Climate Change Compass helps the UK Government monitor, evaluate and learn from UK International Climate Finance

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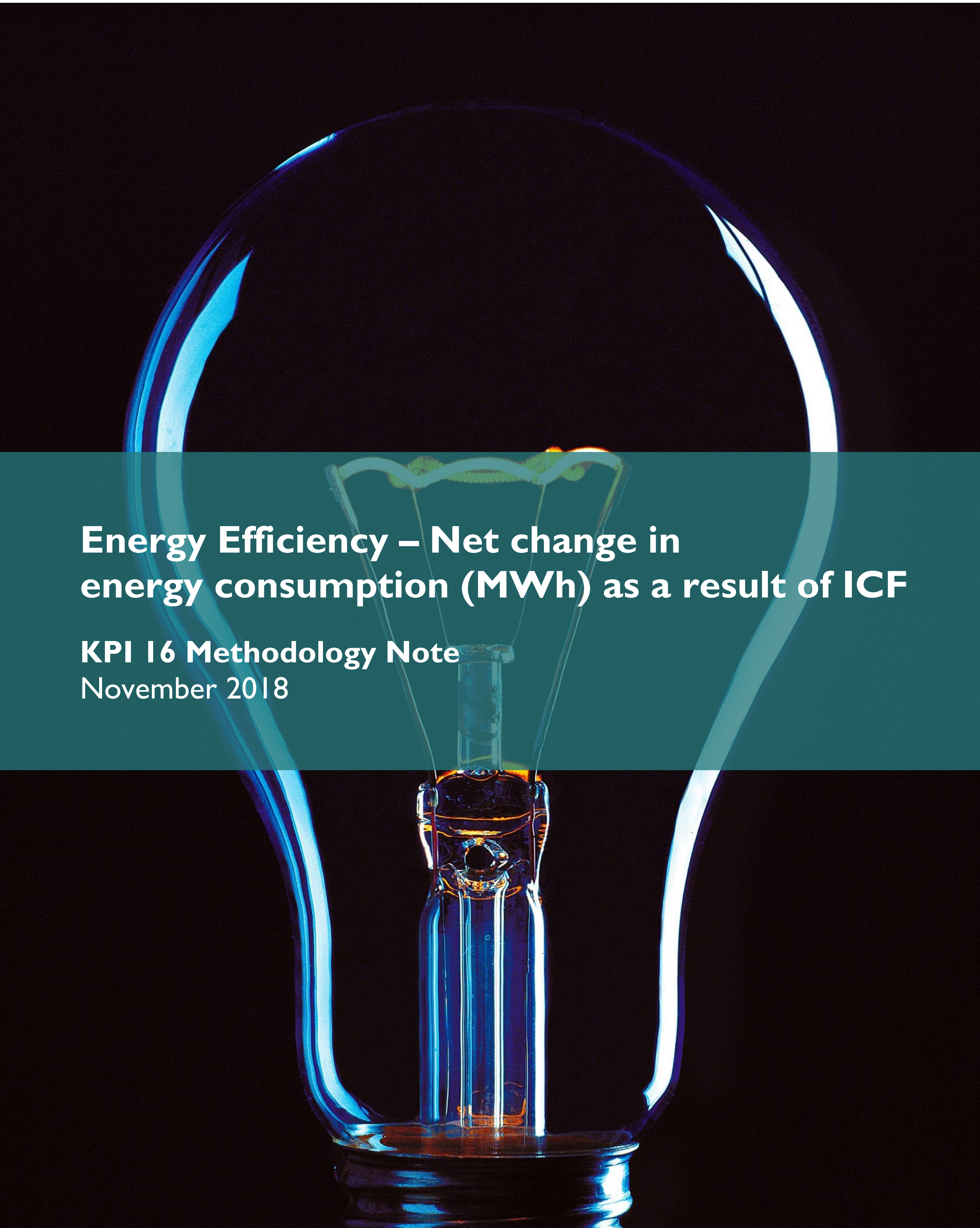

Energy Efficiency – Net change in energy consumption (MWh) as a result of ICF

KPI 16 Methodology Note

November 2018

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About Climate Change Compass
The UK government has committed to provide at least £5.8 billion of International Climate Finance between 2016 and 2020 to help developing countries respond to the challenges and opportunities of climate change.

