering algorithms and assumptions about key parameters. Key evaluation issues:

- Whether the *programme* is responsible for any measures adopted by the targeted customers
- Identifying the actions taken by programme “participants”, including their type, quantity, operating characteristics, timing, etc.

Alternate approach is to use enhanced engineering estimates for systematic, large-scale or high-impact measure adoption. More detailed engineering models and the field data collection may be required and justified.

### 3. Audit Programmes (may promote a wide range of measures)

Preferred approach is simple engineering methods, based on simple engineering algorithms and assumptions about key parameters. Key evaluation issues:

- Identifying the actions taken by programme participants, including their type, quantity, operating characteristics, timing, etc.
- Some well-designed programmes may include sufficient post-audit follow-up data to justify more detailed analysis

Alternate approach is enhanced engineering estimates, where follow-up data indicate significant or systematic adoption of recommended measures. More detailed engineering models and the field data collection may be required and justified.

The authors end the report by defining and providing a brief discussion on a list of 20 evaluation-related terms and issues. Examples include:

- Accuracy, error, precision, and bias;
- Analysis approaches for estimates of average and totals;
- Collinearity;
- Free riders;
- Realisation rate;

- Sampling;
- Serial correlation;
- Spill-over, free drivers, market effects, and market transformation;
- Value of information.

## **APPENDIX: BILLING ANALYSIS ISSUES**

The appendix to the report contains a discussion of problems the authors have observed in their review of billing analyses, including:

- The decision to perform a billing analysis, rather than select a different evaluation method. This can be the wrong decision if:
  - The expected precision of the resulting impact estimate is low;
  - Key data to be used in the analysis (e.g., billing data) is known to be of poor quality;
  - It is obvious from the start that “characteristics of either the measures installed, the customers participating, or the available data or budget are likely to . . . [produce analysis results that cannot] demonstrate some robustness in the face of minor variations in modelling decisions and in the handling of data.”
- Evaluators’ experimental designs sometimes suffer from:
  - Lack of clarity as to whether the evaluation is estimating net or gross savings, and which programme-related factors (free-ridership, spill-over, self-selection, etc.) will be controlled/-accounted for;
  - Not determining how exogenous effects such as changes in the economy or facility will be handled;
  - Failure to address self-selection effects.
- Inappropriate selection of non-participant samples (e.g., not matched properly to participant samples, due to average consumption level or distribution of consumption levels)
- Screening out customer records because they either show unusually large consumption changes or because savings initially estimated are unusually large as a proportion of normalised energy consumption. This can result in upwardly biased savings estimates and can be mitigated somewhat by putting more effort into improving data quality prior to analysis.
- Use of statistically adjusted engineering analyses when there are significant errors in tracking system savings estimates (causes downward bias in savings)
- Inappropriate regression modelling practices. For example:
  - Poor logical and theoretical basis of the selected model
  - Failure to report the sequence of models that have been rejected and the reasons for rejection
  - Inappropriate disaggregation of models by building type or size (resulting in lost precision due to smaller sample sizes used for each model)
  - Failure to account for heteroscedasticity or systematic variations in error terms in C/I programme billing analyses)
  - Failure to perform diagnostics to determine how sensitive and stable the model results are

- Inappropriate rejection of billing analysis results (due to differences from previous evaluation results)
- Misapplication of realisation rates (improper extrapolation of sample results due to use of data filters that fundamentally change the sample population or due to use of realisation rates from a previous year's participants)
- Insufficient documentation.

## MARKET TRANSFORMATION IN A CHANGING UTILITY ENVIRONMENT

Author(s):	S. Hastie, C. McDonald, M. King, R. Smithers
Time:	Prepared for the National Association of Regulatory Utility Commissioners, March 1996

The purpose of this guidebook is to help regulators, utilities and other stakeholders understand market transformation programmes and assess their value and role for achieving energy efficiency objectives.

Utilities and their regulators have long recognised responsibilities beyond merely providing low-cost electricity. One of these responsibilities is to promote energy efficiency, for reasons of environmental quality, resource conservation, sustainable development, economic development, affordability and competitiveness. Recent experience with energy efficiency programmes indicates that market transformation approaches may achieve lasting and widespread energy efficiency improvements at a reasonable cost.

The remainder of this summary provides answers to key questions regarding market transformation, distilled from the more extensive answers appearing in the rest of the guidebook.

### **What is market transformation and why should regulators consider the market transformation approach to achieving energy efficiency?**

Transforming a market means changing the types of products or services that are offered in the market, the basis on which purchase and behavioural decisions are made, the type or number of actors in the market, or in some other way altering this set of interactions in a self-sustaining way. Market transformation is actually a *result* or a *desired outcome*, more than it is a type of programme.

For our purposes, market transformation refers only to those programmes explicitly designed to cause changes in the *structure* of the market for energy efficiency products or service (e.g., new players, different rules, different prices), or in the *behaviour* of some group of market actors, in such a way that energy efficiency is improved and the changes remain after the programme has ended. Unlike traditional DSM programmes, market transformation programmes explicitly try to *change the market* so that energy efficiency products will be purchased in the future without ongoing programmatic intervention to make the targeted purchase or to act in the desired manner.

There is considerable variation (and evolution) in the types of programmes that can be designed to change markets or behaviour, but most are of four general types:

- Introducing a new technology, service, or behaviour into the market.
- Advancing an existing technology, service, or behaviour so that it becomes more widespread.
- Removing or decreasing the use of an inefficient technology, service, or behaviour.
- Accelerating the rate of technological improvement and/or cost reduction.

