Best practices to develop a National Energy Efficiency Action Plan (NEEAP)

Methodology

RCREEE

Regional Center for Renewable Energy and Energy Efficiency
المركز الإقليمي للطاقة المتجددة وكفاءة الطاقة

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The Regional Center for Renewable Energy and Energy Efficiency (RCREEE) is an independent not-for-profit regional organization that aims to enable and increase the adoption of renewable energy and energy efficiency practices in the Arab region. RCREEE teams with regional governments and global organizations to initiate and lead clean energy policy dialogues, strategies, technologies and capacity development in order to increase Arab states' share of tomorrow's energy.

Regional Center for Renewable Energy and Energy Efficiency (RCREEE)
Hydro Power Building (7th Floor)
Block 11 - Piece 15, Melsa District
Ard El Golf, Nasr City, Cairo, Egypt
Tel: +202 2415 4755
Fax: +202 2415 4661
info@rcreee.org
www.rcreee.org

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Authors

Mohamad Mahgoub & Amer Barghouth

Reviewed By

Amel Bida, Senior Associate Expert
Ashraf Kraidy, Senior Advisor to the Energy Department - League of Arab States

Acronyms

CFL	Compact Fluorescent Lamps
EC	European Commission
EE	Energy Efficiency
EPA	United States Environmental Protection Agency
GHG	Green House Gas
GWh	Gigawatt Hour
kWh	Kilowatt Hour
MED-EMIP	Support for the Enhanced Integration and the Improved Security of the Euro-Mediterranean Energy Market
NAMA	Nationally Appropriate Mitigation Action
NEEAP	National Energy Efficiency Action Plan
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
RE	Renewable Energy
SCPG	Specific Consumption of Power Generation
SWH	Solar Water Heater
TOE	Ton of oil equivalent
UNFCCC	United Nations Framework Convention on Climate Change

Contents

1 Introduction

Energy efficiency involves using less energy to provide the same or an improved level of service to the energy consumer in an economically efficient way.[1] It is the most cost-effective and easy-to-implement "source" of energy.

National Energy Efficiency Action Plans (NEEAP)[2] are being developed in the Arab region to effectively create sustainable long-term market transformation towards energy efficiency through electricity savings.

The present document provides a guide to the NEEAP development process. Conditional upon data availability and adequate technical assistance, the timeframe is about 6 months for delivery of a first draft.

Approximate Duration per stage	Details
2 weeks to 1 month	Depends on the availability of the required information for assessing the energy efficiency savings potential for the country. Depends upon factors such as data availability and accessibility.
2 weeks to 1 month	The assessment phase can last between a few weeks to a month.
2 weeks	Once data has been collected, realistic and achievable targets are set. This should be done with national experts on the issue, via workshops and round-table discussions.
2 months	Measures are then selected to properly select the measures based upon cost-benefit analysis, entities responsible for applying the measure, the required laws and regulations that currently exist and that should be implemented.
2 weeks	Once the measures have been selected, they can be assessed as per the design. Do they meet the objectives or not?

1 EPA, Guide for conducting Energy efficiency potential studies

2 The NEEAP is part of a politically endorsed document developed jointly between the League of Arab states, MED-EMIP and RCREEE, and part of the "Arab Guideline for improving Electricity Efficiency and rationalize Consumption at the End user", which was approved during the 26th meeting of the executive bureau of the Arab Ministerial Council for Electricity on 23/10/2010 according to resolution no. 195

2 Assessment

There are two types of assessments:

2.1 Country assessment

Country-level assessment makes use of indicators to analyze the current existing situation with regards to EE at a national level.

Two approaches can be used to analyze the current situation:

	1. Top down	2. Bottom up
Level	Economy-wide level and sector level	EE program level, project and measures
Data for analysis	Energy balances, national accounts and statistics bureau data (at total sectorial and national levels)	Measurements of processes, user-level surveys, sub-sectorial surveys and data collection
Indicators	Energy intensities, consumption per capita, specific consumptions, Energy independency indicator,	Project/Measure-specific indicators (CFL, SWH, S&L…)

The below table provides a set of indicators that can be used to understand the energy situation for a given country.

No	Indicator	Unit
1	Electric power intensity	GWh/GDP (US$)
2	Gross annual electricity Generation	GWh
3	Imported electric power	GWh
4	Exported electric power	GWh
5	Projected growth rate for demand for electric power	%
6	Primary energy consumption at the national level	Toe
7	Share of electric power of primary energy consumption	%
8	Share of electricity consumption by sector: • Sector 1 • Sector2 • Sector 3	 % % %
9	The marginal cost of producing one kWh	$/kWh
10	Electrification Rate (the rate of beneficiaries of the electrical grid)	%

RCREEE's benchmarking assessment tool (the Arab Future Energy Index) categorizes these indicators into four main categories, namely Energy pricing, Policy Framework, Institutional capacity and Utility. It provides an overview of the climate.

