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WORKING PAPER

MONITORING IMPLEMENTATION AND EFFECTS OF GHG MITIGATION POLICIES: STEPS TO DEVELOP PERFORMANCE INDICATORS

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EXECUTIVE SUMMARY

Implementation of greenhouse gas (GHG) emissions mitigation policies and actions can be enhanced through the use of indicators as part of regular monitoring. Indicators are specific, measurable metrics to demonstrate progress that occurs as a result of policy implementation. This working paper provides guidance for developing indicators that can assist policymakers and other stakeholders seeking to enhance the implementation of climate mitigation policies. The paper builds on the GHG Protocol *Policy and Action Standard* and the *Climate Policy Implementation Tracking Framework*.

The paper outlines three steps in developing indicators for monitoring performance: formulating a list of possible indicators, selecting indicators to monitor performance, and collecting and monitoring data (Figure ES-1).

The first step is to formulate a list of possible indicators to track policy implementation and policy effects. Decision-makers can develop indicators at various levels of detail, both aggregated and disaggregated, and express them in absolute or relative terms. This paper categorizes policy monitoring indicators by five types: input, activity, intermediate effect, GHG effects, and non-GHG effects indicators. Input indicators track the delivery of resources to support policy implementation. Activity indicators track activities undertaken by the authority responsible for implementing the policy. Intermediate effects, GHG effects, and non-GHG effects indicators are designed to assess the results of the policy. Results relate to changes in behavior, technology, processes, or practices in relevant environmental, social, or economic conditions, including GHG emissions effects and sustainable development effects. The paper also briefly mentions transformation indicators to monitor transformational change at the sector or economy level.

CONTENTS

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Figure ES-1 | **Steps to Develop Indicators**

Formulate a list of possible indicators

Select indicators to use

Collect and monitor data

The second step involves narrowing down the list of possible indicators to a selection of feasible and relevant indicators that will be used. A set of six principles can help to evaluate and shortlist a subset of indicators for use in regular monitoring. Selected indicators should be:

- policy relevant;
- representative of a variety of indicator types;
- based on available data or on data that can be collected in a cost-effective manner;
- supportive of meaningful comparisons among policies;
- unambiguous and understandable; and
- reported sufficiently frequently for meaningful change to be tracked.

Finally, decision-makers should collect data for the selected indicators. The data collection process begins with establishing data needs for each indicator and answering questions regarding the specific data that are required, whether existing data can be used, and the methods that can be used to collect any additional data. A monitoring plan documenting the data collection system should also be developed.

1. INTRODUCTION

Many governments at all levels are developing mitigation policies and actions[1] to deal with the challenges of climate change. It is critical to ensure that policies and actions (henceforth referred to as policies) are being effectively implemented and achieving their intended goals. Many factors, such as lack of financial resources and lack of coordination across implementing agencies, can hinder adequate implementation of policies and the realization of envisaged goals. If these factors are identified in a timely manner, governments can address them and make necessary modifications in policy design and implementation to increase the likelihood of achieving the policy goals. Therefore, it is important to systematically and regularly monitor how policies are being implemented and whether they are on course to achieve their intended goals and objectives.[2] Performance indicators constitute a powerful tool for this purpose because they facilitate tracking of policy implementation and results.

A wide variety of indicators is in use today. Development, economic, energy, environmental, performance, composite, sustainable development, health, biological, socio-cultural, equity, accessibility and affordability, quality of life, and production indicators are just a few examples. Indicators may pertain to monitoring physical, economic, social, and environmental factors at a macro level—for example, the indicators developed to monitor the UN Sustainable Development Goals (Nichols and Martinot 2000; SDSN 2015). Indicators may also be specific to a policy and designed to demonstrate progress or change as a result of policy implementation, and to assess the achievement of defined outcomes and goals (UNDP 2009). Such indicators are called performance indicators. This working paper focuses on performance indicators for GHG mitigation policies.

The paper builds on the indicators-related discussion in the Greenhouse Gas Protocol *Policy and Action Standard* (GHGP 2014) and *Climate Policy Implementation Tracking Framework* (Barua et al. 2014). Box 1 describes how the discussion here is related to those publications. This paper expands upon the earlier publications by focusing on how to set up useful and realistic performance indicators. It synthesizes the available literature on indicators to provide a step-by-step approach to developing and monitoring performance indicators that track the implementation and effects of mitigation policies. A number of resources on indicators exist in the areas of sustainable development, and health and education, among other areas (EEA 2005; Porta et al. 2011; SDSN 2015; UNAIDS 2010). There is also literature discussing indicators for activities and GHG effects for individual mitigation policies, such as energy efficiency policies (IEA 2014a). However, a resource combining the two, which discusses performance indicators to monitor the progress of climate policies toward achieving their desired GHG and non-GHG impacts, is not readily available. This paper discusses performance indicators for tracking GHG mitigation policies[3] and integrates guidance on monitoring GHG emissions as well as sustainable development impacts.