Visit **www.gov.uk/guidance/international-climate-finance** to learn more about UK International Climate Finance, its results and read case studies. Visit **www.climatechangecompass.org** to learn more about how Climate Change Compass is supporting the UK Government to monitor, evaluate, and learn from the UK International Climate Finance portfolio.

Acronyms

BAU	Business As Usual
CDM	Clean Development Mechanism
DFID	Department for International Development
EE	Energy efficiency
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GWh	Gigawatt hour
HMG	Her Majesty's Government
HVAC	Heating, ventilation, and air conditioning
ICF	International Climate Finance
KPI	Key Performance Indicator
kWh	Kilowatt hour
IEA	International Energy Agency
LED	Light Emitting Diode
MEL	Monitoring, evaluation and learning
Mtoe	Million tonnes of oil equivalent
MWh	Megawatt hour
SDG	Sustainable Development Goal
SE4All	Sustainable Energy for All
TWh	Terawatt hour
W	Watt

Energy Efficiency – Net change in energy consumption (MWh) as a result of ICF

Rationale

The inefficient use of energy has a considerable impact on development. It limits the availability of energy and consequent access to services, reducing economic activity. Most developing countries have considerably higher energy demand than supply, and energy efficiency measures are often the cheapest solution to increase energy access. There is significant opportunity for energy efficiency measures to support socio-economic growth, energy access and carbon savings across all sectors within the economy. This ranges from supply, through transportation, and to consumption by households and businesses.

Key priorities of the UK's International Climate Finance (ICF) are to demonstrate that low carbon development is feasible, and to achieve significant greenhouse gas emissions reductions. Energy savings contribute to reducing greenhouse gas emissions, saving costs, and increasing energy security over the long term. Monitoring the net positive change in energy use from ICF projects is a key indicator of progress and action on the ground.

Summary table

Table 1: KPI 16 summary table

Units	MWh (using appropriate conversion factors from other (non-MWh) energy measurements)
Disaggregation summary (click for full details)	• Whether carbon credits[1] obtained and if these have been sold • Progress for each year of the project should be reported; along with a forecast of expected emissions savings remaining over the technology or intervention lifetime should be noted
Headline data to be reported	Absolute reduction in energy consumption (MWh)
Latest revision	October 2018. The main revisions to this Methodology Note are: • Step-by-step methodological guidance
Timing issues	*When to report:* ICF programmes will be required to report ICF results once each year in March. Please bear in mind how much time is needed to collect data required to report ICF results and plan accordingly. *Reporting lags:* Your programme may have produced results estimates earlier in the year, for example during your programme's Annual Review. It is acceptable to provide these results as long as they were produced in the 12 months preceding the March results commission. In some cases, data required for producing results estimates will be available after the results were achieved – if because of this, results estimates are only available more than a year away from when results are delivered, this should be noted in the results return.
Links across the KPI portfolio	KPI 16 is a contributor to KPI 6 by means of a conversion factor. See KPI 6 Methodology Note for details. There is a possible link between KPI 16 and KPI 2 (energy access) and KPI 9 (low carbon technologies), as both of these categories can also feature important energy efficiency attributes. There is a weaker link to KPI 5 (employment), which may be reported as a co-benefit at outcome level in

[1] A permit which allows a country or organisation to produce a certain amount of carbon emissions and which can be traded if the full allowance is not used.

	programmes, as well as KPI 11 and 12 (public/private finance leveraged) and KPI 14 (institutional knowledge) at output level.