The scope of market transformation efforts can also vary. For example, initiatives can focus on technical efficiency, cost, distributor/trade ally actions or consumer behaviour, and most initiatives will involve efforts targeted at several of these areas. The target market can also vary in size. Aside from building code initiatives dealing with efficient technologies, most product-oriented efforts will probably need to be mounted at the regional or national level (e.g., heat pump water heater), while some service or behavioural efforts are feasible on a state or local level.

Most market transformation programmes generally share the following characteristics:

- *Involvement of multiple market actors, with critical roles often being played by entities up and down the product distribution chain, as well as by brokers/facilitators/specialists with knowledge of and breadth of contacts in targeted technologies and markets; entities to promote the targeted product, service or practice; and possibly others*
- *Activities designed to remove or lower specific market barriers to energy efficiency technologies, both on the supply and the demand side*
- *Longer time frames (than other DSM programmes) before the majority of programme impacts are obtained (i.e., before the market has been permanently changed)*
- *Significant activity upstream from the customer or end user.*

The benefits of the market transformation approach include:

- *Use of market forces to overcome barriers to efficiency.*
- *Promise of greater energy savings at lower cost.*
- *Permanent changes in the market, i.e., ones that continue after the programme ends.*

In addition, some market analysts have viewed market transformation programmes as a way to merge two recent trends — innovative DSM programme design and utilities' need to minimise costs of energy efficiency programmes. Some see market transformation initiatives, with their focus on using market forces to achieve efficiency improvements, as more compatible with future restructured (more competitive) markets. Others see these initiatives as a less expensive way for utilities in the current regulatory environment to achieve energy savings.

### **What should qualify as a market transformation programme worthy of being funded by ratepayers?**

Regulators must determine whether the “market transformation” programmes submitted to them for approval (either unsolicited or in response to regulatory prompting) represent prudent use of ratepayer funds. The market transformation programme must include a coherent plan that maximises the chances for success. This has been required for the traditional DSM programmes in the past; i.e., programmes must be well-conceived and comprehensively planned. A checklist of the features regulators should require market transformation programme plans to address is summarised in **Error! Unknown switch argument.**

*Exhibit Error! Unknown switch argument.: Programme design requirements for market transformation programmes.*

- ◆ *Documentation on how the target market operates* (the set of complex market interactions appropriate to the targeted technology or market)
- ◆ *Baseline information* on efficiency levels and market indicators that will be used to establish that market transformation has occurred
- ◆ *Identification of key market barriers* to increased efficiency in the target market, including both the supply side (e.g., products and services available in the market) and the demand side (end-user attitudes and behaviour)
- ◆ *Development of an implementation plan for lowering or eliminating specific market barriers*, including identification of a lead implementor (or programme champion) and other members of any consortium or coalition formed to implement the programme; a projected timing of costs and benefits; identification of target efficiency improvements and key market indicators; and a forecast of the type and timing of incremental changes to them expected to occur with and without programme
- ◆ *A specific implementation plan and timeline, with a rationale for it that is based on market conditions*, including the presence of existing momentum for change, possible linkage of efficiency to other features valued by the targeted decision makers, and existence of related or supporting efforts in the market and how the programme will interface with them (e.g., market transformation or energy efficiency initiatives being implemented by other organisations)
- ◆ *Estimation of programme cost-effectiveness* to the relevant jurisdiction, and of value to each of the market actors crucial to its success.
- ◆ *A programme evaluation strategy*, including both impact- and process-oriented efforts, that quantifies programme impacts on: (1) energy use (both directly resulting from programme activities as well as lasting changes in efficiency that the transformed market will maintain without intervention); and (2) the market indicators identified as part of the programme design. It also must monitor programme effectiveness and provide reasons for unexpected programme successes and failures.
- ◆ *An exit strategy* for the programme, including projected timing and trigger points/thresholds.

The key features that differentiate the market transformation programme design from traditional DSM programme designs include the following:

- *A focus on removing or lowering market barriers.* Market transformation programmes should be directly targeted at removing or lowering market-specific barriers. Key barriers to the targeted technology, service or behaviour must be identified; the market will not be transformed if the programme removes only barriers existing on the product supply side or only on the customer demand side.
- *Use of market indicators.* These are characteristics of the targeted market that are expected to change if the market is truly being transformed. Examples might include the number or percentage of manufacturers offering a new efficient technology, number or percentage of retail outlets carrying the product, amount of shelf space devoted to a targeted product or the prominence of its display in stores, product price, product technical specifications, percentage of consumers aware of a targeted product or service, or number or percentage of builders installing the technology into new buildings.
- *Permanent change in the market.* The programme must include a logic for a chain of events that will result in permanent change in the market.

- *An exit strategy.* The programme plan should have a clear logic explaining why the programme stimulus to the market will no longer be needed after a specified period of time or after certain market indicators reach pre-specified levels. These exit trigger points/thresholds should be specified.

Regulators may have to approve a programme concept in total, but approve funding for programmes in stages. In this way, planning and market research can inform future decisions on level of effort for, and even the advisability of implementing, the programme. Such market research is likely to be needed in the early stages of programme design, in order to document the operation of the target market, develop a consortium, identify baseline efficiency levels, help refine estimates of energy savings potential, and finalise the most appropriate market change indicators to use in monitoring the programme's success in transforming the market.

