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# JORDAN ENERGY SECTOR CAPACITY BUILDING ACTIVITY

Long Term Evaluation Framework

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# Introduction

Evaluation, Measurement and Verification (EM&V) is a critical component of any renewable energy or energy efficiency program. EM&V demonstrates the value of energy efficiency initiatives by providing accurate, transparent and consistent assessments of their impacts and cost-effectiveness. A central objective of evaluation is to determine the savings to attribute to a program or collection of programs as opposed to other factors (such as changes in production levels or changes in weather). Evaluators also compare benefits to costs in order to determine the cost-effectiveness of programs. Program benefits may include energy savings, demand reduction, lower greenhouse gas emissions, improved health, lower energy prices, job creation, increased income, decreased reliance on foreign fuels, and reduced need for additional power plants or distribution infrastructure. Program costs include the direct and indirect costs borne by program funders, implementers, and participants. In addition to benefits and costs, EM&V can also determine how well a program is designed and delivered (process evaluation) and the programs' impact on products (price, quality, choice, and availability) and markets. Such evaluation efforts are critical to understanding and improving program performance, planning better programs, and determining exit strategies.

This document proposes an EM&V Long Term Framework for Jordan (Framework).

EM&V firms conducting program evaluations are required to design and implement evaluations that reflect the objectives, information needs, planning tasks, and oversight requirements presented in this Framework.

The purpose of this Framework is to:

- Establish an overall approach to the evaluation of the Kingdom's energy efficiency efforts; and
- Standardize evaluation approaches for the assessment of energy efficiency programs.

Reaching agreement on how to assess program achievements and award performance incentives should precede program implementation. It is perfectly acceptable to have difference of opinions on methods and approaches. Energetic and lively conversations should be encouraged as early as possible. Not all parties may agree, but it essential that all parties understand the steps and associated outcomes. What should be avoided is ambiguity or uncertainty in how to interpret program implementation results.

An EM&V Coordination Committee (ECC) should be created with representation from all stakeholder groups This Committee should ensure that all evaluation plans and their subsequent implementation are developed and conducted in alignment with this Framework. ECC should have representation from EMRC, NERC, the distribution companies and other intermediaries to be able to receive evaluation results in timely manner and to make needed course corrections. The committee should be chaired on a revolving basis by JREEF and EMRC, according to the types of programs being evaluated.

This Framework provides guidance on how to achieve the following attributes of an effective and sustainable EM&V activity:

1. **Effectiveness**, ensuring that EM&V activities lead to better programs and better delivery. Best use of EM&V is the provision of information to program managers to

enable them to make course corrections as needed. Evaluation and program plans should be living documents throughout the program cycles. In other words, EM&V feedback should be used to revise both delivery and evaluation approaches as needed.

2. **Independence**, ensuring that firms conducting the EM&V activities have had no connections to the program design or implementation activities. However, due to lack of sufficient number of qualified firms in Jordan, this protocol will allow firms to be involved in design/delivery *and* EM&V. However, this arrangement will not be allowed for the *same* program.

Evaluation efforts are to avoid not only conflicts of interest but also the *appearance* of conflicts of interests. The evaluators should be independent professionals who do not benefit, or appear to benefit, from the study's findings. The evaluations are also to be independent of the distribution companies.

3. **Consistency**, ensuring that similar procedures are applied to similar programs.
4. **Transparency**, ensuring that all EM&V work is replicable and methods are clearly delineated and evident. Each evaluation should have a detailed study plan that identifies how the evaluation is to be conducted, specifying the individual tasks within the study to be completed. The study plan should also specify how data will be collected, describe processes to assure objectivity and accuracy, and identify the analysis approach to be applied for each of evaluation metrics (e.g., jobs created, carbon saved, energy and demand reduction, etc.).
5. **Best Practice**, by using the most current proven analytical approaches consistent with the available evaluation budget and the study timeline requirements. Because the field of evaluation is constantly changing, it is not possible to define best practice approaches in a way that the definition can remain current. Likewise, the selection of best practice approaches is always limited by the available evaluation budget. It is up to the contractors conducting evaluations in Jordan to stay current within the field of energy program evaluation and recommend approaches that produce reliable results and which can be conducted within the available resources. Several guidance documents are available to help the EM&V contractor select and apply best practice approaches. A sample of these guidance documents include:

- National Energy Action Plan Model Energy Efficiency Impact Evaluation Guide
- International Performance Measurement and Verification Protocol
- Uniform Methods Project For Determining Energy Efficiency Program Savings

## **EM&V Objectives**

The goal of evaluation in Jordan is to provide stakeholders with information on the impacts of the delivered programs providing evidence to help guide future programs and service offerings. The EM&V will need to be flexible, especially in the early stages of program planning and implementation.