Technical Definition

This Energy Efficiency indicator will report on the change in energy consumption (in the form of heat, kinetic energy, or electricity depending on the intervention) measured in MWh (or converted into MWh) relative to the assumed Business as Usual (BAU) energy consumption. This indicator will reflect the energy savings directly attributable to ICF interventions over the lifetime of the ICF programme, or product life (if this is shorter than programme). Most energy efficiency interventions reduce energy use beyond the typical 5-year ICF programme, and so the total ('lifetime') energy savings will be significantly more than that reported in this KPI.

Energy savings is the difference between the energy required to provide the same or equivalent products or services, using energy efficient technology or behaviour, as compared to the original technology or behaviour.

Energy efficiency interventions can entail replacement of an existing system with a more efficient system, or use of more energy efficient installations in newly constructed buildings.

To accurately reflect energy savings, we must consider changing circumstances such as i.e. climate, occupancy, and/or behavioural changes. An element in calculating savings is the "rebound effect", which involves possible increase in use of a product or service (and hence energy use) because it has become more efficient.

Programme designers should also consider including the change in energy intensity resulting from the programme. "Change in energy intensity" is the change of energy input needed for the same service or product output, for example MWh/product manufactured, or MWh/unit of cooling service (HVAC). This is an alternative proxy for energy efficiency, and can form a useful value for money metric, or even an outcome-level target.

Methodological Summary

The diagram below shows a step-by-step guide of how to report on KPI 16. These steps are expanded in the Methodology section below.

Figure 1: KPI 16 Methodological Summary

KPI 16: Energy efficiency: Net change in energy consumption (MWh)

1. Determine energy use without ICF intervention
2. Estimate reduction in energy use owing to ICF intervention relative to without ICF intervention
3. Adjust gross savings to account for changing circumstances such as changes in climate, occupancy, and behaviour
4. Calculate proportionate share of HMG contribution, where HMG funded only part of a programme

Methodology

The following equation should be used in concert with the steps below:

Net Change in Energy Consumption = energy consumption without ICF intervention – energy consumption following intervention + adjustments (e.g. Rebound effect)

1) Determine energy use without ICF intervention (counterfactual)

This is to be set out in individual project business cases based on a good understanding of current (or potential) energy use.

The counterfactual[2] should represent the likely evolution of energy-efficient technologies and practices without ICF intervention.

To account for improvements in energy efficiency independent of ICF interventions, the use of a dynamic counterfactual (i.e. that varies for each project year) is recommended. Positive market developments (i.e. that increase energy efficiency), which may occur in the absence of ICF intervention need to be captured. These calculations should ideally be country- and sector-specific, and use recent historic trends in energy use as a guide. For example, the Global Environment Facility (GEF) guidance on calculating the Greenhouse Gas benefits of energy efficiency projects cites the following:

- 1% improvement per year in relative efficiency of baseline technology (i.e. assuming that the unit energy intensity of the baseline technology would decline by 1% per year)
- Increase in market share of improved efficiency (project) equipment of 5% per year.

When determining the counterfactual for new equipment installations (e.g. lighting, appliances, motors or drivers, compressors), only the difference between the high-efficiency (new) equipment and the current market average should be counted.

When the ICF intervention accelerates the replacement of equipment, the energy consumption of the new equipment may be compared to the original equipment, but only for the remaining lifetime of the original equipment. Thereafter, the current market average efficiency baseline should be used. To illustrate, an ICF intervention decommissions an electric motor that uses 5000MWh/year, and replaces it with a high-efficiency motor that uses only 2000MWh/year to provide the same service. The market average replacement would use 3500MWh/year. If the old motor had (an estimated) 3 years life remaining, the energy savings for a 5-year ICF project would be:

3 years x (5000 – 2000) + 2 years x (5000 – 3500) = 9000 + 3000 = 12,000MWh saving over 5 years.

When determining the counterfactual for interventions related to new buildings, only the energy savings over and above the prevailing building regulations or building codes for that particular type of building can be included.

Similarly, if renovations to buildings are covered by requirements under building regulations, only the energy savings above those required by the building regulations can be attributed to the ICF intervention.