**What is the policy rationale for implementing market transformation and other energy efficiency programmes in both the current, rapidly evolving regulatory environment and in one characterised by significant customer choice of energy provider (competition)?**

The decision to provide a programmatic stimulus to the market must be based on a finding that existing market failures result in an inefficient allocation of resources. Restructuring of the electricity industry is likely to remove certain market failures, but others will remain, including:

- Exclusion of externalities (especially environmental ones) in energy costs
- Lack of information
- Transaction costs
- Disconnected decision making.

The decision to provide a market stimulus must be based on an analysis that a market failure exists, that it is significant enough to warrant action, and that the stimulus will have a reasonable chance of improving the situation. The competitive electricity markets in Norway and the United Kingdom have not fostered significant natural market energy efficiency.

**What options do regulators have for encouraging market transformation as an approach to achieving energy efficiency objectives; specifically, what are the implementation and programme options?**

Market transformation efforts are likely to require some level of participation by many parties, in order to truly transform targeted markets. However, in terms of the entities that would assume the lead role in such efforts, regulators have three general implementation options:

- Implementation of initiatives within the state by a utility or utilities
- Implementation of in-state initiatives by a third party (perhaps specially created for the purpose)
- Implementation by either a third party or a utility consortium at the regional or national level.

**Error! Unknown switch argument.** and **Error! Unknown switch argument.** compare the advantages and disadvantages associated with each implementation option. It is likely that regulators will want to consider approving ratepayer funds to be used by a third-party implementor for certain market transformation initiatives, with only a minor if any utility role in the effort, to the extent that this is not precluded by existing statutes. This is especially true for regional and national efforts and for initiatives being implemented in a more competitive utility environment. Ideally, regulators will be in a position to pick and choose among all three options, and construct a portfolio of initiatives (perhaps including some traditional DSM efforts) that best meets their individual objectives, including efficiency gains, economic development, resource conservation and equitable distribution of benefits among ratepayers.

Competition among market transformation initiatives seeking funding support would most likely result in increased innovation and cost effectiveness. A number of sources have identified possible technology and market targets for market transformation efforts, including a June 1994 ACEEE study,<sup>8</sup> the Boston Edison Settlement Board, the Consortium for Energy Efficiency, the U.S. DOE, the U.S. EPA, and others. However, the appropriateness of specific programmes to particular states will vary according to the nature of the markets within each state.

*Exhibit Error! Unknown switch argument.: Summary of advantages of major market transformation implementation options.*

<b>Utility In-State Implementation</b>	<b>Third-Party In-State Implementation</b>	<b>Utility/Third-Party Regional or National Implementation</b>
<ul style="list-style-type: none"> <li>• Experience in implementing energy efficiency programmes</li> <li>• Staff experienced with energy efficiency initiatives (some, with market transformation programmes)</li> <li>• Established relationships with trade allies and customers</li> <li>• History of regulator-utility interactions with regard to energy efficiency initiatives</li> <li>• Regulators have significant level of control over implementation</li> <li>• Easier to ensure compatibility with utility traditional DSM programmes</li> </ul>	<ul style="list-style-type: none"> <li>• If special market transformation entity is created for multiple efforts, can develop efficient protocols and procedures</li> <li>• Need for rate treatment mechanisms reduced (with regard to market transformation programmes)</li> <li>• Would project an image of objectivity, facilitating cooperation of utility and non-utility parties</li> <li>• Utility transition to more competitive market likely to have less effect on implementing ongoing initiatives</li> <li>• Greater willingness to share information to advance the state of the art in programme design, implementation and evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Larger array of programme options, due to ability to address larger (multi-state) markets</li> <li>• Share costs and risks with many others</li> <li>• Only regional or national efforts can transform regional or national markets</li> </ul>

<sup>8</sup>Steve Nadel and Howard Geller, *Market Transformation Programmes: Past Results, Future Directions*, June 1994.

*Exhibit Error! Unknown switch argument.: Summary of disadvantages of major market transformation implementation options.*

Utility In-State Implementation	Third-Party In-State Implementation	Utility/Third-Party Regional or National Implementation
<ul style="list-style-type: none"> <li>• Not all types of programmes are appropriate due to market size (especially for small states)</li> <li>• Costs/unit energy saved may be higher, due to fewer entities over which to distribute programme costs</li> <li>• Advantages in a regulated environment may become disadvantages in a competitive market</li> <li>• May be reluctance to share information with others implementing market transformation initiatives, due to competitive pressures</li> <li>• Possible divergence of the public and commercial interests</li> <li>• Market transformation skills may not be a competency of the utility</li> <li>• Possible conflicts with initiatives in other states</li> </ul>	<ul style="list-style-type: none"> <li>• Largely untried in most states</li> <li>• May be legal issues to address in providing third parties with ratepayer funds</li> <li>• May be more difficult to dovetail efforts with traditional utility DSM programmes</li> <li>• Limited accountability</li> </ul>	<ul style="list-style-type: none"> <li>• Less control over implementation and evaluation</li> <li>• Possibility for greater communications problems and inefficiencies due to size and complexity of efforts being mounted</li> <li>• Limited accountability</li> <li>• May be issues about ability to fund</li> </ul>

**Error! Unknown switch argument.** presents a list of the actions regulators should take to make market transformation programme implementation feasible and efficient in their jurisdictions.

Federal and state governments may develop initiatives that play important roles in encouraging market transformation, including establishing energy policy, supporting research and development, providing technical assistance, encouraging market acceptance of specific technologies, adopting standards and codes, helping to coordinate and taking part in market aggregation efforts to ensure the private sector of substantial markets for efficient products/services, and recognising outstanding examples of private sector efficiency improvements. Regulators should look for synergies between utility-funded efforts and these initiatives.