Best use of EM&V is the provision of timely findings to the distribution companies to allow for course correction. As such, the EM&V contractors need to have easy access to the distribution

companies. However, the process must be transparent and must allow all stakeholders to be aware of the EM&V findings and communications.

### ***EM&V Budgeting***

The evaluation cost in the United States is usually set at 5% to 10% of program budget. Pilot programs often have EM&V budgets over 20% of program budgets.

Regardless of the types of evaluation, the study budgets must be focused on achieving the most reliable results for the most important energy efficiency, renewable energy, and demand response efforts. Careful allocation of evaluation resources must be achieved to provide the greatest value for the evaluation expense.

### **EM&V Responsibility**

All EM&V work needs to be performed by an independent third party. Priority to be given to Jordanian firms. EM&V contractors will report primarily to EMRC and JREEF. However, the EM&V contractor should also convey all important findings to the distribution companies in timely fashion to allow for continuous feedback and course correction.

### **Proposed Procedures for EM&V Proposals**

As part of any DISCO submittal of RE AND EE offering, EM&V plan must be included. EMRC staff will have 30 days to review and present recommendations on whether the plan should be accepted, modified, or rejected.

### ***Early Evaluation Results and Feedback***

There is a need for early feedback approaches so that the distribution companies can, in consultation with the ECC, make prompt in-cycle changes to maximize energy impacts and customer satisfaction. This will also facilitate energy impacts goal attainment. Reporting will therefore include early results and/or feedback wherever possible. All early feedback reports, memorandums or other forms of feedback will be communicated to the ECC on monthly basis.

The reporting function is critical to achieving this evaluation objective. In order for the programs in Jordan to be effective, it is imperative that the evaluation provide timely reporting of both quantitative and qualitative information. Two likely methods for early reporting are: (1) Interim reports (“as needed,” to be determined by the EM&V contractor in consensus with the ECC), and (2) roundtable discussions and/or oral presentations, providing periodic sharing of insights and

The EM & V contractors in Jordan shall report directly to the ECC, which is chaired by the EMRC and JREEF on a rotating basis according to the programs being evaluated. This reflects the shared responsibility of EMRC and JREEF for ensuring high-quality and cost-effective EE, RE, and RE AND EE programs.

The EMRC will require DISCOs to describe a reasonable detailed approach to EM&V as part of any RE AND EE program proposal. The ECC will publicize how measurement and verification studies will be conducted, how the results will be shared with the EMRC and JREEF, and creation of a database of RE AND EE program results. It is recommended that DISCOs and EMRC work jointly to agree on formulas to be used and general procedures for measurement and verification work, especially when the results are to be used to determine performance incentives.

suggested improvements to individual programs and the overall process of the programs in Jordan.

### ***Data Security***

This section of the Framework deals with data security and provides guidance on how evaluation data will be transferred, stored and safeguarded. The guidance provided below represents the minimum level of data security requirements. However, each company may have its own set of data security requirements that may be more restrictive and will take precedence over the guidance provided in the Framework. It is up to the EM&V contractor to understand each of the data security requirements of the participating distribution companies and comply with these requirements or arrange for alternative compliance agreements.

The evaluation database, including all incorporated EM&V data as well as customer data obtained from the companies must be in a secure electronic repository. It will contain all primary and secondary data collected and assembled along with all of the processing code used to data edit and transformation. To ensure data security, methods should be specified for auditing and analyzing the data in addition to the methods employed for identifying, measuring, recording, and transmitting required data in a secure manner.