The counterfactual must also account for the ‘economically useful lifetimes’ of the energy efficiency investments. In some investment environments, this can be very short, particularly in highly dynamic and fast-growing economies, or in economies where old capital is rapidly replaced. For example, a pump rated for 20,000 hours economic life would have an economically useful life of more than 10 years when operating 4 hours/day. But in circumstances of intensive use, operating 20+ hours/day, the economic useful lifetime will be less than 3 years, and thus less than the ICF project period. The above is not expected to affect the majority of ICF programmes, but where it does, the energy savings expected should be adjusted accordingly.

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[2] Energy use without ICF intervention. See Annex 2 for general counterfactual definition.

Lifetime energy savings can be estimated using the CDM lifetime tool default values (from page 4 of the file at: **http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf**) for lifetimes of each technology, unless project specific data, which is more accurate than the CDM estimations, is available and reported in the KPI narrative.

If you are not able to estimate what the counterfactual is, you can use an 'adjustment factor', which should be high (e.g. 95%) if you are confident your results are additional, and your data quality is good. A lower 'adjustment factor' (e.g. 50%) should be used if you have a lot of uncertainty about the quality of data, and additionality of results, for example if there are other partners in the area undertaking similar activities.

See example

2) **Estimate reduction in energy use owing to ICF intervention relative to without ICF intervention**

Before and after energy use calculations may be based on technical estimates of energy use or on real assessments**.** See the worked example below for details of calculation.

See example

3) **Adjust gross savings to account for changing circumstances such as changes in climate, occupancy, and behaviour**

Changing circumstances may include: climate, occupancy, or behavioral changes. A noted example of this is the "rebound effect", involving a consequent increase in the use of the energy because services have become more efficient / cheaper. This rebound effect is the energy demand response by the consumer resulting from more efficient energy provision because of the ICF project. The rebound effect will limit the savings estimated by engineering or technical modelling.

Formally, the rebound effect is measured as: the proportion of technically achievable reductions in energy consumption from efficiency improvements that are not realised. Consequently, the rebound effect is usually represented as a percentage of the potential energy savings. A 5% rebound effect implies that only 95% of the technically achievable efficiency will be realised.

The rebound effect should be considered for all energy efficiency interventions, but should be separated from increased service provision. Where estimating energy savings is based on real measurements of (before and after) MWh savings, then it is necessary to evaluate whether these measurements already capture the rebound effect (if measuring in the same way before and after, it is highly probable the rebound effect is captured).

The rebound effect varies across sectors, countries and project types. In many cases, energy efficiency increases service provision. For example, energy efficient lights in poor households enable affordability of increased lighting time, and increased utility, rather than simply 'wasted' energy.

For electricity energy savings projects where no rebound information is available, a default of 20% for residential customers should be applied and 10% for commercial or industrial consumer electricity use in middle and low income countries. This is based on HMG Appraisal guidance text.

See example

4) **Calculate proportionate share of HMG contribution, where HMG funded only part of a programme**

If HMG is the sole investor in a project or programme, it should assume all responsibility for any results (where the results are assessed to be additional and where HMG has a causal role).

In many instances HMG may be acting alongside one or more other development partners or multilateral bodies that also provide funding or support for projects or programmes – and where each partner has played a role towards the results. In these cases, HMG should only claim responsibility for the portion of results that can be attributed to its support.

If HMG is only funding part of a project/programme, reporters should calculate results as a pro-rata attributable share based on the value of all public co-financing towards the project.

In instances where ICF programmes leverage (public or private) finance that helps to deliver programme results, please contact your central ICF teams on how to address attribution of results delivered. See methodology notes for KPI 11 and 12 for definitions (of public, private, and leveraged finance and co-finance).

If HMG is contributing to a fund

'First best' approach: use project/programme level attribution (as above)

In this approach, reporters calculate results attributable to the UK for each project/programme implemented by the fund using the project/programme level attribution approach, and then sum results across all projects/programmes in the fund to reach total UK attributable results.