*Exhibit **Error! Unknown switch argument.**: Summary of actions regulators should take to encourage implementation of market transformation programmes.*

- ◆ Make clear commitments to encouraging market transformation initiatives both in the current environment and in a more competitive one.
- ◆ Fund market transformation programmes through a non-bypassable, non-discriminatory charge (especially in a more competitive environment).
- ◆ Be willing to approve funding for programmes, or participation in programmes, that may result in significant energy savings outside the jurisdiction.
- ◆ Encourage coordination of market transformation efforts so that synergy of efforts is maximised and initiatives do not run at cross purposes.
- ◆ Work to change statutes, where necessary, to permit funds collected for the purpose of energy efficiency improvements to be spent by consortia or other third-party organisations implementing market transformation initiatives.
- ◆ Change regulatory policies, if necessary, so that:
  - Shareholder incentives can be tied to *indications* of market transformation
  - The system of funding approvals can address multi-year programme efforts that yield few if any impacts in the first year or two
  - Evaluation requirements are modified to reflect the relatively greater uncertainty and complexity of evaluation of market transformation programmes and the greater reliance on market indicators.
- ◆ Make sure that market transformation initiatives are consistent with other public policy goals, both in a franchise market and a more competitive one.
- ◆ Be willing to accept: (1) the reduced level of control and oversight over programme implementation; (2) the front-loading of programme costs; and (3) the greater uncertainty associated with programme impacts that may accompany market transformation programmes in exchange for: (a) the possibility of larger impacts; (b) greater use of market forces to achieve energy efficiency goals; and (c) energy efficiency that will persist.

### How should market transformation programmes be evaluated?

Regulators will need to take a number of important actions with regard to the evaluation of market transformation programmes, stemming from how these programmes are different from traditional DSM programmes. These actions are summarised in **Error! Unknown switch argument.**. Key issues responsible for the difference in market transformation evaluation include the following:

- One year snapshots of energy savings will be of minimal value for deciding whether or not to continue the programme.
- Ability to attribute impacts solely to the programme is likely to be limited.
- It may be very difficult to establish a viable comparison group for estimating programme impacts.

Issues to be considered when determining how and when to evaluate market transformation programmes include the following:

- *First and foremost, what is the purpose of the evaluation?* Evaluation will be needed to (1) help refine programme implementation throughout the programme, (2) monitor the programme's effect on key (pre-specified) market change indicators, (3) estimate overall energy impacts for the programme, and (4) provide lessons of experience to improve future programmes.
- *Second, both baseline estimation and final estimation of energy impacts are likely to be much less precise than they are for traditional DSM programmes.* Baseline estimates will most likely have to be estimated over an extended period of years, and sometimes with regard to new technologies. Attribution of programme impacts and counts of programme participants are likely to be more approximate, due to significantly greater opportunities for exogenous factors to influence participant behaviour and to possible difficulties in determining the exact number of participants. In response to these uncertainties, regulators who want to take advantage of the substantial and lasting impacts promised by market transformation programmes will probably want to require that pre-implementation agreements be reached (between regulators and utilities, or between utilities and other interested parties) with regard to what will constitute evidence of impacts for specific programmes.
- *Evaluation should reflect the fact that the programme is attempting to change a market.* This typically will require shifting resources away from estimating per-unit impacts and toward providing evidence of attribution of impacts to the programme and measuring market indicators. Because of the longer time frames likely to be required to achieve market transformation programme impacts, evaluation efforts are needed to monitor market efficiency levels and especially key market indicators throughout the programme.

One option in dealing with these evaluation issues is to use simpler methods to estimate energy savings and focus much of the evaluation on collecting data on market change indicators identified prior to programme implementation. Evaluators can then assemble evidence from all or most of these indicators as to whether the programme is having the effect anticipated by programme planners. This information can aid in modifying the programme, demonstrate market transformation, and provide a basis for awarding shareholder incentives. Incorporation of evaluation planning into programme design is thus critical: Data on specific market change indicators must be collected as part of the initial programme design, to establish baseline values against which to compare later market measurements.

*Exhibit Error! Unknown switch argument.: Summary of key actions to be taken by regulators to facilitate evaluation of market transformation programmes.*

- ◆ *Regulators need to negotiate evaluation requirements and standards prior to programme implementation.* This is to obtain agreement on areas of uncertainty that are key to measuring the effectiveness of the programme, such as:
  - How will gross energy savings be estimated?
  - How will attribution of energy impacts to the programme be demonstrated (i.e., what will constitute a sufficient proof of attribution)?
  - How will the level of participation be estimated or measured (i.e., those who purchase the targeted product/service or perform the targeted behaviour)? For many programmes, these participants need not inform anyone involved with the programme of their participation status.
  - What will be used as the forecast of how the targeted efficient product or practice would have changed over time, in the absence of the programme?
  - What are the market indicators for which specific changes will be considered evidence that the market is being transformed?

