Introduction to Panel 4: Monitoring and evaluation

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Introduction

The European Union Directive 2006/32/EC on energy end-use efficiency and energy services requires EU Member States to achieve an overall national indicative energy savings target (9 % between 2008 and 2016) and to take cost-effective, practicable and reasonable measures to achieve it. In this European framework, the evaluation of energy saving targets is an important issue. This links to world-wide efforts to evaluate energy efficiency policies and programs especially in the frame of climate change reporting obligations which have been ongoing for several years. The effectiveness of programs and policies (how many savings for what cost) is a central point of the evaluation question which has received new impetus from the energy efficiency directive. Evaluation of energy efficiency policies and measures has many facets which depend whether the evaluation concerns the impact of **individual energy service measures at the micro-level**, of **individual instruments or programmes** or of **complex and comprehensive policies** such as those to be realised in the frame of the energy efficiency directive of the EU. Each level requires **own methodologies** which need to balance evaluation cost and the increasing need for more precise evaluations. If a value is given to energy savings in the form of White Certificates, this need will be further enhanced and the **data quality** as an input to the evaluation methodologies will be scrutinized more carefully than in the past.

Evaluation of individual energy services

The development of a market for energy service is the second broad objective of the EU Directive for energy end-use efficiency and energy services. The need for evaluating individual energy services has triggered already years ago the development of broadly accepted methodologies such as the International Performance Measurement and Verification Protocol (IPMVP). These methodologies developed for energy services have been at the basis of the the so-called bottom-up evaluation methodologies required in the frame of the energy efficiency directive. With the extension of the market for energy services, the requirements on the evaluation of individual energy services will need to be developed further. Two papers and one poster deal with these issues:

- Patrick JULLIAN et al. (4,112) review good practices in measuring and verifying energy savings among French Energy Efficiency Services actors (in particular the activities of the Energy Efficiency Services Club - Club S2E – in France) and emphasise quality securing methods.
- Kathleen CARLSON et al. (4,087) analyse an example of how to incorporate IPMVP and Six Sigma strategies into monitoring and evaluation studies of four residential air conditioner rebate programs implemented by public utilities in California. The IPMVP is a resource savings-verification tool applicable to residential, commercial, and industrial energy efficiency projects and programs. Six Sigma is a performance target that applies to a single critical-to-quality characteristic and focuses on non conformance within a product or process. Products or processes that are complex, such as air conditioners, have greater opportunities for defects especially with respect to energy efficiency performance that is dependent upon installation quality. The purpose of the Six Sigma is to improve profitability through measurement and verification of quality and efficiency improvements.

- Vasco FERREIRA et al. (4,282) present an interesting approach that might help energy service providers to identifying energy and water savings in local authority buildings. Traditionally Leicester City Council collected and analysed monthly and quarterly utility billing data to identify energy and water saving opportunities. More recently, it has been gathering electricity, gas and water consumption data on a half hourly basis using a proprietary system which combines information technology and a proprietary software package. Energy and water consumption for nearly 300 local authority buildings is metered and monitored continuously. The data is then analysed by the energy manager using the software's built-in analysis techniques, leading to the detection of potential energy and water savings. The savings are usually caused by incorrect operational management and maintenance procedures – sometimes described as "low hanging fruits". The paper presents the actual costs and savings produced, and examples of the "low hanging fruits" picked up by the new metering and monitoring system.

Measuring individual energy saving programmes

Measuring efficiency and efficacy of ***individual energy saving programme*** provides the basis for the more complex analysis of larger bundles of policies. Three papers and two posters deal with lessons from the evaluation of individual programmes:

- Ean JONES et al (4,079) report on the evaluation results of twelve commercial air-conditioning energy efficiency programmes. Data loggers were installed to monitor pre- and post-retrofit peak demand and energy use for chillers, cooling towers, controls, and packaged units. Energy savings are based on engineering analysis, regression analysis, building energy simulations, utility billing data, and short-term field measurements consistent with the International Performance Measurement and Verification Protocols (IPMVP). They conclude that future evaluations should include the following requirements: tracking database, net savings including precision and error bounds, process evaluation, independent study management, adequate time, and evaluation contractors experienced with IPMVP measurement procedures.
- Juozas ABARAVICUS and Jurek PYRKO (4,096) show how better load demand analysis in commercial buildings helps to evaluate savings. This study contributes to new knowledge of energy use patterns (load demand) in commercial buildings. It proposes solutions of load-related problems, evaluates energy and load savings potential, identifies and analyses the needs, motives and barriers for participation in demand response (DR) programmes. The study provides recommendations for ongoing and future efficiency and DR strategies and discusses the potential economic benefits from the DR measures.
- Kevin LANE et al (4,292) provide insight into evaluating the impact of energy labelling and minimum energy performance standards (MEPS) in the case of refrigerators in the UK and Australia. Estimating the impact of programs such as these that operate over very long periods provides special challenges. The existence of the program itself is now part of the base case scenario and it becomes increasingly difficult to estimate the scenario that would have occurred if labelling had not been introduced. Other external factors such as changes in technology and changes in product type (e.g. share of frost free) or attributes (volume) also complicate the analysis as these factors also have an indirect impact on energy consumption.
- Robert MOWRIS et al. (4,086) discuss evaluation, measurement, and verification findings for a commercial high-efficiency boiler incentives program in California. The evaluation adhered to the International Performance Measurement and Verification Protocols (IPMVP) and comprised field measurements of boiler efficiencies, motor loggers installed on the combustion supply-air fan to determine hours of use, statistical sampling methods to extrapolate mean savings estimates from sample measurements to the population and to evaluate precision. The program design was based on manufacturers' reported performance data and product literature. Future programs should be based on field-verified boiler efficiency ratings rather than manufacturers' ratings (which were found to be overstated especially for high efficiency boilers examined in this study).
- Kathleen GAFFNEY (4,304) presents the results of the energy savings potential analysis completed as part of the first-ever, comprehensive needs assessment conducted for California's low income population. The needs assessment was commissioned to direct future policy regarding the various low-income energy programs offered in the state. The focus of this paper in on one of these programs: the Low-Income Energy Efficiency (LIEE) Program, which installs weatherization and energy efficiency measures in qualified dwellings at no charge.

Evaluating complex bundles of energy efficiency and energy savings policies

Evaluating complex bundles of energy efficiency and energy savings policies is at the heart of the EU Directive for Energy Efficiency and Energy Services. Main questions arising from cross-cutting comparisons of policies are related to the effectiveness of energy efficiency measures and programmes, to the cost of energy efficiency programmes (including transaction costs), to the methodologies used etc. Six papers deal with these issues:

- In the context of the EU Directive for Energy Efficiency and Energy Services Stefan THOMAS et al. (4,056) raise the question of how much energy saving is 1 % per year? The paper reports on the project "Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services" (EMEEES). It is the objective of this project to support the smooth implementation of the Directive on energy end-use efficiency and energy services. It will develop necessary tools for implementation and monitoring of the Directive: (1) a system of bottom-up, top-down and integrated methods for the evaluation of energy services and other energy efficiency improvement measures, harmonised between Member States; (2) a set of harmonised default data and benchmarks for the methods; (3) a template and a guide for Member States for the Energy Efficiency Action Plans

(EEAPs); and (4) an agreed method for the Commission to assess the plans.