Box 1 | **Relationship of this Paper to Other WRI Frameworks and Standards**

This working paper can be used in combination with the GHG Protocol *Policy* and *Action Standard* and *Climate Policy Implementation Tracking Framework* to monitor the implementation of policies:

- ***GHG Protocol Policy and Action Standard:*** The publication provides guidance on how to estimate the greenhouse gas (GHG) effects of policies and actions. It also discusses indicators to monitor performance of policies over time. In particular, Chapter 10 provides guidance on which indicators to track over time.
- ***Climate Policy Implementation Tracking Framework:*** This tool presents five steps to guide decision-makers through the process of climate policy adoption and implementation. Two of these steps relate to developing indicators and formulating a plan to track them over time. This working paper further elaborates on these steps and also discusses other steps needed to develop and monitor indicators.

This working paper is focused on a single aspect of monitoring policies, which is developing performance indicators. It uses the same terminology and definitions for types of indicators as used in the two previous resources, while deepening the discussion and focusing on the key steps to develop indicators for monitoring GHG effects and sustainable development impacts of policies. It should be noted that this paper uses the term "performance indicators" to define what is termed more generally as "indicators" in the two earlier WRI publications. Unless otherwise cited, this paper draws heavily from these two publications.

The paper begins, in Section 2, with a discussion of the role of performance indicators and their limitations. Section 3 discusses five broad categories of performance indicators. It also briefly introduces transformation indicators, which help monitor progress toward achieving long-term targets at the sector or economy level. Section 4 outlines three key steps to develop and use performance indicators. Annex 1 presents examples of indicators from different policies and Annex 2 describes the use of aggregated and disaggregated indicators in South Africa and the United Kingdom.

The aim of this working paper is to assist decision-makers, including policymakers at national and sub-national levels who are implementing emissions mitigation policies; representatives from non-governmental, research institutes, and statistical organizations interested in monitoring policy implementation and effectiveness; and funding agencies seeking to maximize the impact of their resources.

2. ROLE OF PERFORMANCE INDICATORS

Before designing performance indicators, it is important to understand both the role they can play in the overall policy process and their limitations.

2.1 What Performance Indicators Can Do

In general, performance indicators help policymakers and stakeholders observe progress, trends, and short-term and long-term effects related to policies, and provide information to support decision-making. They can perform these functions before, during, and after policy implementation. Key functions of indicators are summarized below (Horsch 1997; Mosse and Sontheimer 1996; SDSN 2015; UNAIDS 2010; UNDP 2009):

- **Support the design of policies:** Information already being collected to support existing performance indicators for various policies can assist with understanding past trends and the current situation. Such information can help future policy design and can be used to establish more credible baselines and projected effects. The set of indicators used to establish this ex-ante evaluation provides a good starting point for defining performance indicators for the policy implementation phase.

- **Enhance policy implementation:** Using key performance indicators can provide information to support ongoing policy evaluation and give timely feedback to improve the implementation of policies. For example, the use of indicators can help identify implementation barriers, thereby leading to necessary policy modifications and targeted solutions.
- **Evaluate goal achievement:** Performance indicators related to the effects of a policy provide feedback on whether policy objectives are being met. Depending on the timeframe over which they are tracked, indicators can help assess both short-term results and long-term impacts. Data collected throughout the policy implementation period can provide input to further analysis of factors that contribute to policy effectiveness and the potential for transformation. Results from such analysis can in turn positively influence the design of new policies.
- **Promote accountability:** The use of performance indicators can bring transparency and accountability to the policy implementation process. Monitoring progress shows how resources are being spent and whether the implementation process is on track.
- **Communicate the policy impact:** Using performance indicators helps with reporting and communicating the impact of policies to stakeholders, such as groups targeted by policies, donor agencies, and relevant government and international agencies. Reporting can take the form of periodic policy assessments, annual progress reports, input to national communications under the United Nations Framework Convention on Climate Change, donor reports, and so on. Tracking performance indicators over a longer period of time can demonstrate whether the policies have led to sustainable, transformational, and lasting effects. The use of indicators can also help build support, and assessments can be used to justify additional resources needed for policy implementation.

2.2 Limitations of Using Performance Indicators

The use of performance indicators contributes to a better understanding of the achievement of goals and targets, the effectiveness of policies, and the factors hindering or facilitating progress. However, their use also has limitations:

- **The information that performance indicators provide is only as good as the raw data:** The most relevant and comprehensive set of indicators will not deliver the information needed for policymaking and assessment if the required data cannot be collected with sufficient rigor. Indicators should be selected based on a realistic assessment of the feasibility of data collection, among other things. This involves evaluating the quality and availability of data, and the resources and capacity necessary to collect them on a regular basis.
- **Comprehensive monitoring does not guarantee success:** A policy may fail to achieve its objectives because of improper design or poor implementation or other external factors. The monitoring of performance indicators provides an opportunity to correct the course of a policy by detecting undesirable changes or a lack of desired changes. The use of performance indicators, however, does not guarantee that a policy will be able to accomplish all of its objectives. Nor do the insights gained from using relevant indicators automatically lead to changes in policymaking. Such changes may require a political, administrative, and/or legal process that reviews and adjusts policies based on the findings from monitoring (Parks et al. 2015). Monitoring systems should therefore link to, and provide timely inputs to, larger policy design or modification processes.
- **The use of performance indicators alone cannot explain the outcomes of policies:** Performance indicators can tell whether a policy is achieving its goals; they cannot always explain why the goals have or have not been achieved (Church and Rogers 2006). The reason is that factors unrelated to the policy, for example, energy prices, weather, consumer preferences, other policies applicable to the same target group, and political and economic circumstances, may also influence its course, and may not be captured by the performance indicators (UNAIDS 2010). Explaining policy outcomes warrants a different type of analysis that determines the cause-and-effect relationship between actions and outcomes.[4] Well-crafted indicators that take into account linkages between implementation activities and the desired effects can, however, provide some insight into potential explanations for the observed performance.