*(to be continued)*

(continued)

- What is the approximate order and timing of the changes that should occur to these market indicators, if the programme is transforming the market? When should measurements occur?
  - What types of data will be sufficient in demonstrating that the selected market indicators have changed in the expected manner?
  - What is the expected level of effort required to measure changes to all market indicators?
  - Which indicators, or combination of indicators, will signal that the programme should end, and how will they be measured or estimated?
- ◆ *Shareholder incentive mechanisms linked to evaluation results should be altered* to address delayed market transformation impacts, for example, by tying portions of incentives to achieving specified market indicator milestones.
  - ◆ *The rigor of the evaluation requirements needs to be tied to the level of utility participation.* It may make sense to require little if any evaluation research for utilities playing a minor role in a programme (e.g., sending bill stuffers to customers). Utilities or third parties serving as primary programme implementors should face more rigorous requirements, though these requirements should acknowledge the uncertainties involved in market transformation evaluation. It may be advisable to have an independent evaluation team to perform some or all of the key research tasks: Baseline efficiency and market indicator analysis, monitoring of energy savings and market indicators during the programme, and post-programme evaluation of energy savings and market transformation impacts.

This approach holds promise for maintaining a degree of rigor while acknowledging the practical cost and technical limitations of the evaluation of market transformation programmes. The method may be useful in the current utility environment, especially in situations involving shareholder incentive mechanisms, though (as noted earlier) such mechanisms themselves will need to change to reflect the limitations of data collection associated with market transformation evaluation. It is also likely to be effective in assisting decision-makers in a more competitive environment.

The effects of market transformation programmes are not entirely controllable by the implementors. They must take advantage of existing forces in the market for change and stimulate that market so that permanent efficiency change results. They do not try to compensate market actors for acting in a way inconsistent with their own interest; they try to change that self interest. Such a significant change may require substantial, orchestrated activity on the part of a wide range of market actors, any of which can be influenced by factors outside of the programme to act in ways that greatly accelerate programme objectives or hinder them. Further, the programme may succeed in removing the targeted market barriers and still not result in the energy savings projected, due to factors either unknown to the programme implementors or not controllable by them.

Regulators and implementors will have to share this risk in some way. Penalising an implementor for a well-conceived but ultimately unsuccessful market transformation programme — by, for example, denying cost recovery or withholding shareholder incentives altogether — will send a message that market transformation programmes are not worth the risk. Rather than discouraging market transformation programme implementation, a sharing of risk emphasises the substantial, lasting benefits that may result from the programme, as well as the importance of pre-programme market research and ongoing evaluation activities to carefully assess market conditions, market barriers, market indicators, market indicator baseline levels, and overall implementation effectiveness.

## Conclusions

Programmes that influence energy efficiency decisions by transforming markets have some obvious advantages over those relying on repeated stimuli to influence each decision. These advantages include potential for increased cost effectiveness and greater use of market forces in attaining efficiency objectives. Market transformation initiatives

may replace or complement "traditional" DSM efforts. They are likely to involve multiple market actors working together for an extended period of time, require a longer time frame to achieve their objective (transforming a market), and include significant activity upstream of the targeted decision maker. These differences suggest corresponding differences in the evaluation of such programmes and in regulatory policy.

The promise of market transformation programmes, however, will not be realised unless regulators make clear to utilities and other interested parties their expectations regarding such programmes. This guidebook attempts to provide a basis on which regulators can provide such guidance.

**EUROPEAN B/C ANALYSIS METHODOLOGY - A GUIDEBOOK FOR B/C EVALUATION OF DSM AND ENERGY EFFICIENCY SERVICES PROGRAMMES**

Author(s):	SRC International ApS for the European Commission DGXVII
Time:	February 1996

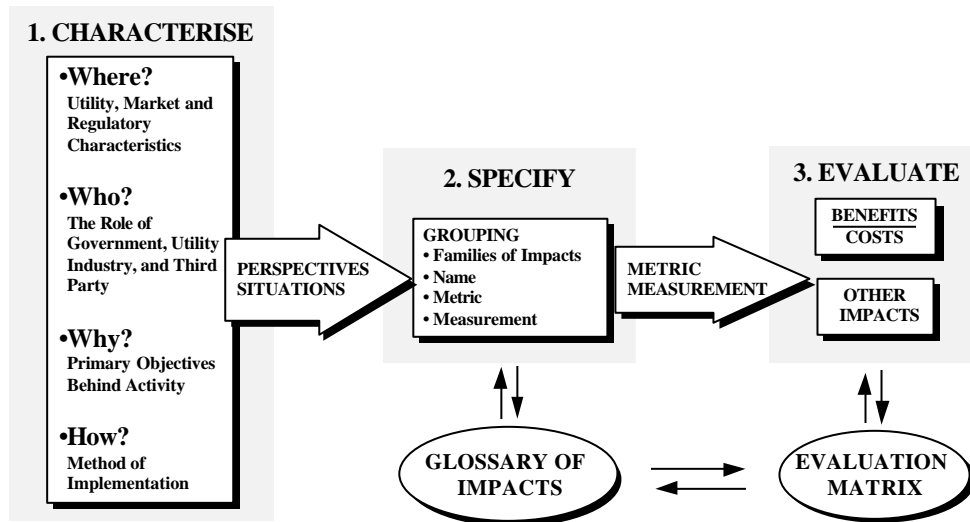
A consistent methodology and a guidebook for how to perform B/C analysis of DSM and energy services programmes in different utility and market situations are provided. The methodology is flexible and robust so as to allow for the B/C analysis to take place in different European countries and types of energy systems.

Structured B/C analysis consists of three steps:

- Characterisation of external environment;
- Specification of impacts;
- Evaluation.

These steps constitute the EUBC methodology and an overview of the methodology is presented in **Error! Unknown switch argument.**

*Exhibit Error! Unknown switch argument.: Overview of B/C methodology.*



## STEP 1 — CHARACTERISATION

A robust methodology must be established upon which a discussion of cost-effectiveness of DSM and energy services programmes can be based. Phase one of this study offers such a framework. Without a framework it would be very difficult to perform a meaningful discussion, and results would be of limited value. The main outcome of the characterisation process is an improved understanding of the situation at hand and the perspectives to be included into the analysis.