### ***Management, Coordination, Communication & Progress Tracking***

It is critical that the ECC is kept informed regarding the progress of program implementation and EM&V results. To accomplish this objective the EM&V contractor will provide monthly progress report detailing the status and progress of each program evaluation. At a minimum, the report needs to present participation in the month and to date, milestones, budget expended, budget remaining, difficulties encountered, potential risks, tasks completed, tasks remaining, any potential changes to timeline, a summary of financials (e.g., cost per kWh, cost per participant, etc.), and recommendations for course changes if any.

Any issues raised by the ECC need to be explicitly mentioned and addressed in every monthly report.

## Evaluation-Related Policy

Several evaluation-related policies need to be overseen by the ECC. The intent of this chapter is to convey the key policy aspects to be communicated to stakeholders. It is assumed that some of these policies will need to be revised by the ECC through some annual Framework updating process.

All third party EM&V contractors in Jordan should be familiar with the policy issues presented in this chapter.

## Evaluation and Analysis Approach

EM&V documents program performance, operations, changes in energy efficiency markets, and cost-effectiveness. There are three broad categories of efficiency program evaluations:

### Impact Evaluations

Impact Evaluation is an assessment that determines and documents the direct and indirect benefits of a program. Program benefits include energy and demand savings as well as non-energy benefits (examples being avoided emissions, health benefits, job creation and local economic development, decreased dependence on foreign oil and energy security, transmission and distribution benefits, and water savings). Impact evaluations also support cost-effectiveness analyses.

Evaluation attempts to measure  
*what did not happen.*

We actually  
measure  
energy use.

- **Savings:** The difference between energy use after the program and what the energy use would have been without the program
- **Impact = Actual post – Actual pre ± Adjustment**
- Not an easy question to answer; we need a baseline...

Methods fall into two categories

1. **Statistical Modeling.** These models involve the use of billing data (pre and post measure installation). The comparison is expected to yield an estimate of the change in use which may be attributable to the program. Statistical models try to account for changes that may have taken place outside of the program through the use of surveys (asking people if conditions had changed between pre and post installation of measures) or the use of similar group of customers that had not received program services (referred to as comparison group). These models work best for programs involving homogenous populations and with impacts that are expected to exceed 5% of the pre installation use (e.g., the solar water heater program implemented by the Jordan River Foundation). Many regulators in the US have voiced preference for these models as they tend to be more “real” due to their use of actual billing data and that they take into account measures interaction and customer behavior.
2. **Engineering Modeling.** Engineering models are the alternative when statistical models are inappropriate (e.g., unique programs of small impacts relative to use – e.g., the LED residential program). They range from simple prescriptive approaches (e.g.,  $\Delta\text{watt} \times \text{hours of use}$ ) to more complicated modeling involving simulation software such as eQuest.

### Process Evaluations

Process evaluations are systematic assessments of an energy efficiency program. They tell the *story* behind the impact numbers. They document program operations and identify and

recommend improvements that are likely to increase the program's efficiency or effectiveness for acquiring energy efficiency resources, preferably while maintaining high levels of participant satisfaction. Issues addressed by process evaluations are shown below.



Process evaluations data collection efforts include customer surveys, stakeholder interviews (distribution companies, JREEF, EMRC, NEPCO, ESCB).

### **Market Effects Evaluation**

This component of EM&V evaluates the different ways in which the programs may have impacted their markets. RE AND EE programs often cause significant market changes ranging from increased awareness among customers and contractors to increased shelf space dedicated to energy efficient products. There may be additional savings above and beyond those achieved through direct program services to participants. Such savings should be quantified and credited to program efforts. Market effects evaluation involves assessment of awareness, availability of energy efficient products at retailers, and any changes to country codes.

### ***Updating the Framework***

The Framework is a living document that will be updated annually by the ECC.

### ***Deemed Savings and Jordan Technical Reference Manual***

Prior to launch of any RE AND EE effort, the ECC needs to agree to some initial assumptions about program potential savings and associated inputs (e.g., hours of use, pre wattage, post wattage, etc.). These are often obtained from secondary sources. Once agreed to, these inputs are used in some pre-established algorithm that creates deemed savings.