3. TYPES OF PERFORMANCE INDICATORS

This paper groups performance indicators into two broad types: those that track policy implementation and those that assess policy effects (Table 1).[5] These categories provide a framework to monitor progress during each stage of policy implementation.

- **POLICY IMPLEMENTATION INDICATORS:** Input and activity indicators, described below, provide a picture of how well a policy is being implemented. These indicators are directly related to the policy; a change measured by an input or activity indicator is a result of policy implementation.
  - **Input indicators**: Input indicators track the delivery of resources that go into implementing a policy, for example, financial, human, and organizational resources.
  - **Activity indicators**: Activity indicators track activities involved in implementing the policy (undertaken by the entity that implements the policy), for example, licensing, permitting, procurement, compliance and enforcement, and other policy administration activities.
- **POLICY EFFECTS INDICATORS:** Indicators related to intermediate effects, GHG effects, and non-GHG effects measure progress in achieving the objectives of the policy. The direct relationship between the policy and changes in these indicators is usually not as straightforward as with input and activity indicators. Depending on the policy being assessed, many other factors may influence the observed change in the indicators.
  - **Intermediate effects indicators:** These track changes in behavior, technology, processes, or practices that result from the policy being implemented. Changes in intermediate effects indicators can be directly observed, for example, number of buildings retrofitted, area of agricultural land managed, or tons of compost generated.
  - **GHG effects indicators:** GHG effects indicators monitor changes in GHG emissions as a result of policy implementation.
  - **Non-GHG effects indicators:** These indicators track changes in relevant environmental (other than GHG emissions), social, or economic conditions that result from the policy. Examples of non-GHG effects include air or water pollution effects, public health effects, and household income effects, among others.

In addition, the paper also discusses indicators related to monitoring the transformational aspect of policies. These indicators relate to tracking the ways in which policies are resulting in transformational change (defined in Section 3.6).

Each type of indicator is explained in more detail, with examples, in the following sections.

Table 1 | **Types of Performance Indicators**

POLICY IMPLEMENTATION INDICATORS		POLICY EFFECTS INDICATORS		
INPUT INDICATORS	ACTIVITY INDICATORS	INTERMEDIATE EFFECTS INDICATORS	GHG EFFECTS INDICATORS	NON-GHG EFFECTS INDICATORS
■ Finance ■ Human and organizational resources ■ Other inputs	■ Licensing, permitting, and procurement ■ Compliance and enforcement ■ Other policy administration activities	■ Behavioral changes ■ Technology changes ■ Process changes	■ Changes in GHG emissions	■ Changes in environmental, economic, or social conditions, other than GHG emissions changes
■ Changes in indicators directly related to policy implementation ■ Data often available from the entity implementing the policy		■ Changes in indicators may additionally be influenced by factors beyond the policy ■ Changes are likely to be observed in the target group(s) of policy, making data collection more challenging		

Source: Adapted from Barua et al. (2014).

3.1 Input Indicators

Input indicators measure resources that have been devoted to a particular policy during implementation by the agency implementing the policy. Resources can include financial and human resources. Using input indicators helps to assess whether the required resources are available to implement the policy in a timely manner. See Box 2 for some examples of input indicators.

Depending on the policy implementation stage, input indicators can refer to resources allocated or resources disbursed. Input indicators can also be designed to collect more detailed, disaggregated information. In the case of renewable energy policy, for example, funds allocated and funds spent could be distinguished by different components, such as solar, wind, hydro, and biomass. Input indicators can help gather additional information on how resources are being managed and used, and can detect deficiencies in the administrative implementation process at an early stage. For example, one of the indicators chosen in an EU study of the effectiveness of urban wastewater policy was the timing of receipt of funds for implementation. It was found that, in Spain and France, local municipalities responsible for the provision of sewage treatment did not receive funds in time and that this negatively affected the timely implementation of agreed measures (EEA 2005).