Four key issues must be addressed to allow assessment and comparison of DSM and energy services programmes:

- Where — Characterisation of the environment in which the DSM and energy service programme is being implemented. This external framework includes describing the energy market type, utility industry structure, and regulation type.
- Who — Identification of the role of government, utility industry, and third party involved in the DSM and energy service programmes.
- Why — Identification of the reasons for performing DSM and energy service programmes? Are programmes, for example, performed as a part of public policy to achieve a public policy goal, or as part of a utility strategic marketing programme to increase market share and profitability?
- How — Determination of the implementation method for the DSM or energy service programme.

## STEP 2 — SPECIFICATION OF IMPACTS

The main outcome of this step-by-step process is an improved understanding of which impacts to include in the B/C evaluation. As support for the B/C specification process the report provides a glossary of B/C impacts containing the following for each impact:

- Name and definition of B/C impact;
- Suggested metric unit and measurement;
- Perspectives for which perspectives the impact is relevant;
- How the impact should be included in the B/C equation — as a cost or a benefit;
- Potential for overlap with other benefits;
- Guidance on interpretation of results.

## STEP 3 — EVALUATION

Step 3 encompasses compilation of the impacts in a manner that allows a consistent comparison of alternatives. Experience in performing these evaluations has shown that both qualitative and quantitative impacts should be used in the evaluation.

*Exhibit Error! Unknown switch argument.: Example of a generic EUBC evaluation matrix.*

Perspective	Costs	Benefits	B/C Ratio	Other Impacts
Customer				
Distribution Utility				
Wholesale Utility				
Government				
Society				
Other				

The guidebook suggest that for each of six different perspectives costs, benefits, benefit/cost ratio and other impacts be analysed (see **Error! Unknown switch argument.**). Monetized costs and benefits are often given the most weight, so they are listed individually. Other impacts are sometimes critical to decision-making, and they are included formally in the matrix so they can be used if desired.

Which impacts are relevant depends on the specific programme, programme context, and the perspective of the valuation. However, as a guideline a generic overview of possible relevant impacts for each perspective is given in **Error! Unknown switch argument.** The evaluation planner may then decide which impacts are irrelevant to the evaluation in question and eliminate these and maybe add others. Impacts can be added or subtracted from this list, as can be seen in the examples. Some perspectives shown in this table may not be used or may not have any meaning in some analyses. Impacts marked with a (\*) indicate that they should be included in the primary equation if they are translated into monetary equivalents.

*Exhibit Error! Unknown switch argument.: Overview of likely relevant benefits and costs by perspective.*

Perspective	Included In Primary Equation	Otherwise Accounted
Participating Customer	Consumption of Other Fuels Change in Energy Bill Industrial Productivity Customer Capital Investment Customer O&M Utility Incentives Third Party Incentives Tax Credits Taxes Other Customer Transaction Costs (*) Customer Value (*) Tariff Changes (*)	Proven Performance Ease of Implementation Availability of Capital (Other Customer Transaction Cost (*)) (Customer Value (*)) (Tariff Changes (*))
Non-participating Customer	Tariff Changes (*)	(Tariff Changes (*))
Generation and Transmission Utility	Energy Generation Costs Generation Capacity Cost Transmission Capacity Cost Power Purchase Revenue Wholesale Utility Programme Costs Wholesale Utility Incentive Payments Risk and Reliability (*)	Public Image (Risk and Reliability (*))
Distribution and Supply Utility	Power Purchase Cost Utility Revenue Change Distribution Capacity Cost Distribution Utility Programme Costs Distribution Utility Incentive Payments Tariff Changes (*)	Market Share Public Image Proven Performance Ease of Implementation Ease of Evaluation Availability of Capital Cash Flow (Tariff Changes(*))
Government	Tax Revenues Government Programme Costs Tax Credits Environmental Effects of Supply (*) Environmental Effects of Consumption (*)	Industrial Productivity Regional Employment Public Image Diminishment of Natural Resources Anti-Competitiveness (Environmental Effects of Supply (*)) (Environmental Effects of Consump. (**))
Society	Energy Generation Costs Generation Capacity Cost Transmission Capacity Cost Distribution Capacity Cost Utility Programme Costs Government Programme Costs Third Party Programme Cost Customer Capital Investment Customer O&M Environmental Effects of Supply (*) Environmental Effects of Consumption (*) Tariff Changes (*) Other Customer Transaction Costs (*) Customer Value (*)	Industrial Productivity Regional Employment Diminishment of Natural Resources Anti-Competitiveness (Environmental Effects of Supply (*)) (Environmental Effects of Consump. (**)) (Tariff Changes (*)) (Other Customer Transaction Costs (*)) (Customer Value (*))

## THE INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL

Author(s):	U.S. Department of Energy
Time:	August 2000

When firms invest in energy efficiency, they naturally want to know how much they have saved and how long their savings will last. If the installation had been made to generate energy, measurements would be trivial — install a meter. But to measure savings is a challenge, and requires both metering and a methodology, known as a measurement and verification protocol.