2.2 Potential assessment

"An energy efficiency potential study is a quantitative analysis of the amount of energy savings that either exists, is cost-effective, or could be realized through the implementation of energy efficiency programs and policies."[3]

Potential assessment is mostly applied to facilities, such as production facilities, industrial facilities, buildings, or projects. The main idea is to identify measures for energy savings and quantify these measures in terms of costs.

An example would be to conduct an energy audit of a government building. Measures will be divided into no cost, low cost, medium cost and high cost measures.

Conducting a potential assessment on a national level would involve mobilizing a large amount of financial and human resources, since it would literally imply conducting micro-level potential assessments per sector and region on a nation-wide scale.

The time required for such an initiative can be 3 to 4 years, and cost between 5 to 6 million USD, and the savings potential identified after this exercise will often oscillate around the 20% mark.

Energy efficiency potential is categorized as follows:

Technical Potential Technical potential takes into consideration only the engineering and technical perspective. It does not consider any cost-effectiveness or behavior from the end-user. It is the maximum theoretical energy efficiency potential.	**Economic Potential** In addition to being technically feasible, the economic potential assesses cost-effectiveness.
Achievable Potential (Maximum Achievable Potential) This is the maximum achievable potential if for instance the most aggressive program scenario is implemented, heavy funding is provided and the end user does not contribute to the incremental costs involved.	**Program Potential** Program potential is the achievable potential through specific program actions and funding. Program potential is less than the achievable potential.

Once technical potential for savings has been identified in one sector (for example, results of an energy audit in a governmental hospital complex), this can be replicated to all similar facilities in the country (in our example, this implies assuming that public hospitals have

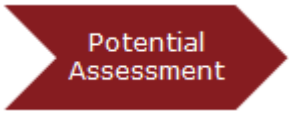
[3] EPA, Guide for conducting Energy efficiency potential studies

more or less similar specifications since they are built in conformity with a set of requirements specified by the state).

The next step is to include the cost factor to determine whether the program will be cost-effective of not.

Several tests existing in literature have been developed for this purpose that take into account the different parties involved in the process (utilities, final consumer, etc)[4]. Countries get inspired from these tests, but are advised to adapt and develop their own criteria and methods for evaluating so as to be realistic and consistent with their national situation.

Summary



- Understand the country energy situation using key indicators
- Overview of the technical potential assessment
  Use appropriate survey, data collection, questionnaires etc.
  Determine if there is an economic potential (cost-benefit analysis)

3 Target Setting

When defining targets, the implementing agency for the measure must be defined to ensure there is an accountable and traceable entity.

3.1 Types of targets

There are two main types of targets mentioned in the NEEAP: interim targets and final targets. The interim target is set for each NEEAP period and can be sectorial or national (aggregated sum of the sectorial interim targets). The final target corresponds to the desired value of savings the country wants to achieve by the year 2020.

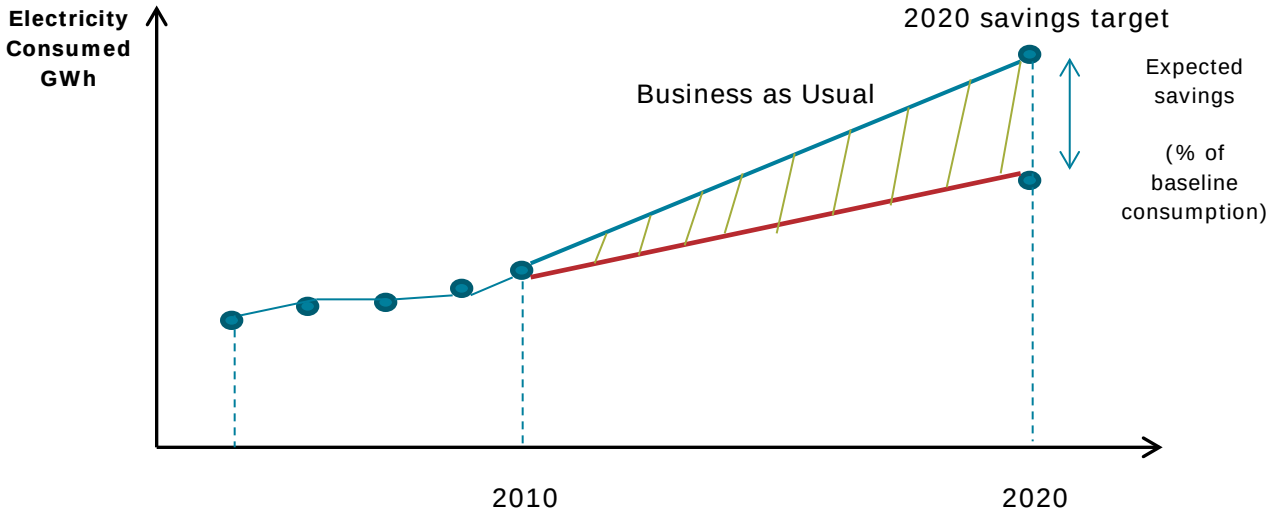
	Baseline consumption **GWh/ Average consumption in the last 5 years**	The national indicative energy efficiency target			
		In the year 2020		In the year 2013 (after implementing the first national plan for energy efficiency)	
		%	GWh	%	GWh
Total					
Sector 1					
Sector 2					
Sector 3					