This approach allows for recognition of other co-finance contributions at the project/programme level. However, this approach may be complicated or not always possible in practice as it relies on (i) full information about project/programme level inputs, (ii) additional work to calculate results at the project/programme level.

'Second best' approach: use fund-level attribution

Reporters apply fund-level attribution (i.e. at point of UK investment) for reporting results. I.e. results should be shared across all donors that contribute to a fund. All results are attributable to the relevant fund (e.g. CIFs, CP3, GAP) regardless of whether these funds blend with other sources of finance in implementing projects at levels below the point of UK investment. This approach assumes that any further finance towards the project is counted as leveraged. Where this is known to not be the case, a more conservative approach to attribution may be appropriate, please contact your central ICF teams on further guidance.

While this is the less preferred approach as it does not recognise additional contributions at the project/programme level, it may be more practical to implement where full data on project/programme level inputs is not available.

Note: The distinction between attribution at the project/programme level and at the fund level (or at point of UK investment) is only an issue where the UK is investing in funds where there are multiple investment levels. **See example**

Worked Example

Worked Example 1

Based on a fictitious programme where ICF matches the German government in funding 50% of an intervention that replaces inefficient light bulbs with energy efficient lighting.

The programme installs 10,000 8.5 Watt LED (Light Emitting Diode) bulbs, replacing 60-watt incandescent light bulbs (the counterfactual, which is assumed to remain static over the project period) in a single year. This results in a positive change in energy intensity of approximately 85% – a seventh of the energy is needed to produce the same (or better) light output.

It is assumed that an average household in the target country lights their home for 3.5 hours a day, over 365 days per year, and the bulbs last 5 years. As a result of the energy efficiency and its associated cost savings, a household sample survey finds that households increase their consumption to 4 hours a day – a rebound effect of 12.5%.

To estimate annual results:

1. **Determine energy use without ICF intervention (counterfactual)**

60W x 3.5 hours x 365 days x 10,000 bulbs ÷ 1,000,000 (to convert Wh to MWh) = 766.5 MWh

2. **Estimate reduction in energy use owing to ICF intervention relative to without ICF intervention**

Table 2: KPI 16 Worked Example calculation

	Calculation	**Number**	**Unit**
BAU consumption	(60W x 3.5 hours x 365 days x 10,000 bulbs) ÷ 1,000,000 (to convert Wh to MWh)	766.5	MWh
New energy use	(8.5W x 4 hours x 365 days x 10,000 bulbs) ÷ 1,000,000 (convert to MWh)	124.1	MWh
Rebound effect (increase in use)	Already included in the calculation of 4 hours/day rather than 3.5 hours/day	NA	MWh
Change in energy use	BAU – new energy use – rebound effect = 766.5 – 124.1 – 0 =	642.4	MWh

The lifetime impact on the bulbs being installed in one year is the annual result multiplied by the life of the product. In this case 642.4 MWh x 5 = 3,212MWh

3. **Adjust gross savings to account for changing circumstances such as changes in climate, occupancy, and behaviour**

Already included in the calculation of 4 hours/day rather than 3.5 hours/day

4. **Calculate proportionate share of HMG contribution, where HMG funded only part of a programme**

3,212 / 2 = 1,606 MWh

This example assumes that all light bulbs distributed are installed at the start of the first year, and are used fully. To more accurately estimate of the project's energy efficiency impact, more information is needed about the effectiveness of the intervention (for example, clarification that the light bulbs are used fully) to refine the calculation. Please see the worked example on lighting in the KPI 6 methodology note.

Data Management

Data Sources

Some data will be available directly from programmes, for example from project-level M&E. Ideally, the duty to collect data should be the responsibility of recipients of ICF funding, or a third-party auditing entity. This information will need to be kept up to date by liaising with programme managers.

Data may be obtained from operating information (e.g. engineering, short-term monitoring, utility bill analysis or end-use metering), or calculated using a commonly accepted methodology on energy efficiency.