Box 2 | **Illustrative Examples of Input Indicators**

FINANCIAL RESOURCES

- Amount of funds allocated and spent per year to support renewable energy policy
- Amount of funds allocated and spent, by type of renewable energy (solar, wind, hydro, and biomass)
- Amount of funds to augment domestic manufacturing capacity for solar panels

HUMAN RESOURCES

- Number of staff assigned to administer a GHG emissions reporting program for industry
- Skills of staff administering a GHG emissions reporting program for industry
- Number of staff employed to maintain a public transit system

3.2 Activity Indicators

Activity indicators pertain to activities undertaken by the entity implementing the policy. Activities involved in implementing the policy can include, for example (Barua et al. 2014):

- Licensing, permitting, and contracting (for example, issuing permits for building construction, formulating power purchase agreements, issuing renewable energy certificates, certifying auditors, etc.).
- Procurement of equipment and services needed to implement the policy (e.g., procurement of energy services by public institutions); capacity building and education-related activities (e.g., training a team of energy auditors, carrying out an information campaign to promote an energy efficiency labeling scheme); direct investment in infrastructure and equipment (e.g., construction of bus rapid transit lines, purchase of buses, purchase of residential electricity meters or ambient pollution sensors).
- Compliance and enforcement activities (such as reviews of regular reporting required by the policy, spot checks to ensure that reports are correct, checks to ensure that technical equipment is working correctly, enforcement measures for non-compliance, and so on).

Box 3 lists some examples of activity indicators.

3.3 Intermediate Effects Indicators

While input and activities indicators provide insights into the status of policy implementation, effects indicators provide information on whether or how well a policy is achieving its intended impacts. This particular category of performance indicators helps with monitoring the intermediate effects of the policy. The indicators relate to changes in behavior of the policy target groups (such as consumption behavior or transport habits), technology (such as shift to renewable energy or energy efficient products), or processes (such as switching to cleaner industrial production processes), which result from implementing a policy. Box 4 provides some examples of intermediate effects.

Box 3 | **Illustrative Examples of Activity Indicators**

LICENSING, PERMITTING, AND CONTRACTING

- Number of building permits issued for wind parks
- Number of bus rapid transit lines approved for construction
- Number of power purchase agreements signed between renewable energy generators and utilities
- Number of credit lines approved to promote energy efficiency in small- and medium-sized enterprises
- Number of renewable energy certificates issued

PROCUREMENT

- Number of bus rapid transit lines constructed under a public transit policy
- Number of energy auditors trained to perform audits in industries
- Number of clean-fuel buses purchased to implement a policy to reduce air pollution
- Number of ambient pollution sensors purchased to monitor air pollution
- Number of energy efficient light bulbs purchased to distribute for clean energy lighting

COMPLIANCE AND ENFORCEMENT

- Frequency and number of reviews conducted to check regular reporting by industry
- Number of on-site visits made to ensure measurement equipment is installed and working properly
- Amount of money collected in fines for non-compliance
- Number of legal cases instigated for non-compliance

3.4 GHG Effects Indicators

GHG effects indicators represent changes in GHG emissions and removals that are the result of the policy. The increase or decrease in GHG emissions due to the policy can be estimated:

- before the policy is implemented, by quantifying expected future changes in emissions (ex-ante assessment);
- after (and during) policy implementation, by quantifying emissions changes to date (ex-post).

Briefly, the steps involved in calculating changes in GHG emissions and removals (GHGP 2014[6]) include:

1. Define the policy and choose ex-ante or ex-post assessment. For example, the policy may be a government subsidy for home insulation. (Subsequent steps are illustrated using this policy example.)

2. Identify all potential GHG effects of the policy. The home insulation subsidy policy may result in consumers installing more insulation. This can lower natural gas and electricity use in homes, thereby reducing GHG emissions. However, the energy savings by consumers can translate to more disposable income, leading to the consumption of more goods and services, thereby increasing emissions (the rebound effect).

3. Define the GHG assessment boundary around significant effects, and identify the sources/sinks inside the boundary. In the case of the home insulation subsidy policy, reductions in carbon dioxide emissions from reduced use of natural gas and electricity are expected to be significant and included in the GHG assessment boundary. The increase in emissions from higher consumption of goods and services is, however, expected to be insignificant for the purposes of this discussion, so it is excluded from the boundary.

4. Estimate baseline emissions for all affected sources/sinks included in the boundary. The baseline scenario represents conditions most likely to occur in the absence of the policy. In the case of the home insulation subsidy policy, the baseline scenario is assumed to be the continuation of historical residential energy consumption trends.

5. Estimate policy scenario emissions for affected sources/sinks. The policy scenario represents the conditions most likely to occur in the presence of the policy, for example, a 10 percent reduction in residential natural gas use.

6. Estimate the GHG effect by subtracting baseline emissions from policy scenario emissions.

3.5 Non-GHG Effects Indicators

Many mitigation policies are implemented to fulfill several objectives, including reducing emissions, and often result in a range of benefits. Non-GHG effects are social, economic, and/or environmental (other than GHG emissions) impacts resulting from mitigation policies (Box 4). In many instances, non-GHG effects can be the key drivers for implementing mitigation policies. Non-GHG effects are also known as sustainable benefits, sustainable development effects, or co-benefits; they include changes related to biodiversity/wildlife loss/conservation, public health, road safety, gender equality, employment and job creation, household income, inflation, and so on (IPCC 2007). For example, in the agricultural sector, building reserves of soil carbon is also likely to increase soil productivity, and management practices such as reduced tillage can improve water-use efficiency. Motor optimization to enhance engine efficiency and reduce GHG emissions also decreases operating costs and increases reliability. Trees planted on wasteland can reduce soil degradation and water runoff while storing carbon, and also benefit the local economy by generating employment. Transport-related mitigation measures are likely to reduce local air pollution. Table 2 presents examples of non-GHG effects and corresponding indicators to monitor some of these effects.