4 C.f. The California tests for cost effectiveness were developed in the 1970s for utilities to manage their Demand Side Management programs. They act as screening tests to help guide utilities in selecting the measures for their EE programs

3.2 Calculation methodology

A calculation support tool will be provided by RCREEE to countries wishing to develop a NEEAP, in the form of a spreadsheet. According to the methodology developed in the Arab Guideline steps for calculating are as follows:

1. Calculate average growth in electricity consumption rate over past five years
2. From the baseline, calculate the 2020 target
3. Using the average growth rate, business as usual scenario can be used and plotted
4. Using the last year as a first point and the 2020 target as last point, a linear relation can be plotted (Y = mX+C)
5. The area between the two curves represents the cumulative savings predicted



Calculation of Electricity Consumption Growth rates:

If we are in the current year, 2014, then the table below will represent values:

Year	2010	2011	2012	2013	2014
Electricity Consumption (GWh)	EC_{2010}	EC_{2011}	EC_{2012}	EC_{2013}	EC_{2014}

(EC_{2010} corresponds to Electricity consumption value in 2010 and so on)

Growth for 2010 to 2011 = $EC_{2011} - EC_{2010}$

$$\% \text{ Growth for 2010 to 2011} = [(EC_{2011} - EC_{2010}) / EC_{2010}]*100$$

Average Growth Rate over the past five years (from 2010 to 2014) =

[Σ (% Growth for 2010 to 2011, 2011 to 2012, 2012 to 2013, 2013 to 2014)] / 4

Calculating the baseline consumption

Baseline consumption (GWh) = five year average of past five years

$$= (EC_{2010} + EC_{2011} + EC_{2012} + EC_{2013} + EC_{2014}) / 5$$

Setting the target for 2020

As mentioned in the Arab Guideline document:

- Member States shall use the end use electricity consumption for the most recent five year period previous which official data are available, to calculate an average amount of annual electricity consumption.
- This electricity shall constitute the average amount consumed during the five-year period, not adjusted for degree days, structural changes or production changes.
- On the basis of this average amount of electricity consumption, called the baseline consumption, the national indicative electricity savings target shall be calculated for the total duration of the NEEAP.

Example: If the five year averaged national end use electricity consumption has been 10,000,000 MWh and the indicative target for 2020 has been set at 20% than 10,000,000 x 0.20 = 2,000,000 MWh of electricity need to be saved through projects listed in the NEEAP until the end of 2020.

The indicative electricity savings target in MWh for 2020 should be supported by measures listed and described in the national NEEAP. The calculation to reach this target is based on accumulated accounting of annual electricity savings.
This methodology does not require by definition to select only measures producing sustainable electricity savings for all years up 2020; nor does it require “infinite” sustainability. However a realistic sustainability of each measure should be given to calculate the accumulated electricity savings up to and including 2020.

Mathematical relation between Final National Targets, Interim Targets, Sectorial Targets and Measures Savings targets

Once the national final target for 2020 has been determined, the number of intermediary phases before the final target year is to be determined.

Ideally, the NEEAP document is drafted and revisited every 3 years until the target date of 2020 to accommodate for changes in technology, lessons learnt and further improvements a result of monitoring and evaluation phase.

Each phase is assigned an interim national target, which is composed of the interim sectorial targets of that phase. As such, the sectorial targets are the result of savings target for each measure in the corresponding sector.