As soon as possible, ECC should start working on a repository of measures savings and inputs. Inputs and deemed savings need to be documented in the Jordan Technical Reference Manual (JTRM). The TRM is a very important document and serves as the primary source for establishing measure specific deemed energy savings values and the associated calculation approaches (algorithms). The TRM is a program planning tool. It provides the approach for calculating estimated energy savings for future program initiatives. ECC should not start from scratch as there are many examples of TRMs available from the US at no cost.

### ***Sampling***

Energy program evaluation is typically based on estimating energy impacts using a representative sample of program participants or measures to conduct data collection activities.



The results of these efforts are then used to estimate savings for the program. In this Framework, we assign a target confidence level of 90% with a relative precision of  $\pm 10\%$ . If the EM&V contractor were to deviate from this requirement, justification must be provided to the ECC. The confidence and precision values are set at the program level for annual evaluations. For Jordan evaluations, the effort should target sampling efforts at key energy estimation metrics to achieve a 90/10 objective.

The development of the sample requires understanding the necessary accuracy, determining the sample frame, and developing the suitable sampling methodology. Appropriate statistical techniques typically used in energy program evaluation include:

- ***Simple random sampling:*** drawing randomly from an entire population. This is often, but not always, the most efficient form of sampling.
- ***Stratified sampling:*** drawing randomly from sub-groups within a population. This is used when the variance in a measure is unequally distributed across a population, such as when the size of savings varies by the size of sites and there is a broad distribution of sizes. Random sampling is done within size groupings.

## ***M&V Field Protocols***

This section of the Framework deals with the M&V protocols, and principles relevant to applying activities for evaluation of the programs. Engineering calculations, observation site visits, and metering are techniques that fit together as M&V and are used to varying degrees depending on the measure and program and site context.

### **Overview of M&V**

Evaluators generally conduct post-retrofit site visits and associated M&V to determine the savings realization rates associated with a sample of completed RE AND EE projects.

### **Selection of an M&V Methodology**

The selection of an M&V methodology or analysis rigor for each sampled site will typically be based on several factors (measure complexity, magnitude of savings, etc.), and this will affect planning for site M&V unit costs accordingly. The following types of on-site verification activities are available to meet the evaluation goals, and will need to be adjusted based on actual site details:

- ***Verification:*** These sites include physical inspection and verification of the operating conditions of the systems under consideration.
- ***Verification with spot measurement:*** These sites involve physical inspection of the installation with spot measurement/reading of the current operating conditions.
- ***Verification with basic rigor:*** These sites will involve meeting—at a minimum—the standards of IPMVP Option A (Partially Measured Retrofit Isolation), including the use of direct measurement.

### **Developing the Site Visit Sample**

The primary sampling criteria will usually involve stratification of the program population into homogenous groups based on type (e.g., office vs. retail, etc.), the expected contribution to



overall savings, and the uncertainty of input variables. Selecting a statistically valid sample is important to an evaluation.

Evaluators will normally develop the final sampling plan in the first phase of the project and will ensure that the statistical concepts and underlying sampling procedures are clearly explained.

### **Quality Assurance and Quality Control**

Quality Assurance and Quality Control (QA/QC) procedures should be set at the inception of the evaluation process: only reliable tested meters should be used; and nearly all measurements logged should be confirmed using an independent spot-measuring tool—both at installation and at removal—to check logging meter readings. Field staff members should remain on site until all readings are stable and in explainable or expected ranges. Best practice indicates that all metering points are photographed: before the meters are installed and after the meters are removed. This allows the evaluation team to confirm equipment nameplates and meter placements after they leave the field.

### **Training**

To ensure consistency of data collection processes and analyses among all members of the evaluation site-visit team, the evaluation team's senior engineers will generally conduct a training session covering general technology, data collection topics, and project-specific forms and databases. All staff members must be trained in safety topics appropriate for their work and are to be provided with industry-standard safety gear.