Until recently energy efficiency financing has been limited because investors and financial institutions lacked a reliable approach to measure and ensure savings from these investments. *The International Performance Measurement and Verification Protocol* (IPMVP) has helped to overcome this barrier. This new version, developed by hundreds of organisations and experts from over 25 countries, is an effective tool for increasing investments in energy efficiency. The IPMVP is revised every year and is maintained under the sponsorship of the US Department of Energy by a broad coalition of facility owners/operators, financiers, contractors or ESCOs and other stakeholders.

The IPMVP has become the industry standard in the United States, is published in ten languages, and is becoming the industry standard in countries around the world to finance energy efficiency projects

It is an updated and improved version of the *North American Energy Measurement and Verification Protocol* (1996). It was the result of a collaborative effort between federal and state agencies and experts in the United States, Canada and Mexico. The effort was sponsored by the U.S. Department of Energy and reflected a broad consensus in the energy and efficiency industries. It addresses measurement and verification needs for performance contracting (contracts to install energy efficiency measures in which payment is in some way based on the performance of the measures installed).

The IPMVP is not intended to prescribe contractual terms between buyers and sellers of efficiency services, although it provides guidance on some of these issues. Once other contractual issues are decided, this document can help in the selection of the measurement & verification (M&V) approach that matches best:

- Project costs and savings magnitude,
- Technology-specific requirements, and
- Risk allocation between buyer and seller, i.e., which party is responsible for installed equipment performance and which party is responsible for achieving long term energy savings.

### Purpose of the IPMVP

When firms invest in energy efficiency, their executives naturally want to know how much they have saved and how long their savings will last. The determination of energy savings requires both accurate measurement and replicable methodology, known as a measurement and verification protocol.

The long-term success of energy and water management projects is often hampered by the inability of project partners to agree on an accurate, successful M&V Plan. This M&V Protocol discusses procedures that, when implemented, help buyers, sellers and financiers of energy and water projects to agree on an M&V Plan and quantify savings from Energy Conservation Measure (ECM) and Water Conservation Measure (WCM). Simply put, the purpose of the IPMVP is to increase investment in energy efficiency and renewable energy. The IPMVP does so in at least six ways:

- Increase energy savings.

- Reduce cost of financing of projects.
- Encourage better project engineering.
- Help demonstrate and capture the value of reduced emissions from energy efficiency and renewable energy investments.
- Increase public understanding of energy management as a public policy tool.
- Help national and industry organisations promote and achieve resource efficiency and environmental objectives.

### **Role of the IPMVP**

This Protocol:

- Provides energy efficiency project buyers, sellers and financiers a common set of terms to discuss key M&V project-related issues and establishes methods, which can be used in energy performance contracts.
- Defines broad techniques for determining savings from both a "whole facility" and an individual technology.
- Applies to a variety of facilities including residential, commercial, institutional and industrial buildings, and industrial processes.
- Provides outline procedures, which i) can be applied to similar projects throughout all geographic regions, and ii) are internationally accepted, impartial and reliable. Presents procedures, with varying levels of accuracy and cost, for measuring and/or verifying: i) baseline and project installation conditions, and ii) long-term energy savings.
- Provides a comprehensive approach to ensuring that building indoor environmental quality issues are addressed in all phases of ECM design, implementation and maintenance.
- Creates a living document that includes a set of methodologies and procedures that enable the document to evolve over time.

### **Audience for the IPMVP**

The target audience for this Protocol includes: Facility Energy Managers; Project Developers and/or Implementers; ESCOs (Energy Service Companies); Non-Governmental Organisations (NGOs); Finance Firms; Development Banks; Consultants; Government; Policy Makers; Utility Executives; Environmental Managers; and Researchers

### **Summary of IPMVP volumes**

Volume I defines basic terminology useful in the M&V field. It defines general procedures to achieve reliable and cost-effective determination of savings. Verification of savings is then done relative to the M&V Plan for the project. This volume is written for general application in measuring and verifying the performance of projects improving energy or water efficiency in buildings and industrial plants.

Volume I is largely drawn from the December 1997 edition of IPMVP. Apart from a general refocusing of the document for increased clarity, the definitions of Options A and B have been significantly modified in response to reactions received to earlier editions. These changes now include required field measurement of at least some variables under Option A, and all variables under Option B. Examples of each M&V Option have been added in Appendix A. Former sections on M&V for new buildings, residential and water efficiency have been moved to Volume III. The text has been updated and language tightened to achieve greater technical consistency and ease of use.

Volume II reviews indoor environmental quality issues as they may be influenced by an energy efficiency project. It focuses on measurement issues and project design and implementation practices associated with maintaining

acceptable indoor conditions under an energy efficiency project, while advising on key related elements of M&V and energy performance contracts. Volume II is scheduled for publication concurrently with Volume I.

Volume III is planned for publication in early 2001, and reflects guidance and input of over 100 international experts. It will review application specific M&V issues. It is intended to address M&V specifics related to efficiency projects in industrial processes, new buildings, renewable energy, water efficiency, and emission trading. This volume is expected to be an area of continued development as more specific applications are defined.

### M&V options

The Protocol defines a range of M&V options so that readers have flexibility in the methods chosen and the cost to implement them. **Error! Unknown switch argument.** below is provided by the document as a summary of the major types of performance contracts.