Final National Target (2020) = SUM (Interim National Targets Phase 1, Interim National Target Phase2… Interim National Targets Phase 2)

For a given phase:

Interim National Target = SUM (Interim Sectorial Targets)

Interim Sectorial Target = SUM (Measures Savings Target)

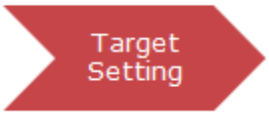
If we consider a sectorial approach, this also implies that:

Final sectorial target (2020) = SUM (Interim Sectorial Targets)

E.g.:

Final Target for residential sector = SUM(Interim Target for Residential in Phase 1, Interim Target for Residential in Phase 2 ….. Interim Target for Residential in Phase n)

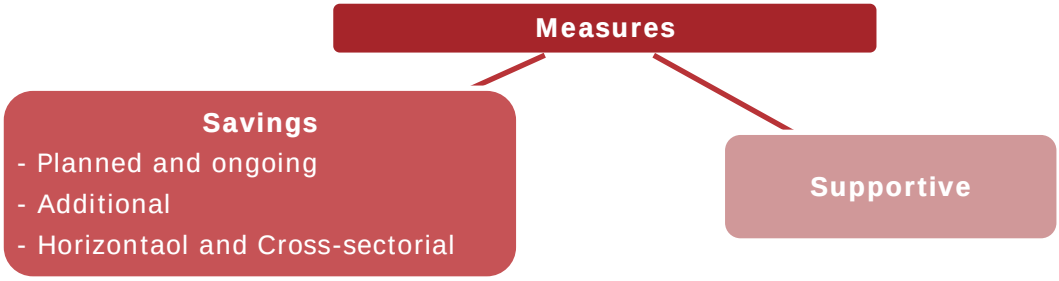
Summary



- Gather total national electricity consumption data for past 5 years
- Calculate baseline consumption
- Calculate average % Growth
- Determine the Business As Usual (BAU) scenario until 2020
- Set National (Global) target as a % of the baseline consumption
- Set interim targets

4 Measure Selection and Design

Measures are categorized as quantitative measures (savings) and qualitative (supportive[5]). The measures are grouped by sectors. The most common sectors in the member states for electricity consumption are Residential, Industrial and Commercial/Tertiary.



The list includes sections to be developed when describing measures. Its use as a diagnostic tool can ensure that measures are SMART (Specific, Measureable, Achievable, Realistic, Time-bound) and contain sufficient information for stakeholders.

Implementing these measures can lead to existing technology improvements, process changes and energy savings. The benefits can then be measured and evaluated using cost-benefit analysis.

1	Title of the measure
2	Objectives
3	Description of the measure
4	Implementing agency
5	Stakeholders involved
6	Target group
7	Program cost
8	Total resource cost
9	Cost/KWh saved
10	Reduction of subsidies
11	Source of funding
12	Financial instruments
13	Awareness
14	Monitoring & Evaluation

Sector[6]	Common measures
Residential	- Energy efficient lighting - Standards and labeling for domestic appliances - Diffusion of domestic solar water heaters - Developing building codes for energy efficient buildings and thermal insulation
Commercial	- Replacing a piece of standard efficiency equipment with a more energy efficient alternative
Industrial	- Depends upon the targeted industry
Power sector & utilities	- Correction of power factor - Reduction of transmission losses

The measures can be categorized according to their costs: No cost measures, low cost measures, medium cost measures, high cost measures.

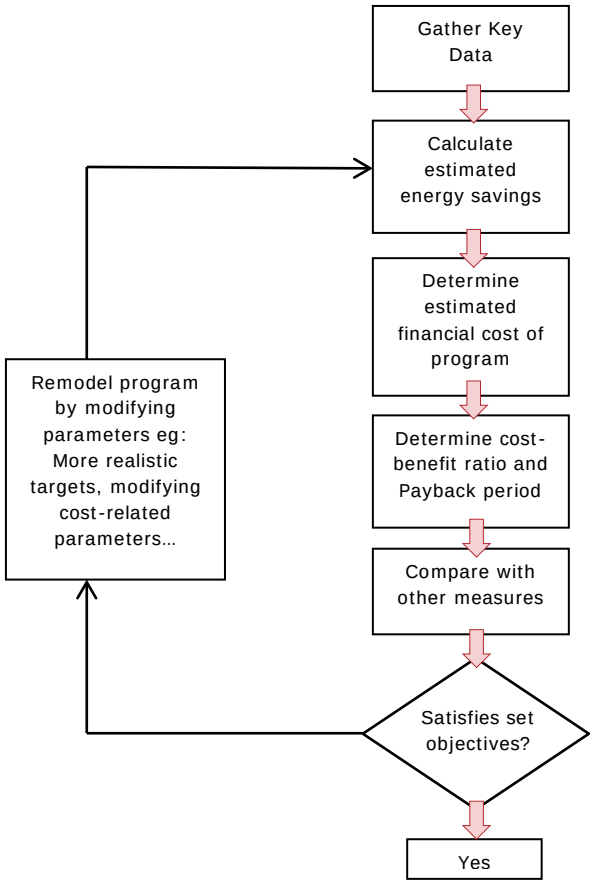
[5] These measures do not have a quantitative value that can be measured and used during monitoring and evaluating the progress and impact of implementation. They are qualitative and their results are mostly measured in the long term. For example, introducing energy efficiency in the educational curricula.