- Anson WU and Pedro GUERTLER (4,247) also analyse the key elements needed for a template and guidance, tailored specifically to the buildings sector. Adapted from the Global Reporting Initiative reporting guidelines, the key principals are identified which fulfil the central purpose of the Plan – enabling the European Commission to examine progress towards the Directive's 9 per cent energy saving target. The detailed structure and content can then be identified from the Directive and an international range of existing energy and climate change action plans. Using these principles, the details included within each plan are assessed for relevance and importance. These results are then compared against expert opinion, which includes a rating to establish how difficult including each detail in a template might be. A final assessment and ranking of the details required in an ideal template is then produced. By doing so, the template balances the requirements of the European Commission and administrative burden to Member States and therefore provides practical advice about prioritising particular details as well as guidance for developing new programmes and policies to fulfil the Directive.
- Paul BAUDRY and Dominique OSSO (4,067) point in their paper to the uncertainties in the evaluation of energy savings potential. The potential of energy savings in the EU has been evaluated in the recent years. The EU green paper for energy efficiency published in June 2005 and the resulting European Action Plan for Energy Efficiency indicate that the economic energy saving potential is higher than 20 % of the total energy consumption in the EU. On the same time, markets face barriers to fill the gap between this economic energy savings potential and the actual observed energy consumption. An investigation of the evaluation methods for assessing the energy savings potential at a global level introduces many assumptions. The paper reports the different issues to be addressed in order to evaluate the energy savings potential at a regional or national level and debates the issues at the example of results obtained at EDF/R&D on technical potentials of individual energy end uses in France. The authors consider that at the present time the uncertainty is still too high to enable a consistent quantification of the potentials.
- Marvin J. HOROWITZ (4,092) carries out a counterfactual analysis of energy efficiency policies in the U.S. across three decades in a time series cross section approach. This statistical methodology measures the net annual impacts of energy efficiency policies at the aggregate level. This methodology joins together the econometric techniques of time series cross section modelling and counterfactual analysis, creating a program or policy evaluation approach that is parsimonious, transparent, robust and generalizable. The author considers that it can be adapted to any pre-defined multi-regional area, such as the United States or the European Union, or sub-regions, using readily available published data from government or public agencies. The findings presented in this paper indicate that in the United States, strong policy commitment at the state level resulted in substantially positive energy efficiency policy impacts in the commercial and industrial sectors. The findings for the residential sector are mixed, possibly due to complications that arise from spillover and/or earlier policy adoption in this sector of the economy.
- Mirjam HARMELINK et al (4,070) report about lessons learnt from 20 ex-post evaluations of energy efficiency instruments. Within the AID-EE project (Active Implementation of the Directive on Energy Efficiency) the authors reconstructed and analysed the implementation process of energy efficiency policy instruments with the aim to identify key factors behind successes and failures. The analysis was performed using a uniform methodology called "theory based policy evaluation". With this method the whole implementation process is assessed with the aim to identify: (i) the main hurdles in each step of the implementation process, (ii) key success factors for different types of instruments and (iii) the key indicators that need to be monitored to enable a sound evaluation of the energy efficiency instruments. Based on the assessments and the experience from applying theory based policy evaluation ex-post, the authors suggest that the method should already be used in the policy formulation and design phase of instruments, making policy theory an integral and mandatory part of the policy process which would facilitate the development of more efficient and effective instruments.
- Tudor CONSTANTINESCU and Rod JANSSEN (4,180) look into current evaluation methods based on recent Energy Charter and IEA analysis and provide a review of the approaches that proved to be successful in the evaluation of energy efficiency policies and measures internationally. They conclude that evaluations should be more and more developed as an instrument of planning and of monitoring in early stages and that the development of indicators and of evaluation methodologies should go hand in hand.

Evaluation methodologies

Evaluation methodologies are one important leg of policy and measure evaluations and need to evolve in the future into more complex and interacting methods: top-down or bottom-up evaluation methods, evaluation of free-rider, multiplier, rebound effects, autonomous progress and measure interactions are at the heart of the development of future evaluation methodologies. Five papers deal with these issues:

- Olivier POL and Doris ÖSTERREICHER (4,088) propose a combined ex-ante and ex-post evaluation methodology to assess the theoretical energy impact and the actual energy performance for the 27 communities of the European CONCERTO initiative. The ex-ante evaluation consists of assessing the theoretical impact of the CONCERTO initiative with a set of indicators prepared by DG-TREN. This requires the definition of baseline scenarios and system boundaries for the representation of energy flows. The ex-post evaluation consists of assessing the actual energy performance of the individual communities. After buildings and plants have been built or refurbished, available metering will be used to assess the actual energy consumption and production from

renewable energy sources and to compare it with the figures proposed initially by the communities.