Box 4 | **Illustrative Examples of Intermediate Effects Indicators**

- Number of energy efficient appliances purchased
- Passenger-kilometers traveled, by mode (bus, train, private car, etc.)
- Total electricity generation by source (such as wind, solar, coal, natural gas)
- Total capacity of renewable energy installed
- Number of efficient pumps installed
- Units of electricity used by residential buildings
- Quantity of waste sent to landfills
- Installed cost of solar home systems
- Number of energy auditors certified to undertake audits in manufacturing facilities
- Volume of lending for small- and medium-sized enterprises

3.6 Transformation Indicators

Indicators can also be used to monitor the transformational aspect of policies. In the context of GHG mitigation, transformational change can be defined as a change that disrupts established high-carbon pathways and leads to low- or zero-carbon sustainable development (Clarke et al. 2014; Mersmann et al. 2014). It refers to systemic change achieved by overcoming barriers to, and ensuring lock-in of, a low- or zero-carbon development model, in order to limit global average temperature increase to less than 2°C above pre-industrial levels.

Unlike performance indicators monitored at the level of policies, indicators for transformational change are typically observed and tracked at the sector or economy level, and over a long period of time. They track progress toward long-term targets, such as decarbonizing a country's economy by 2080, reducing emissions from deforestation by 50 percent in 2050, or increasing the share of renewable energy in the national energy mix to 80 percent by 2050. See Box 5 for examples of transformation indicators in the energy sector.

However, transformation can be monitored at the policy level as well. Generally speaking, policies contributing to broader economy-wide goals and targets, by seeking to change prevailing structures and development models, are more likely to result in transformational change. Such policies can lead to, for example, a higher rate of market penetration by a cleaner technology and mobilization of large-scale investment from the private sector.

Policies with the potential to bring about transformational change tend to have the following attributes (Levin et al. 2012):

- Durable and not easily reversed, that is, "sticky" in nature
- Expand their coverage and include new populations over time
- Tend to become more entrenched over time as they deliver a diverse set of benefits and gain support

Accordingly, indicators can be developed to measure such effects.

Table 2 | **Examples of Non-GHG Effects and Indicators for Mitigation Policies in Select Sectors**

SECTOR	EXAMPLES OF POTENTIAL NON-GHG EFFECTS	EXAMPLES OF NON-GHG EFFECTS INDICATORS
Agriculture	Improve food security, improve groundwater quality and environmental health of the cultivated ecosystem, prevent degradation, improve soil and livestock productivity, reduce desertification, increase social security of those dependent on the land, increase incomes	■ Agricultural yield measured in tons of crop produced per unit area ■ Crop production per volume of water withdrawn ■ Total volume of groundwater and surface water withdrawal for agricultural use as percentage of total renewable water resource ■ Water stress ratio measured as water demand/water supply ■ Share of agricultural land affected by soil erosion
Energy	Improve energy security, reduce local pollutant emissions and dust with consequent health benefits, create new business opportunities and jobs	■ Share of households without electricity or commercial energy or heavily dependent on non-commercial energy ■ Share of household income spent on fuel and electricity ■ Jobs generated ■ Fuel mix or energy use for each income group ■ Local air pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide) ■ Energy imports
Forestry	Reduce wasteland, prevent soil degradation, improve management of water runoff, enhance food production in agro-forestry plantations, increase rural employment, enhance biodiversity, reduce local haze and air pollution from forest fires, increase revenue from ecotourism and sustainably harvested timber sales	■ Area of land characterized as wasteland ■ Soil condition as expressed by chemical soil properties and soil compaction ■ Employment generated by forestry as a percentage of total employment ■ Forest area designated for recreational use ■ Groundwater recharge ■ Head count index of poverty
Transport	Reduce congestion, reduce local air and noise pollution, improve mobility and reliability, realize fuel-cost savings, enhance traffic safety, increase health benefits, enhance access of individuals to economic, social, and cultural life	■ Average travel time to basic everyday activities or points of interest ■ Average commuting time by public and private transport ■ Percentage of non-motorized commuting trips ■ Frequency of public transport ■ Value of fuel savings, using different modes ■ Number of fatalities and injuries in traffic accidents ■ Number of stops and congestion incidents at traffic signals ■ Average access time to public transport
Waste and wastewater management	Reduce pollution of water, soil, and air; enhance public health of residents and workers; realize economic benefits of water reuse; reduce requirement for artificial fertilizers; increase public spaces for recreation; generate local employment; reduce demand for energy and raw materials by recycling products	■ Measurements of water pH, biological oxygen demand (BOD), and chemical oxygen demand (COD) ■ Use of organic fertilizers per hectare of agricultural land ■ Access to safe drinking water ■ Employment generated ■ Volume of runoff to streams, rivers, and seas ■ Aggregate amount of land transformed through habitat restoration, or through conversion to parks and other open spaces for recreation and community use

Sources: Emenanjo et al. (2015); IPCC (2007); Kaparias and Bell (2011); Özerol and Günther (2005); Reytar et al. (2014); ToSIA (2013); Vera and Abdalla (2005); Vos et al. (2005).