[6] The most electricity consuming sector among RCREEE member states remains the residential sector.

4.1 Cost-effectiveness

NEEAPs contribute to creating a sustainable long-term market transformation. Cost-effectiveness in its simplest form is a measure of whether an investment's benefits exceed its costs.[7] Types of costs in the energy efficiency measures include:

1. Initial costs (including investment for new equipment, installation costs, etc.)
2. Running costs (energy costs, maintenance costs etc., which usually exceeds the initial costs)
3. Non-energy costs (The societal and environmental costs can allow measures to qualify for carbon mitigation-related funding for instance)
4. Forecasted/avoided costs are the avoided costs that would have been present if the measure were not implemented. The forecasted avoided costs include both energy and capacity costs.



In terms of cost-benefit analysis, focus should be on:

1. No cost measures that can be implemented
2. Low hanging fruits and low cost measures

Once these have been implemented,
additional savings in the same sector can be achieved from the implementation of measures identified during potential assessment phase, which will incur a greater implementation cost than those implemented already. For these measures, the higher cost of implementation justifies the investment in time and resources to conduct a detailed feasibility study, and economic calculations based upon the Payback Period, Net Present Value and Internal Rate of Return.

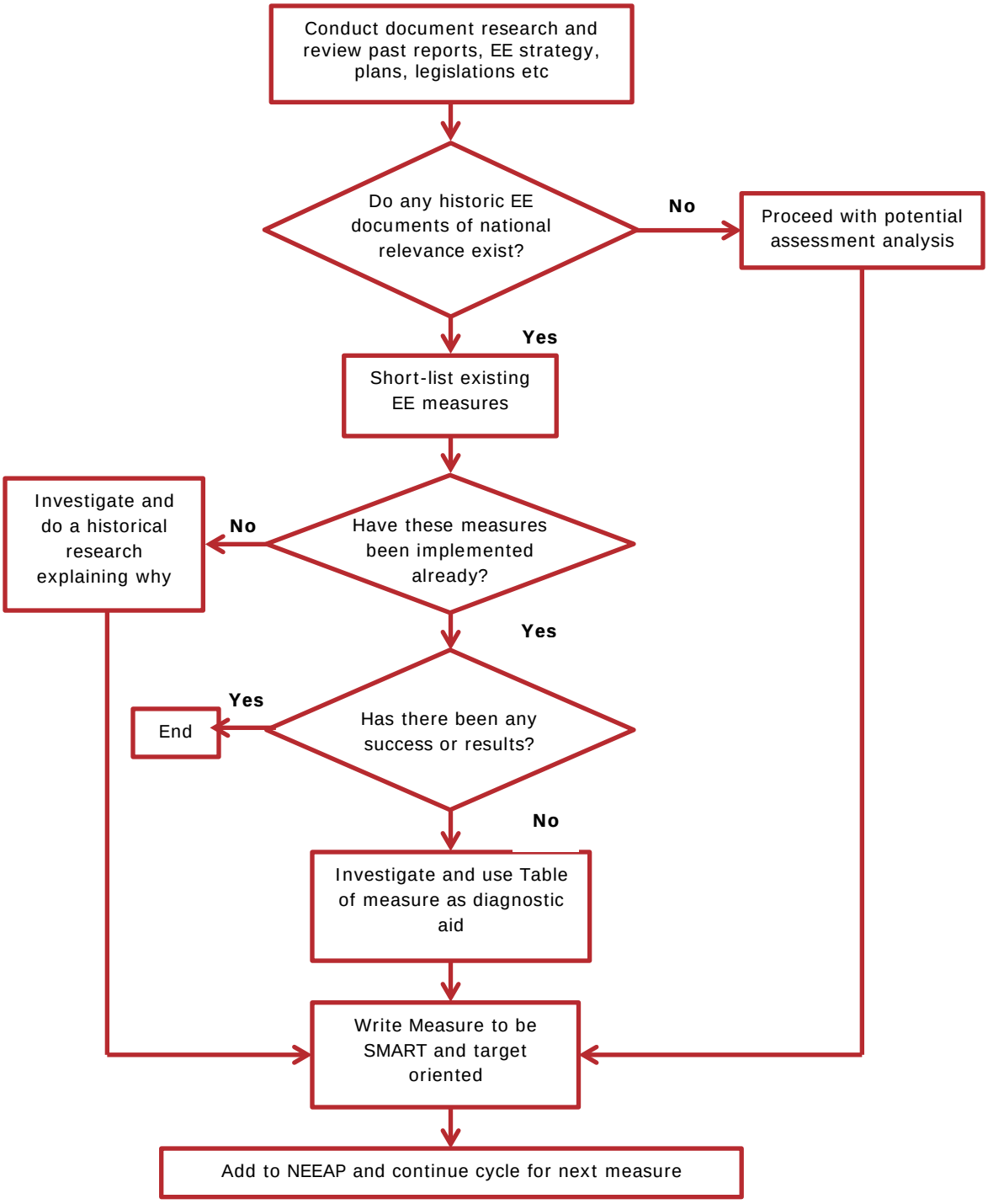
Once a NEEAP has been developed, the overall cost of the NEEAP (including the cost of measures that do not contribute to savings) has to be calculated.
If these costs are greater than the savings produced, then the overall NEEAP as a plan is not cost-effective.

