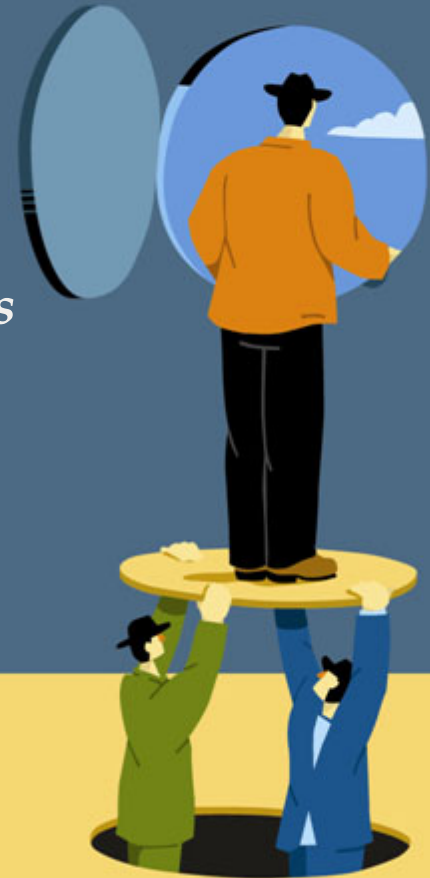


## Building Confidence in Meeting Energy Efficiency Targets: Addressing Free Riders and Additionality

*Presentation at the International Energy Programmes  
and Policies Evaluation Conference (IEPPEC)*

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**Treatment of free riders/additionality is one component in building confidence in EE as a resource that can meet future needs.**

## Understanding the EE Challenge

- EU Energy Efficiency Directive (EED) sets a target of 20% EE.
- Targets also set in North America.
- Confidence is needed that EE delivers the promised resource.

## Building Confidence

- Understanding of what each EE resource can provide.
- Treatment of free riders and additionality – define the net resource achieved

## Approaches for estimating net savings

- Compare methods across Europe and North America.
- Consider different views about methods.
- Criteria for selecting methods.

## Needed – Timely Plan of Action

- Net resource estimates that are acceptable to planners and stakeholders
- Supports continuous EE Programme improvements
- Cost-efficient, best use of monies in EE investments

- » The paper is based on U.S. DOE project on evaluation methods – Uniform Methods Project (UMP):
  - ◆ Covers both technology and programme specific methods;
  - ◆ As well as cross-cutting methods that apply across different technologies and end-uses, e.g.,:
    - Persistence and Related Estimation Issues; and
    - Survey Design and Implementation.
    - New methods for estimating net savings for different types of programs.
  
- » New report on “Estimating Net Energy Savings: Methods and Practices” is being put on line this week --  
<http://www.nrel.gov/docs/fy14osti/62678.pdf>
  - ◆ Reasonably technical exposition of methods with examples.

## » OVERVIEW:

- 1) A recently completed review of net savings methods in North America is used along with papers that review methods used in Europe.
- 2) Interviews with EE evaluation researchers in Europe were conducted to provide additional perspectives.
- 3) The approaches used for estimating net savings have a number of common elements across Europe and North America – almost every approach used in Europe is also used in North America.
- 4) However, there are distinct differences in philosophy and the emphasis on the types of methods applied.

- » Differences are seen in eight areas – themes in application:
- 1) The role of ex ante and ex post approaches for estimating savings.
  - 2) Methods for estimating savings from behavioural programs
  - 3) Use of randomized design approaches in evaluation
  - 4) The relative emphasis on free riders versus spillover and market transformation
  - 5) Views on trade-offs between study costs versus the value of information that can be produced by studies focused on additionality
  - 6) The treatment of self-selection in estimating energy savings has received considerable attention in North America, but is not typically considered in Europe
  - 7) The focus on statistical approaches designed to achieve certain confidence and precision targets.
  - 8) Views on the role of ex ante estimates of net savings and the need for field work to confirm the initial ex ante savings estimates other than validating installation.