Box 5 | **Illustrative Indicators of Transformational Change in the Energy Sector**

- CO_2 intensity of new power generation capacity installed (grams of CO_2/kWh)
- Additional renewable capacity installed (MWh), where "additional" is defined as above and beyond what would have happened if the policy did not exist and existing market conditions continued to prevail
- Number of financing institutions dedicated to cleaner energy sources, and volume of lending
- Number of technology and service providers for cleaner energy sources
- Measures of regulatory reform (e.g., number of policies in place to support clean energy)
- Annual investments in renewables as a percentage of total investment in energy sources
- Cost of renewable energy, by technology, to the consumer
- Percentage of total energy sector employees working in renewable energy
- Number of new local enterprises providing renewable energy services established
- Value of renewable energy-related procurement orders placed within national supply chain

Sources: Mersmann et al. (2014); Nichols and Martinot (2000); WSP Environment and Energy (2010).

4. DEVELOPING AND USING PERFORMANCE INDICATORS

This section outlines three broad steps to develop and use performance indicators, based on the information available in indicators-related literature (Figure 1). However, the steps do not need to be carried out in linear fashion.

1. Formulate a list of possible indicators to track policy implementation and assess progress made toward desired impacts (Section 4.1)
2. Select performance indicators from the list, based on a set of guiding principles (Section 4.2)
3. Identify data sources and monitoring methods for each performance indicator to ensure a high degree of quality (Section 4.3)

Each step is illustrated using the example of a national policy to promote renewable energy and provide secure, sustainable, and competitively priced energy.

4.1 Formulate a List of Possible Indicators

Decision-makers should begin by developing a list of possible indicators to track progress made in policy implementation (UN Women 2012). It is important to clearly articulate objectives that fulfill the overall broad goal of the policy because these can help identify

Figure 1 | **Steps to Developing Indicators**

FORMULATE A LIST OF POSSIBLE INDICATORS

- Choose input, activity, intermediate effects, GHG effects, non-GHG effects indicators
- Choose aggregated and disaggregated indicators, as well as absolute and relative indicators, as needed

SHORTLIST INDICATORS

- Shortlist indicators guided by six principles: policy relevance, variety, data quality and availability, comparability, clarity, and timeliness

COLLECT AND MONITOR DATA

- Collect data and develop a monitoring plan performance indicators to be monitored. Policies are often tracked by monitoring only discrete activities and direct outputs, rather than with indicators that also track effects (Beardmore and Haydock 2012; Nichols and Martinot 2000). The use of different types of performance indicators together—input, activity, intermediate effects, GHG effects and non-GHG effects—provides useful information to assess both policy implementation and policy effectiveness.

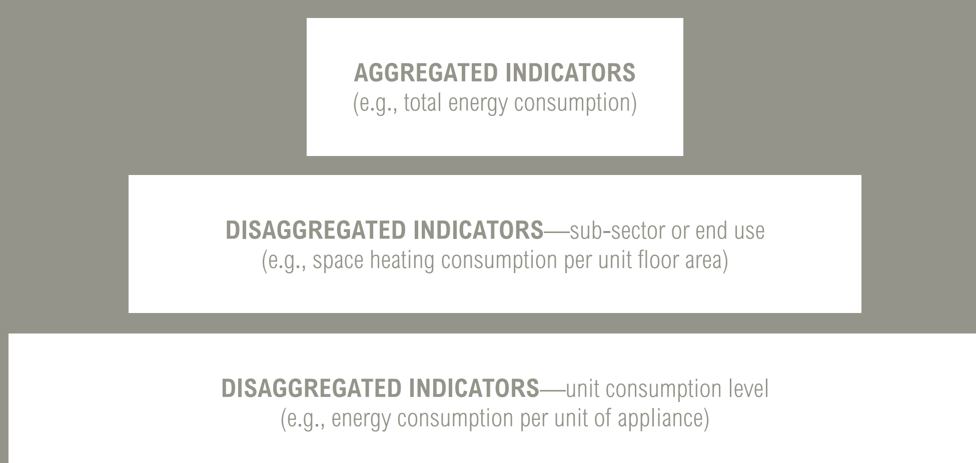
Indicators can be developed at various levels of detail in order to support decision-making. Aggregated indicators, such as total energy consumption by domestic appliances and total energy consumption by sector, are used to track change by summarizing information for policy monitoring at a higher level. Disaggregated indicators, such as average energy consumption per floor area of single houses using natural gas for heating, or diesel consumption by type of vehicle, provide more nuanced information at a greater resolution (Box 6).

Box 6 | Aggregated and Disaggregated Indicators

While aggregated data provide a broad overview that is useful for initial assessment, disaggregated indicators capture focused information to track policies more closely. Decision-makers can employ a combination of aggregated and disaggregated indicators for monitoring policies because, when used together, they can provide more meaningful information. For example, an aggregated indicator in the form of total residential energy consumption per capita shows the trend in energy consumption and efficiency gains over time, but it does not provide any information about where the energy is being consumed (IEA 2014b). To evaluate whether a particular energy efficiency policy was successful, it may be important also to obtain disaggregated data for end uses driving energy consumption, for example, energy consumed by space heating per unit floor area, and by appliances per dwelling.