It is important to determine:

1. Cost of the whole NEEAP
2. Savings incurred in the entire NEEAP

7 EPA – page 15 – Understanding cost-effectiveness of Energy Efficiency Programs (1-1)

The process diagram summarizes the methodology for measure selection in the NEEAP:



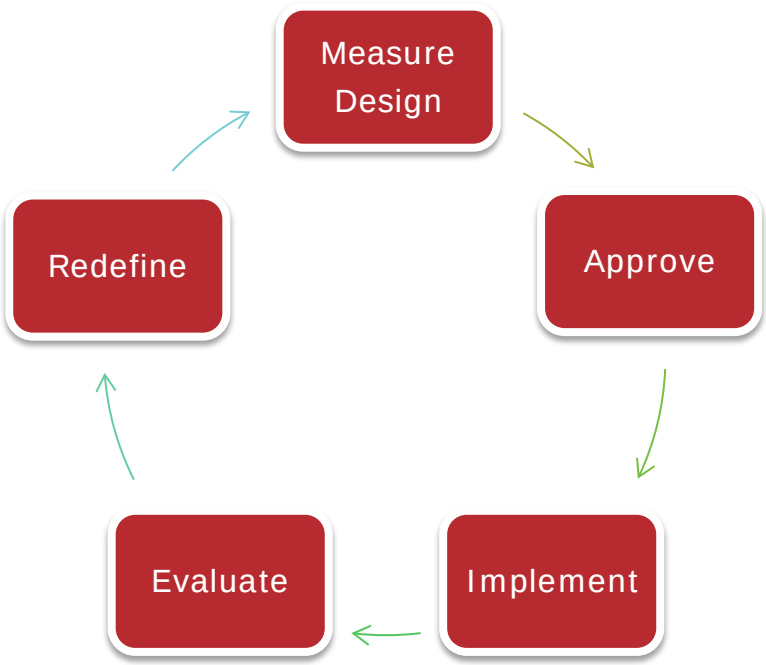
5 Design Evaluation (Ex-ante evaluation)

Once the measures have been chosen and implemented, the consistency of the measure is assessed. The main pre-requisite is that the measure satisfies initial conditions in the measure design section.

Design evaluation involves ensuring conformity with template and Arab Guideline document, delivery of expected results during implementation and catering for the proper monitoring and evaluation framework.

- Do the measures cover all sections required? Are they SMART?
- Have the targets (interim and final) been defined?
- Have surveys been accommodated for, or any other methods for monitoring and evaluation specific to the measure (Efficient lighting, SWH measures, S&L)?
- Have indicators of performance been created and how will the achievement be assessed?

Observing best practices and lessons learnt from similar measures in the region can help assess the measure and its improvement for future NEEAP phases



6 Monitoring and Evaluation (Ex-post evaluation)

Monitoring and Evaluation involves measuring and determining the actual energy savings after implementation of the energy efficiency measure and the extent to which the measure is meeting the set targets.

The three stages of evaluation conducted for measures in NEEAP are:

- **Process** – process analysis evaluates the progress of the measure based upon Implementation, finance, capacity building and regulation.
- **Impact** – evaluates the energy savings and financial savings brought about by the measure implementation. CO_2 emissions reduction is also included.
- **Market** - evaluates the transformation created in the market supply and demand.