- » The eight themes set out in the paper illustrate differences
  - ◆ In assumptions;
  - ◆ Views regarding the value of value of conducting different types of studies; and,
  - ◆ A determination of what constitutes credible evidence regarding estimates of net savings.
  
- » This presentation sets out estimation approaches used in both Europe and North America – then, contrasts the use of different approaches used with a focus on the eight themes.

- » EE investment goal: Increase the amount of energy efficiency (EE) over what would have occurred naturally.
  - ◆ Naturally occurring savings represents the “baseline” or the “counterfactual scenario” from which EE impacts are measured.
  - ◆ Savings from an EE investment are then “net” of what would have occurred naturally and represent a new added resource.
  - ◆ Net savings can either be estimated directly, or by a calibration of gross savings.
    - Gross savings: Changes in energy consumption that result directly from program-related actions.
    - Net savings: Changes in energy use attributable to an EE programme, i.e., they are net or additional to the baseline that represents what would have happened in the absence of the EE programme.

- » Gross are often estimated first, and then adjusted to get to net savings:

$$\text{Net Savings} = \text{Gross Savings} - \text{FR} + \text{SO} + \text{ME} \quad (\text{Eq. 1})$$

FR = Free Riders who are participants that would have implemented programme measures or actions even if the EE activity had not been offered.

SO = Spillover savings referring to additional reductions due to EE programme influences that go beyond those directly associated with the EE activity, i.e., additional actions not directly part of the program.

ME = Market effects are longer term impacts that may reflect a change in the structure of a market or the behavior of market actors that is causally related to the market interventions and programmes.

- » Two sets of net savings equations are found in recent work on evaluation in Europe show similar attributes, but also some differences.



» Bundgaard et al. (2013) sets out net savings as:

**Net impact** = Reported savings \* Technical accuracy in the calculation of savings \* Additionality \* Rebound \* Spillover (Eq. 2)

Reported savings is essentially the equivalent of gross savings.

Technical accuracy in the calculation of the reported savings refers to the over (or under) estimation of the savings due to calculation errors or improper/incorrect use of assumptions.

Additionality occurs if the measure or project would not have been implemented or accelerated without the obligated party's involvement. Additionality expresses the likelihood that the energy savings would not have been realised without the obligated party's involvement.

Rebound effect occurs when participants replace the savings achieved with a new use or increased consumption of energy.

Spillover is defined as the “positive co-benefits of energy efficiency programs and measures to promote energy savings.”

- » Vreuls (2012, p.8) sets out net savings using the formula:

$$\text{Net Savings} = \text{total gross annual savings} * f(\text{DC}) * f(\text{MP}) * f(\text{FR}) * (\text{RE}) \quad (\text{Eq. 3})$$

Where:

$f(\text{DC})$  is double counting;

$f(\text{MP})$  is the multiplier effect;

$f(\text{FR})$  is the free rider effect;

$f(\text{RE})$  is the rebound effect.

- » Each equation has common elements, but they differ in terms of their view of net savings and techniques used to estimate terms.
  - ◆ North American view is that double counting and rebound should be addressed in the initial estimation of gross savings.
  - ◆ It is important to know what gross or total savings represents and the adjustments that go into that estimate.

- » Recent reports address evaluation methods in Europe and in North America providing points of comparison.
- » Europe:
  - ◆ Ecofys (2012) for the UK Department of Energy and Climate Change.
  - ◆ Regulatory Assistance Project (RAP, 2014) as part of its Global Best Practices series.
  - ◆ Selected interviews with evaluation practitioners.
- » North America:
  - ◆ SEEAAction (2012) -- SEE Action is a state- and local-led effort facilitated by the U.S. Department of Energy and the U.S. Environmental Protection Agency.
  - ◆ Net Savings Methods and Practices (Violette and Rathbun, 2014) as part of the U.S. Department of Energy, Uniform Methods Project.