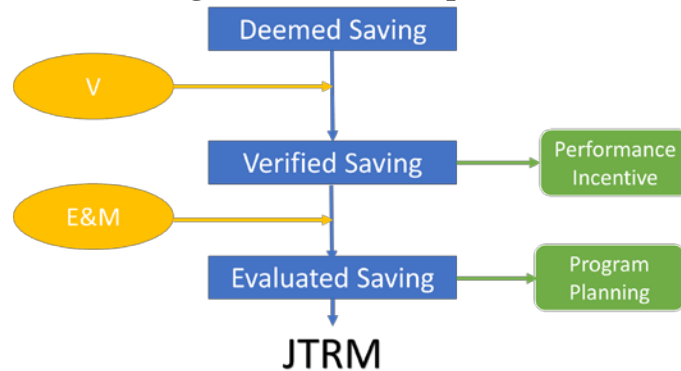
### **Use of Control or Comparison Groups as Baselines**

In cases where the EM&V contractor opts for the use of billing analysis, the use of a comparison group approach is required ("quasi-experimental" evaluation approach). The participant (test) group's energy use is statistically compared to the consumption of a matched non-participant group (comparison group).

### ***Savings and Application of Results***

This section describes the typical steps taken in conducting impact evaluations of RE AND EE programs. It also provides definition of different types of energy savings and proposes their appropriate use. Figure 1 illustrates the proposed EM&V steps needed for Jordan. The intent of this chapter to set the process in place to avoid potential conflict or difference of opinion at later stage. ***Agreement on the EM&V approach must be reached before the EM&V process starts to produce results.***

**Figure 1: EM&V Steps**



### Step 1: Verification (V)

Start with the “deemed savings” (i.e., agreed upon values prior to launch of the program). These are often based on certain inputs (e.g., initial wattage, final wattage, hours of use, etc.). These values remain set for the duration of the EM&V process. Verification of savings occurs through:

1. **Audit of Data Tracking:** Distribution companies present their data bases to the EM&V contractor that assesses the accuracy of data:
  - Check saving estimates and calculations against the deemed approach.
  - Review hardcopy program applications from a sample to verify consistency with data recorded in program tracking databases. Sample size preliminarily set at 75 per company. However, there may be a need to make a *finite population correction factors* for smaller programs.
  - Adjust program tracking data as necessary to correct any errors, omissions identified in above.
  - Recalculate program savings based on the adjusted program tracking data.
2. **Conduct Verification of Installation.** This step uses a random sample of installations selected for detailed analysis. Typical methods for collecting necessary data include telephone surveys or site visits. We suspect that the telephone survey option for Jordan may not be feasible. This step may be adjusted to address issues such as:
  - (a) Measures rebated but never installed;
  - (b) Measures not meeting program qualifications;
  - (c) Measures installed but later removed; or
  - (d) Measures improperly installed.

Findings from this step produce **Verified Savings**. These savings are used for determining performance incentives and determining if companies have met their goals. There will be a need to produce two verified savings values: 1) removing the savings of all measures that are not found, failed and removed, removed by customer for other reasons, not meeting programs specs, etc., and 2) same as 1, but keeping the measures removed by customer of having failed. No. 2 is used for assessing performance incentives and no. 1 is used for future program planning.

## Step 2: Perform Evaluation (E)

At this stage, engineering analysis, building simulation modeling, billing analysis, metering analysis or other accepted statistical methods are used to determine **evaluated savings**.

Adjustments may include: changes to the baseline assumption; adjustments for weather; adjustments to occupancy levels; adjustments to decreased or increased production levels; etc.

For the steps above, EM&V contractors may use Options A, B, C, or D from the International Performance Measurement and Verification Protocols.

**Evaluated Savings** are used for planning future program offerings.

**Verified Savings form the basis upon which distribution companies in Jordan are assessed. This applies to achievement of goals and quantification of any performance incentives.**

## Updating the JTRM

The EM&V process is the primary driver of JTRM updates. Updates to the JTRM will be initiated when EM&V has established sufficient evidence to suggest that a change is necessary. This may apply to calculations or specific inputs. Any company or member of the ECC can initiate a request for an update at the end of each program year. Also any member may initiate additions of new measures to the JTRM.

## Benefit Cost Tests

A variety of frameworks have historically been used to assess cost-effectiveness of energy efficiency initiatives. In the late 1970s, the California Public Utility Commission (CPUC) implemented a least-cost planning strategy in which demand-side reductions in energy use were compared to supply additions. One result of this strategy was the Standard Practice Manual (SPM) that is now used in throughout the United States for informing the benefit cost approach and for use as a starting platform from which non-California state-specific changes to the SPM approach are established.