A generic questionnaire for monitoring and evaluating measures is attached in the annex inspired from questionnaires developed by RCREEE for the four common measures in existing NEEAPs.[8]

Calculating the energy savings

Methods for calculating energy savings are required to monitor progress. This can be done using two approaches:

1. Top down – the energy savings data used is at the national level, and obtained as an aggregated value.
2. Bottom up – monitoring is conducted at an individual measure/participant level.

[8] A guide to monitoring and evaluation has been developed at RCREEE and can be consulted for detailed information regarding the four common measures mentioned above

7 Annexes: List of complementary documents

Additional documents that are required for understanding and drafting a NEEAP include:

1. The Arab Guideline for improving electricity efficiency and rationalizing its consumption at the end user
2. Template for NEEAP drafting – available in the Arab Guideline document Annex
3. Proposed methodology for the preparation of a National Energy Efficiency Action Plan (NEEAP) according to the Arab EE Guideline

NEEAP drafting and adoption phases

Pre- drafting
Country confirms intention to adopt Arab EE guidelines
Responsible entity and national focal point created/appointed
Ministry adopts EE guideline on a national level
Drafting (Assisted by RCREEE)
National stakeholders are contacted for data collection to conduct assessment
Data collected for past 5 years
Indicative targets are estimated (national and sectorial)
Measures selection and design
Design evaluation
Create monitoring and evaluation system
Post-drafting
Circulate the draft NEEAP for feedback
Improve draft based on feedback and circulate final draft
Present final draft to minister, cabinet and LAS
Present NEEAP for technical and financial support
After approval of NEEAP, laws and regulations for EE developed
Reporting (Assisted by RCREEE), Monitoring and Evaluation
Implement measures
Conduct monitoring and evaluation
Reporting of progress
Use feedback and lessons learnt to improve for next phase

Assessing current energy situation

Indicative questionnaire for surveying the current situation in the country.

Energy Pricing Questions:

- What is the current level of subsidies in the country?
  (Check which sectors are subsidized and which are not).
- Is subsidy in an annual sum guaranteed by state budget, or is it in a percentage form? (Is it a full sum payment or is it provided per unit of output as a percentage?)
- Selling price of kWh? And the cost of kWh produced? (These values can be classified as per type of technology used, and also as per power plant).
- What is the electricity pricing scheme existing currently? (This can be arranged as per sector: ToU, Flat, inclined blocks).

What is the total amount of electricity sold annually for the past 5 years?

Policy Questions

- What has been done in the past on a national level for energy efficiency?
- Have energy efficiency targets been set previously? If yes, what methodology used and what were the target values?
- What is the legal status regarding energy efficiency in all sectors?
- What is the current situation with regards to: Buildings, energy efficiency lighting (domestic and street), electrical appliances
- What are the financing methods at the moment for past and existing projects in energy efficiency?
- Is there an energy efficiency fund set in place?

Institutional Capacity Questions

- Does a designated mandated energy efficiency agency exist? If yes, how many people are dedicated to it? What is the status?
- What awareness campaigns have been conducted regarding energy efficiency? What was the targeted audience?
- Any workshops, training and capacity development conducted in the country? If yes, by whom, for whom, duration and nature of the training to be specified
- What energy efficiency programs have been implemented to date? What is the budget for these programs? How much of the initial quantitative target has been reached? What was the duration of the programs?

Utility Questions:

GENERATION

- What is the total installed capacity?
- How many power plants exist, what is their location geographically, and is there any preference or priority given to the plants? If yes, list in order of priority
- Technology, maximum installation potential for each technology
- The ownership type of the power generation facilities to be specified
- What is the amount of electricity sold annually for the last 5 years by sector?
- What is the difference in electricity generation and electricity sold, expressed in GWh?
- What are the factors that are responsible for the difference in the amount of electricity generated and sold?
- Compare current existing technology with ideal efficiency.
- Have there been any updating and major renovation projects recently? If yes, has there been any monitoring and evaluation done to assess the benefits in terms of energy efficiency after implementation of project?
- What is the contribution of the power plant to the electricity generation mix? Where is the plant located, and what is the main use of the electricity it generates? - Industrial intensive region, or city and mostly urban residential-oriented region?
- How old are the power plants? Accordingly what are the effects on performance of the system and efficiency?
- Are maintenance schedule and measures carried out and tailored accordingly?