## Approaches to Net Savings – North America:

- 1) **Randomized control trials (RCTs) and quasi-experimental designs** – These are experimental design approaches that use control groups to help establish the baseline against which EE impacts are calculated.
- 2) **Survey-based approaches** – Surveys may target up to three types of respondents: (1) programme participants, (2) programme non-participants, and (3) market actors. Survey-based approaches are used in evaluations that start with gross estimates, and then adjust for net savings factors – i.e., free riders, spillover and market transformation.
- 3) **Common practice baseline approaches** – The common practice baseline approach uses a counterfactual based on estimates of what a typical energy user would have done at the time of the project implementation.
- 4) **Market-wide sales data analyses** – A market-wide sales data method in which post-programme data are compared with data from a non-programme comparison area (or multiple comparison areas) for the same point in time.

- 5) **Top-down evaluations (or macroeconomic models)** – This method uses energy consumption across a large number of cross-sectional units at the national level or regional level in an econometric model.
- 6) **Structured expert judgment approaches** – Structured expert judgment approaches involve assembling a panel of experts who have a good working knowledge of the technology, infrastructure systems, markets, and political environments (often used in a Delphi Panel structure).
- 7) **Deemed or stipulated net savings metrics (NTG ratios)** – This approach is used in both the U.S. and in Europe, and is given a little broader discussion here. Deemed or stipulated NTG ratios are predetermined values and do not rely on an ex post calculation-based approach.
- 8) **Historical tracing (or case study) method** -- This method involves reconstructing the events (such as the launch of a product or the passage of legislation) that led to the outcome of interest. The historical tracing method traces chronologically a series of interrelated events either going forward from the research point of interest to downstream outcomes, or working backward from an outcome along a path that is expected to lead to precursor events

- » The net savings concept is similar across North America and Europe: To determine the net energy savings resulting from the use of a baseline or counter-factual scenario. (Bertoldi and Rezessy, 2009)
- » Common methods (RAP, 2014) are:
  - 1) Performance of average equipment sold.
  - 2) Performance of most commonly used equipment (“average-on-the-market” for appliances and equipment.
- » Bertoldi and Rezessy (2009) presents three methods:
  - 1) Deemed savings approach -- no in-field measurement
  - 2) Engineering approach – implies some in-field measurement.
  - 3) Metered baseline – when needed for case-by-case analyses.

» Bertoldi and Rezessy present the Table below:

Country	Measurement and Verification System in Place
Italy	<p>AEEG, the Italian Regulatory Authority for Electricity and Gas, uses three evaluation approaches:</p> <ul style="list-style-type: none"> <li>• Default value: energy saving is defined ex ante</li> <li>• Engineering approach: on-field measurement</li> <li>• Energy monitoring plan</li> </ul>
Great Britain	<ul style="list-style-type: none"> <li>• The regulator OFGEM assesses and approves all measures suppliers take.</li> <li>• DEFRA (Environment Ministry) developed a ‘Target-setting Model’ for ex ante determining the energy savings attributed to different measures.</li> </ul>
France	<ul style="list-style-type: none"> <li>• ADEME (French Agency for Environment and Energy Management) and ATEE (Association Technique Energie Environment) are in charge of setting methodologies for calculation of the achieved savings.</li> <li>• Savings are validated by the French High Council for Energy.</li> </ul>

Source: EuroWhiteCert (2007)

- » The solution most often adopted for Energy Efficiency Obligation (EEO) programmes is that additionality is defined ex ante (either deemed or by calculation) and reviewed on a regular basis.
- » Often, EEO programmes have targeted energy efficiency measures that are highly replicable on a large number of projects.
- » Under the French System, additionality is assessed ex-ante for over 100 standardized measures.
- » Ecofys (2014) emphasized that:
  - ◆ Additionality estimates are always a trade-off between the costs of the approach and the certainty of the savings achieved.
  - ◆ For a EE financial incentives programme, Ecofys proposed a deemed ex ante approach where there is a “regular update of measures supported (based on market, technology, and policy analysis).”