- Susan GORDON and Lisa A. SKUMATZ (4,323) explore the benefits of integrated ongoing data collection for evaluation as part of already-established points of contact with participants. On-going data collection provides several advantages over traditional methods: timely availability of data during program implementation; the data are collected at a point closer to when the program participation decision is made – potentially improving the quality of the data; expense on surveys can be reduced. The paper describes the experience to date, benefits, costs, and lessons learned.
- David FREEMAN et al. (4,322) analyse impacts of education, outreach, advertising, and training programs which present particular difficulties in evaluation, as they focus on modifying behaviours and purchases rather than directly installing measures. The paper summarizes the results of a literature review of more than 80 studies evaluating strengths and weaknesses of evaluation work on outreach and education programs and presents the results of several applications of advanced evaluation techniques that are being applied to outreach, education, and training programs.
- Jean-Sébastien BROC et al (4,105) describe a process to develop operational bottom-up evaluation methods from reference guidebooks to a practical culture of evaluation. The methodology handles both impact and process evaluation. For the impacts, focus is on calculations transparency, data quality and reliability of the results. Regarding operation process, main issues are analysing causality between actions and results, and detecting the success and failure factors. This work was first developed for the evaluation of local operations in France. The resulting methodology was tested on two case studies from the Eco Energy Plan, a local EE programme implemented in South-East of France.
- Antoine BONDUELLE and Damien JOLITON (4,271) touch upon the delicate question of calculating "marginal carbon saving" to compare efficiency measures in competition with supply-side power stations. This helps in the case such as France where the electric system has low carbon emissions on average, but may have wide hourly variations due to the use of carbon intensive plants during peaks. The authors state that the methods and results must be carefully discussed, because the results of such modelling cannot be used directly to credit carbon emissions limitations. This is because the sum of marginal calculations differs with the emissions saved for the whole portfolio. But the tool can benefit for example the regulator of an efficiency market instrument such as 'White certificates' or the Kyoto Mechanisms, to verify the claims of utilities, or to optimise the requests to the supply industries.

Data for evaluation and monitoring

Data for evaluation and monitoring (including data availability and data acquisition costs): Data are the foundation or better the Achilles' heel of all evaluation. Important questions with respect to the establishment of sound databases for our evaluations are in particular: How can we improve the data on which evaluations need to rely, especially in sectors which traditionally are badly covered such as the residential and the service sector but also for individual energy uses in all sectors? How can we enhance our databases despite shrinking budgets for energy statistics and less data available from energy supply industries due to the pressure of competitive markets? Integrating data collection into the measures themselves is often a key to reliable evaluation results. Three papers and one poster deal with these issues:

- Andrew AMATO (4,129) describes monitoring & targeting using integrated datasets. The Energy Saving Trust, with funding from UK governments has developed the Homes Energy Efficiency Database (HEED). HEED integrates and stores installations and survey data from a wide variety of sources. This allows national, regional and local analyses of measure uptake, remaining potential and energy/carbon savings to be made. The database stores data at individual property level to eliminate the potential for "double counting" of measure or survey data. The paper details how the project has developed, the challenges faced and how they were overcome and explores the future plans as to how the database will be used to assist the development, implementation and monitoring of sustainable energy activities at a variety of levels.
- Agneta PERSSON et al (4,135) demonstrate that improved statistics on energy end use in buildings is a key to success: In Sweden the quality of national building energy statistics has declined during recent years, resulting in an increasingly difficult situation for policy makers and energy-efficiency advocates. To improve this situation the Swedish National Energy Agency has launched a new programme, including one project dealing with improved energy statistics in non-residential buildings. The project runs in six year cycles, and step-wise covers all categories of tertiary buildings. The paper describes the findings of the two first years of audits and elaborates on the rational behind improved building energy statistics, including important applications of such data.
- Ulla SUOMI and Heikki VAISANEN (4,166) describe a comprehensive monitoring system to show the results Finnish audit and voluntary agreement programmes. These policy measures and their monitoring systems are integrated. The collected data is based on engineering calculations by the energy auditors. By 2005 these two policy measures have saved nearly 2 % of Finland's total energy end-use which largely paid back the investment on monitoring.
- Rose WOODs and Lisa SKUMATZ (4,319) investigate how long does energy efficient equipment really last on-site. Estimated useful lifetimes EUL (measure lifetimes) are the key elements in computing energy savings for a program or intervention. In work for a large west coast agency, the authors conducted a detailed assessment of more than 100 measure retention / lifetime studies to identify the real-world lifetimes for numerous energy saving measures used in: 1) Residential, 2) Low income, 3) Commercial / industrial, 4) agricultural, and 5) military buildings. The paper summarizes these results and provides information on updated / recommended EUL estimates for energy efficiency equipment.