Most Recent Baseline
The baseline should reflect the situation prior to ICF funding being provided, as well as anticipated projections of what would happen without the ICF. The baseline should align with the economic appraisal in the project design.

Data Issues / Risks and Challenges
There may be varying degrees of quality of data, from data generated by large DFID projects with good-quality data, to that produced by multilateral partners with their origin in government partners' data systems, which may be of lower quality. It is assumed that the norm will be ex-post engineering or technical estimates of energy use of energy efficiency products, rather than actual recordings of before and after energy use.

Quality Assurance
All results estimates should be quality-assured before they are submitted during the annual ICF results return, ideally at each stage data is received or manipulated. For example, if data is provided by partners, this data should be interrogated by the ICF programme team for accuracy, or at the very least data should be sense-checked for plausibility. When converting any provided data into KPI results data, quality assurance should be undertaken by someone suitable and not directly involved in the reporting programme. Suitable persons vary by department; this could be an analyst, a results / stats / climate and environment adviser / economist.

Central ICF analysts will quality-assure submitted results. This may lead to follow-up requests during this stage.

To avoid inherent reporting biases, it is strongly recommended that, where possible, data collection is undertaken by a third party that is not directly involved with implementing the project. Where not possible, consider using independent evaluations or alternative means to periodically check the validity of results claims. Any concerns about data quality or other concerns should be raised with your departmental ICF analysts and recorded in documentation related to your results return.

Data Disaggregation

- Please report if carbon credits[3] have been obtained or not, and if these have been sold.
- Progress for each year of the project should be reported, and a forecast for the remaining expected energy savings over the project lifetime, and over the expected lifetime of the energy efficiency product, should be noted.

[3] A permit which allows a country or organisation to produce a certain amount of carbon emissions and which can be traded if the full allowance is not used.

Annex 1: Comparability and synergies with other external indicators

Energy savings are almost always measured in MWh (or GWh or TWh), as this is a simple standard measurement of a quantity of energy that can be saved through different behaviours, processes or technologies. An alternative international unit, as used by organisations such as the International Energy Agency (IEA) is Mtoe (million tonnes of oil equivalent), but this is interchangeable with MWh as a unit of energy. 1 Mtoe = 11,630,000MWh, or 11.630 GWh. See the **International Atomic Agency** website for a simple online unit convertor.

SDG 7.3 is the "Rate of improvement in energy intensity (%) measured in terms of primary energy and GDP." Energy intensity is determined by many factors, not just energy efficiency. Such factors can include the structure of the economy, type of industry base, exchange rates, affordability of energy services, the size of a country, climate and behaviour. Efficiency impacts can be masked by variation in these non-energy-related factors. Thus, using energy intensity as a proxy for energy efficiency can generate misleading results (IEA).

Annex 2: Definitions of key methodological terms used across Methodology Notes

As different HMG departments may use the same terminology to refer to different concepts, this section sets out definitions for key terms used across Methodology Notes for ICF KPIs. The terms used in these notes refer to the concepts as defined below, rather than to alternative, department-specific usages of these terms.

Counterfactual: The situation one might expect to have prevailed at the point in time in which a programme is providing results, under different conditions. Commonly, this is used to refer to a 'business as usual' (BAU) counterfactual case that would have been observed if the ICF-supported intervention had not taken place.

Additionality: Impacts or results are additional if they are beyond the results that would have occurred in the absence of the ICF-supported intervention. That is, results are additional if they go beyond what would have been expected under a BAU counterfactual.

Causality: Causality refers to the assessment that one or more actors bear responsibility for additional results or impacts, because of funding provided though the ICF or actions taken under an ICF programme. Multiple development partners may be assessed to have played a causal role in delivering results.

Attribution: Attribution refers to allocating responsibility for impacts or results among all actors that have played a causal role in programmes that deliver additional results. Results are commonly attributed to causal actors based on their financial contributions to programmes (though there may be cases where greater nuance is needed, as with KPI 11 and KPI 12).

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