The level of detail chosen for indicators has consequences for data collection. In general, the more disaggregated the data, the more resource intensive is the collection process (Figure B-1). It is important to strike a balance between the need for a comprehensive assessment of policy implementation and the resources employed for it. Annex 2 discusses examples of indicators in South Africa and the United Kingdom. Both examples show a mix of aggregated indicators to measure overall progress at national or sectoral level and disaggregated indicators to track effectiveness of individual measures.

FIGURE B-1 | AGGREGATED AND DISAGGREGATED INDICATORS



Note: Wider area represents greater data requirement
Source: IEA (2014b)

Further, indicators may be described in absolute or relative terms. They can be presented in terms of absolute values, such as number of permits issued. They can also be given as ratios and percentages to show the relationship between different elements, for example, energy consumption per ton of cement production. Intermediate effects and GHG effects indicators are often expressed in ratios and percentages (Box 7).

Table 4 lists different types of performance indicators for a hypothetical renewable energy (RE) policy. Policy objectives include increasing the share of renewables in electricity production, reducing GHG emissions, and achieving a high degree of market penetration for renewable energy technologies by overcoming technological and non-technological barriers. This policy example is also used in subsequent sections to illustrate various steps.

Box 7 | Indicators Expressed in Absolute versus Relative Values

Indicators presented as relative values, rather than absolute values, often deliver additional important information to the end user and are easier to understand. For instance, indicators that express the achieved percentage of a policy target are a direct assessment of the success of the policy at any given point in time. Similarly, the share of renewables in electricity production is an indicator that conveys policy impact more powerfully than the absolute values it combines, that is, electricity production from renewables and total electricity production. Another consideration is that absolute values can be misleading when the context is not known. For example, 300 TWh of renewable electricity production per year might mean a lot for a small country, but very little in a large country. The degree to which renewables have penetrated electricity supply can more readily be captured and communicated through a percentage value.

Further, any indicator value can be expressed in relative terms by choosing a meaningful denominator to provide additional information to increase its usefulness. It is important to identify meaningful denominators and ensure that data are collected to allow the expression of indicators in relative terms.

Table 3 lists more examples of absolute and relative indicators.

TABLE 3 | ABSOLUTE AND RELATIVE INDICATORS

EXAMPLES OF ABSOLUTE INDICATORS	EXAMPLES OF RELATIVE INDICATORS
■ MW of capacity installed ■ Overall energy consumption of residential sector ■ Energy consumption by domestic appliances ■ Amount of insulation purchased and installed by consumers ■ Total area of forest under sustainable forest management ■ Total number of jobs created by the solar industry ■ Amount of funds allocated to implement an afforestation project ■ Number of small- and medium-sized enterprises trained to employ energy efficiency measures	■ Kilowatt hours per ton of product manufactured ■ Percentage share of the residential sector in total energy consumption ■ Percentage of houses with access to electricity ■ Percentage of businesses that participated in GHG-reporting programs and consequently adopted mitigation strategies ■ Percentage of households purchasing efficient appliances ■ Percentage share of urban development with transit-oriented development design features ■ Area of forest under sustainable forest management as a percentage of total forest area ■ Jobs created in the wind sector as a percentage of jobs created in the entire economy in a year

Table 4 | **Performance Indicators For a Hypothetical Renewable Energy (RE) Policy**

TYPE OF PERFORMANCE INDICATOR	EXAMPLES OF INDICATORS	COMMENTS
Input indicators	■ Funds allocated per year to operationalize the policy ■ Funds allocated per type of RE technology ■ Number of staff with necessary expertise hired to implement the policy	Provide insight into the level of financial and human resources committed toward the policy on a regular basis. Tracking provides early alert if the resources available are insufficient
Activity indicators	■ Number of RE certificates issued ■ Number of building permits issued for wind parks ■ Amount of funds disbursed through subsidy scheme for solar home systems ■ Number of states where policymakers were trained to develop a state-level strategic plan to increase the use of RE ■ Number of developers receiving project development assistance ■ Number of transmission lines built to import power and facilitate grid integration ■ Number of new funds created to support the development of RE (also, amount of financial resources allocated/utilized under each fund, e.g., a rural electrification fund to support the development of rural mini-grids)	Monitor activities performed by the implementing agency, for example, issuing certificates and permits, developing strategic plans, providing financial support for different types of RE technologies, training and capacity building, and building transmission infrastructure
Intermediate effects indicators	■ Installed capacity of RE technologies by type (e.g., wind, biomass, solar, etc.) (MW) ■ Annual or cumulative production (MWh) ■ Number of individual solar home systems installed ■ Capacity of off-grid rural power supplies from mini-hydro, biomass, wind, and solar PV (MW)	Assess RE production and capacity
	■ Installed costs per kWh for each RE technology ■ Production costs (per kWh) for each technology ■ Unit cost of RE electricity relative to conventional power costs	Track the change in technology cost
	■ Manufacturing output of RE industries by product ■ Number of commercial businesses selling, installing, and/or providing maintenance services per type of RE technology ■ Existence of quality assurance and certification procedures for equipment and installation	Monitor the development of manufacturing capacity and supporting services
	■ Number of financial institutions and volume of lending for RE technologies (also, by type of technology) ■ Total amount of financing (government, commercial, bilateral/multilateral) for RE technologies	Assess the availability of finance for investment in RE projects
GHG effects indicators	■ Change in GHG emissions due to the displacement of fossil fuel-generated electricity by electricity from renewable sources (also, by type of RE technology, e.g., residential solar panels, wind, etc.)	The GHG Protocol *Policy and Action Standard* provides guidance on estimating the GHG effects
Non-GHG effects indicators	■ Energy consumption and expenditure by different income groups, or per household, or per capita ■ Energy expenditure as a percentage of household income ■ Share of population with access to electricity ■ Fuel mix in the residential sector ■ Number of lumen hours of lighting available per day per household ■ Employment generated as a result of RE technology (also, as a percentage of total employment generation) ■ Measure of ambient air quality ■ Number of hospital visits for conditions exacerbated by air pollution (e.g., asthma) ■ Water availability per capita	Insight into possible influence of RE on: ■ household income ■ energy access ■ fuel mix ■ job creation ■ public health ■ water supply