TRANSMISSION

- What are the losses involved in the transmission sector?
- What are the latest projects in terms of transmission lines?
- Has there been any renovating and updating of transmission technology?
  If yes, specify the type of technology used before and after, as well as the benefits observed with regards to reduction of technical losses

DISTRIBUTION

- How many customers currently registered and within the past 5 years?
- What are the customer categories, and how many per category?
- What is the type of payment used? Pre-paid, post-paid? To what extent are losses accounted for?

CONSUMPTION

Type of consumers:

- Rural electrification
- Grid connected in urban regions
- Grid connected in rural areas…

Monitoring and evaluation

Process evaluation questionnaire

Implementation plan:

- Brief description of the implementation plan for the selected approach?
- At what stage of the process is the measure?
- Is the plan being followed? Have there been any modifications?
- Has the process of quantifying the number of replacements/implementation of technology been made?
- Quantify the implementation of the measure by the number of replaced/distributed/installed equipment
- Have targeted areas for implementation been made?
- Do the targeted areas have the required infrastructure?
- If contractors are involved, what is the current situation with the contractors?
- What the approach has been/is to be used for: Replacement or installation or others?
- What is the type of technology chosen?
- In the case of consumer-oriented products/technology (appliances for example) has there been a survey evaluating the technology based on market penetration and energy consumption?
- Have any norms and quality standards been implemented for the new technology to be introduced?
- Does a proper and clear communication channel/information exchange channel exist between the local authority in charge of setting rules and regulations/standards and certification and the relevant stakeholders?

Finance:

1. ***Source of funding***

- Is there any financing for the measure? Who is financing? How much is being financed? Since when? For how long is the financing expected (full program duration or partial)? What are the financial tools and mechanisms used?
- Is funding for the measure in the feasibility study phase, preparation before implementation or has it been implemented?
- Has the financing source (s) been identified? A brief description of the source (s) of funding is to be provided.
- How is the budget being managed and allocated and how much has been spent until this stage in the process?

2. ***Program costs***

- How much has been spent on awareness activities?
- What are the upfront investment costs of the measure?
- Running costs? Costs of awareness and campaigning/advertising
- Any implementation costs and related costs (for conducting surveys for example)

3. ***Financial mechanisms***

- Are there financial incentives for the measure?
- Kindly provide a brief description of the incentive mechanism.
- Financial incentives mechanisms normally received in a form of tax deduction or payment installment
- What is the incentive mechanism used? Tax deduction, soft loans, and direct grants? In case of using soft loans: what is the percentage of the interest rate? What is the duration of the loan?
- Is there an "incentive phase out" plan involved?

Capacity building:

- Is there a capacity building plan for the technology involved?
- Provide a description of this plan if it exists.
- Is capacity being developed in technical knowledge about the technology involved in the measure? Installation and maintenance?
- Any capacity building measures provided to the manufacturers?
- What is the current status of capacity building? Quantitative estimate of the achievement to date. Categories: Private, public, students. How many trainings were provided and at what level?

Regulations:

- Have the existing regulations specific to the technology/measure been documented / reviewed?
- What are the latest changes conducted and any new laws implemented?
- Has there been any adaptation of a new code? What are the specificities mentioned?
- Is the project voluntary, mandatory (in case of building codes, S&L for manufacturers for example).
- Does any legal document exist regarding enforcement of measure?

Impact evaluation questionnaire

Calculating energy savings:

- What is the average energy efficiency of the currently used technology?
- What is the average energy efficiency of the new technology proposed by the measure?
- What is the energy consumption of the target group before and after the measure?
- What is the average electricity demand per individual/unit/entity in the target group?
- What is the amount of financial savings from implementing the measure?
- What is the effect of the measure on the reduction of CO2 emissions and peak load reduction?

Market evaluation questionnaire

Market transformation calculations

- How many items related to the measure have been sold before and after the procedure implementation?
- What was the number of manufacturers/installers involved in the particular technology /service before implementation of the measure and after?
- What type of governmental support has been provided for local manufacturers?
- What was the number of equipment sold before the measure implementation, and after?

Survey

- In the case of substitution of a less efficient technology with a more efficient technology, has there been any market survey/study conducted to test the market transformation in the country?

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مبنى المحطات المائية (الدور ٧)
بلوك ١١ - قطعة ١٥، عمارات ملسا
أرض الجولف، مدينة نصر، القاهرة، مصر
الهاتف: ٤٧٥٥ ٢٤١٥ ٢ ٢٠+
الفاكس: ٤٦٦١ ٢٤١٥ ٢ ٢٠+

Hydro Power Building (7th Floor)
Block 11 - Piece 15, Melsa District
Ard El Golf, Nasr City, Cairo, Egypt
Telephone: +20 2 2415 4755
Fax: +20 2 2415 4661

www.rcreee.org