- » North America emphasizes ex post approaches using the collection of data on equipment performance after installation in combination with surveys of participants, non-participants, and trade allies.
  - ◆ More emphasis on statistical approaches.
  - ◆ Greater use of surveys to get at customer attribute information that may indicate FR or SO.
  - ◆ However, some jurisdictions do use deemed savings for select measures, and the common practice baseline approach is now being considered for some programs.
- » Europe emphasizes engineering approaches to develop ex ante measure savings estimates that also account for additionality.
  - ◆ Some survey approaches and statistical analyses of participant energy use were also found in applications in Europe, but not as commonly used compared to North America.

- » There is no right or wrong approach, but the relative emphasis on different net savings methods illustrates differences in focus and views/beliefs.
- » Going back to the eight themes listed at the start of the presentation.

### **1) Role of ex ante and ex post approaches:**

- Work in Europe, in general, demonstrates greater confidence in the ability of engineers to develop ex ante estimates of savings across a wide range of measures.
- Deemed savings in North America are developed, but generally are used in programme planning with ex post in-field work to verify savings using a sampling method that helps keep costs low.

### **2) Estimating net savings from behavioral programs:**

- Behavioral programs in Europe are generally not directly credited with savings.
- The role of behavioral programmes in North America is increasing with sophisticated customer bill comparison and reference information efforts. Estimated savings from these programs have been somewhat surprisingly large resulting in large numbers of ex post evaluations.

### 3) Use of randomized design approaches in evaluation:

- Randomized control trials (RCT) has increased in recent years as some EE programs have become opt-out rather than opt-in (e.g., conservation pricing and behavioral programmes).
- Recognition of the advantages of RCTs has made more programme designers and administrators willing to build in random assignment of participants and controls as part of programme rollout.

### 4) Relative emphasis on free riders versus spillover and market transformation:

- Net savings factors in both Europe and North America have focused on free riders.
- A growing number of jurisdictions in North America are requesting information on spillover and market transformation.
- As a result, the evaluation community is increasing its use of panel survey data and trade ally panels/surveys to address SO and ME.

- 5) Views on trade-offs between study costs versus the value-of-information that can be produced by ex post studies of additionality:
- Given similar stated objectives, Europe spends less on evaluation as a percent of energy efficiency expenditures than is common in North America.
  - North America is more likely to take the position that the cost of well-designed ex post studies using new sampling methods produce useful information on net savings, as well as on programme design issues.
  - Ex post studies generally focused on programme components important to the portfolio, but not for all components (e.g., sites with large savings or measures that contribute to a large fraction of the savings).
- 6) Treatment of self-selection in estimating energy savings:
- Self-selection bias has been a significant concern in North America dating back to the 1980s.
  - A belief that self-selection of participants into a programme that are more likely than average non-participants to purchase more efficient equipment tends to limit the use of market average baselines.
  - Approaches for addressing self-selection have been advancing.

- 7) Focus on statistical approaches to achieve certain confidence and precision targets:
- Evaluation research in North America often has targets of confidence and precision to be achieved by estimates of energy savings (gross or net).
  - Results in a focus on efficient sampling strategies and statistical approaches (even if embedded in survey-based estimates).
  - There is a growing debate in North America about whether the confidence and precision targets that have traditionally been set are too high AND result in distortions in evaluation research to meet the targets.
- 8) Views on the estimation of savings:
- The literature reviewed indicates different views regarding EE evaluation, and the methods used to produce net savings estimates in particular.
  - In Europe, there is less ex post evaluation work, and fewer studies of the characteristics of programme participants.
  - Ex post studies can show net savings to be higher or lower than ex ante deemed savings but, in general, ex post studies have produced lower net savings estimates.

- » The goal of evaluation is to provide the information needed for making good decisions regarding the expenditure of the public's monies on investments in energy efficiency.
- » Evaluators in both Europe and North America recognize the same issues, but have generally taken different evaluation paths.
- » Question: Will one path converge towards the other?
- » Future evaluation work will likely be a guide, but the answer will depend on views regarding the cost and value of the information produced.

### FINAL NOTE:

- » Evaluators of EE programs in both North America and Europe have been criticized as working in a vacuum and not incorporating methods from the broader evaluation literature spanning other fields.
- » There likely is some merit to this criticism and embedding EE evaluation work in the boarder set of methods used across other fields will likely improve overall results.

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