The SPM established several tests that can be used to evaluate the cost-effectiveness of energy efficiency initiatives. Most regulated energy efficiency programs use one or more versions of these tests, sometimes with variations unique to the requirements of a particular regulatory commission.

For RE and EE programs in Jordan, it is recommended that that the efficacy of the programs be determined by the Utility Cost Test. This used to be called the revenue requirements test.

- **Utility cost (UC) test.** The UC test measures the net costs of a program *as a resource* option based on the costs incurred by the utility. The benefits include the avoided fuel and capacity costs (energy and demand savings value). The costs are defined narrowly to include only the utility costs, i.e., no consumer costs. This cost resembles the analysis conducted for supply side options and, as such, it is the one that treats RE AND EE as a resource.

$$\text{Utility Test} = \frac{\text{Avoided Costs}}{\text{Utility Program Costs}}$$

The net present value of this tests shows the impact of the program on the utility revenue requirement. When a program passes this test, the utility revenue requirements will decrease indicating that the utility needs less revenue to cover its costs of operations.

Other tests to consider in secondary fashion:

- **Participant test.** The participant test assesses cost effectiveness from the participating consumer's perspective. Since many consumers do not base their decision to participate entirely on quantifiable variables, this test is not necessarily a complete measure of all the benefits and costs a participant perceives.

$$\text{Participant Test} = \frac{\text{Bill Reduction}}{\text{Participant Costs}}$$

- **Societal test.** The societal test adopts a societal rather than a utility service area perspective. To calculate life cycle costs and benefits, the societal test accounts for externalities (e.g., environmental and other non-energy benefits) and uses a societal discount rate.

$$\text{Societal Test} = \frac{\text{Avoided Costs} + \text{Environmental} + \text{Other}}{\text{Utility Costs} + \text{Participant Costs Net of Incentives}}$$

- **Ratepayer impact measure (RIM) test.** The RIM test measures what happens to consumer rates due to changes in utility revenues and operating costs caused by the program. This test indicates the direction of the expected impact on rates. It does not, however take into account the impact of the programs on average bills. For example, if a program passes the Utility Cost Test and fails RIM (very common occurrence), the program will cause a decrease in revenue requirement (i.e., the system is running more efficiently). However, although the rates may increase, the bills will decrease. It also assumes that utilities will lose revenue for the duration of the measure life and that the utilities will go in for rate cases (requesting rate adjustments) immediately after the measure installation

$$\text{RIM Test} = \frac{\text{Avoided Costs}}{\text{Utility Program Costs} + \text{Lost Revenue}}$$

## **Contents of Evaluation Reports**

All evaluated and verified energy savings will be reported annually. The reported results will include:

- Energy savings (kWh).
- Demand savings on peak (kW).
- Coincident Peak kilowatts (kW).

*Reporting of process evaluation results.* Although the process evaluation efforts will be somewhat different for each program, to a certain extent these studies will follow a similar theme and approach associated with reporting the results of the approved evaluation's scope of effort. That is, the reporting of process evaluation results will depend on the researchable issues on which each evaluation will focus. For this reason we are not identifying the topics on which the

evaluation effort will report, however each evaluation report will report the methodological approach used in the process evaluation, the researchable issues on which the evaluation focused, and the findings and recommendations associated with each issue.

Reporting of results will focus on assessment of the following:

- Establishment of the Key Performance Indicators.
- Verification of program tracking databases.
- Assessment of participation processes.
- Assessment of stakeholders' interactions.
- Analysis of program design.
- Verification of program processes.

### **Consistency Across Reporting Years**

In order for reporting to be useful for the intended audiences across program years and cycles, and to support energy efficiency planning at the country level to guide policy and planning, it is essential that the evaluation research be reported in a comparable manner. This means that reports must be consistently structured so that reviewing and commenting on evaluation reports does not require substantial investments of time for stakeholders. Further, key messages should be communicated succinctly and executive summaries should be concise. The body of evaluation reports must be consistently organized across reports and years, and technical details supporting the work are preferably contained in appendices only.

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