*Exhibit Error! Unknown switch argument.: Major types of performance contracts.*

	On Owner's Balance Sheet	Not On Owner's Balance Sheet
<b>Net Owner Payment Contingent on Performance</b>	<ul style="list-style-type: none"> <li>• Guaranteed Savings</li> <li>• (Long Term)</li> </ul>	<ul style="list-style-type: none"> <li>• Shared Savings</li> <li>• Pay from Savings</li> <li>• Chauffage</li> </ul>
<b>Net Owner Payment Not Contingent On Performance</b>	<ul style="list-style-type: none"> <li>• Guaranteed Savings Loans</li> <li>• (Short Term)</li> <li>• Capital Leases</li> </ul>	<ul style="list-style-type: none"> <li>• Certain Municipal Leases</li> <li>• Operating Leases</li> </ul>

The Protocol discusses various aspects of the measurement and verification process, including:

- Baseline verification;
- Post-installation verification;
- Regular interval post-installation verification;
- M&V techniques (engineering calculations, metering and monitoring, utility meter billing analysis, computer simulations, agreed upon stipulations by the owner and the contractor/ESCO);
- Energy use stipulations.

The document then addresses M&V issues such as metering and monitoring issues and protocols, the role of energy costs in the contracts and M&V protocol, minimum energy standards, and interactive effects.

Determining the level of effort for M&V depends on:

- Value of the energy efficiency measure (called an energy conservation measure, or ECM, throughout the document) in terms of projected savings;
- Complexity of the measure;
- The number of measures at a single facility and the degree to which their savings are interrelated;
- Uncertainty of savings;
- Risk allocation between the contractor/ESCO and the owner;
- Other uses for M&V data and systems.

**Error! Unknown switch argument.**, from the Protocol document, presents the four basic M&V options, how savings are calculated, and typical applications.

*Exhibit Error! Unknown switch argument.: Four basic M&V options.*

<b>M &amp; V Option</b>	<b>How Savings are Calculated</b>	<b>Typical Applications</b>
Option A: Partially Measured Retrofit Isolation	Engineering calculations using short term or continuous post-retrofit measurements and stipulations.	Lighting retrofit where power draw is measured periodically. Operating hours of the lights are assumed to be one half hour per day longer than store open hours.
Option B: Retrofit Isolation	Engineering calculations using short term or continuous measurements.	Application of controls to vary the load on a constant speed pump using a variable speed drive. Electricity is measured by a kWh meter installed on the electrical supply to the pump motor. In the base year this meter is in place for a week to verify constant loading. The meter is in place throughout the post-retrofit period to track variations in energy use.
Option C: Whole Facility	Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.	Multifaceted energy management programme affecting many systems in a building. Energy use is measured by the gas and electric utility meters for a twelve month base year period and throughout the post-retrofit period
Options D: Calibrated Simulation	Energy use simulation, calibrated with hourly or monthly utility billing data and/or end-se metering.	Multifaceted energy management programme affecting many systems in a building but where no base year data are available. Post-retrofit period energy use is measured by the gas and electric utility meters. Base year energy use is determined by simulation using a model calibrated by the post-retrofit period utility data.

The *International Performance Measurement and Verification Protocol* can be obtained at <http://www.ipmvp.org>

## EVALUATING MARKET TRANSFORMATION INITIATIVES: ISSUES, CHALLENGES, AND STATE OF THE ART

Author(s):	Jeff Schlegel, Schlegel and Associates
Time:	Presented at the ACEEE Workshop on Market Transformation, Washington, DC, March 11, 1997

The following summarises Mr. Schlegel's presentation.

- “All evaluations will not look the same – there will be a wide variety of evaluation and research activities.”
- Purposes of evaluation for market transformation initiatives:
  - Help determine whether to intervene in market (prior to programme).
  - Support planning/design of programmes, including up-front market analyses and baseline studies.
  - Provide ongoing feedback on programme design and implementation.
  - Document indicators of programme effectiveness (changes in market indicators signalling reductions in market barriers).
  - Assess overall programme success.
  - Provide data on which to base performance incentives offered to programme administrators/implementors.
  - Document need to change nature or level of market intervention.
- Key questions to be addressed:
  - What changes have occurred in market? (Need for up-front market research to gain a detailed understanding of how market operates, identify market barriers, and determine market indicator and efficiency baselines.)
  - What was the role of the market transformation initiative in bringing about these changes?
  - Will the observed changes persist?
- Key evaluation challenges:
  - Difficult to (1) prove that the initiative “caused” any observed market effects and (2) forecast what would have happened in the absence of the programme
  - Difficult to estimate effects of one partner in coordinated or regional market transformation initiatives
  - Important to obtain information at a time when it can affect decision making about the initiative, and to know when to estimate programme impacts (where the product/practice is on the technology diffusion curve)

- In evaluating the success of an initiative:
  - Define success in multiple ways:
    - Ultimate outcomes (e.g., energy savings, products sales)
    - Market effects (e.g., changes in market indicators, reductions in market barriers)
    - Good-faith effort by the administrator/implementor in implementing tasks that are based on a consensus plan of key decision-makers.
  - Focus on market indicators (timely, observable, real-time feedback, close in time to programme activities).
  - Provide a complete logic for whether the initiative has been successful
    - Evidence of market changes caused by initiative
    - Logic of how and why initiative caused the changes
    - Explanation of confounding factors and alternative theories.
  - Use a systematic framework throughout planning-evaluation process (e.g., market influence diagram or flow chart showing expected effects of programme)
  - Consider the option of retrospective analysis (limited usefulness for certain types of decision making)
  - Balance the level of effort with the purposes of the evaluation
- Possible approaches for evaluating market transformation initiatives:
  - Track and analyse indicators of market effects
  - Analyse decision, actions, behaviour and attitudes of affected market actors
  - Analyse and model adoption and penetration of targeted product/practice
  - Track sales and analyse sales data
  - Analyse changes in load data over time

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