Sources: Barua et al. (2014); Beardmore and Haydock (2012); Nichols and Martinot (2000).

4.2 Select Indicators to Monitor Policy Implementation

The next step is to prioritize indicators to be monitored. The following six principles,[7] synthesized from the existing literature (Church and Rogers 2006; OECD 2011; UNAIDS 2010), can help to evaluate and shortlist indicators for use in regular monitoring:

- **POLICY RELEVANCE:** The indicators selected should target a specific element of change, and be relevant to the policy being monitored. Each indicator should have a clear link to the assessment of policy implementation or results of the policy's implementation. It should provide insights into the effectiveness of implementation or the achievement of the policy objectives. For example, in the case of renewable energy policy, measuring energy generation is more relevant than measuring installed capacity. Installed capacity does not reveal the actual productivity of a renewable energy installation, because it does not allow for factors such as effective siting, maintenance, or grid integration (Nicholls et al. 2014). Measuring generated output, on the other hand, captures the operational performance of installations.
- **VARIETY:** In many cases, it is useful to have multiple indicators to obtain balanced information. Use of a number of different, non-overlapping indicators, drawn from each of the types discussed in Section 3.1, is likely to provide a more comprehensive picture. The need for a range of distinct, multiple indicators should be balanced with financial and human resource constraints. Policymakers can also choose a combination of aggregated or disaggregated indicators that will yield useful and easy-to-interpret information while remaining within such constraints (see Box 6).
- **DATA QUALITY AND AVAILABILITY:** Decision-makers should select indicators based on a realistic assessment of the feasibility of data collection. Indicators should be measurable and based on available data that are of good quality and regularly updated. If data are not available, policymakers should first consider whether data can be collected in a cost-effective manner without sacrificing quality in terms of completeness and accuracy, and whether the benefits of measuring the indicator are worth the associated costs (see also Section 4.3). For example, in the case of renewable energy policy, monitoring installed capacity is a straightforward indicator that provides limited information and entails low data requirements. However, an indicator that monitors the additional generation achieved by a technology in a given year is a stronger measure of market penetration but it needs more data in order to determine what should be considered additional (Nicholls et al. 2014).
- **COMPARABILITY:** Policymakers and stakeholders may be interested in comparing the results of the policy across geographical areas, for example, different administrative areas within the country, or they may be interested in comparing results with other countries, or across policies. Indicators should support a meaningful and true comparison but not all indicators are equally good for this purpose. For example, in the case of renewable energy policy, comparing installed capacity/generation among countries does not take into account differences related to resources, or technical and economic constraints. Therefore, it is not an appropriate indicator to compare across geographical boundaries. An indicator such as the percentage of technical potential achieved allows a more nuanced comparison. Technical potential is defined as the maximum achievable potential if all existing barriers can be overcome (Nicholls et al. 2014). The percentage of technical potential achieved therefore encapsulates different country sizes and starting points in terms of renewable energy deployment (Nicholls et al. 2014). However, data collection for this indicator is more complex, requiring assessment of technical and economic constraints to model the realizable potential value.
- **CLARITY:** To avoid confusion and enable correct interpretation, an indicator should be clearly defined in terms of the following elements (UNAIDS 2010):
  - **Title:** Captures the focus of the indicator
  - **Definition:** Describes the indicator clearly and concisely and states what is being measured and observed
  - **Purpose:** Describes the intended use of the indicator and ensures that it is unambiguous and specific
  - **Rationale:** Justifies the usefulness of the indicator for the intended audience
  - **Method:** Describes the method of measurement to determine the value of the indicator and avoid confusion in collecting and synthesizing data

- **Unit of measurement:** Describes the values used in calculating the indicator

Table 5 provides an example of defining an indicator for monitoring a hypothetical renewable energy policy.

- **TIMELINESS:** Indicators should be reported over the timeframe of the policy with sufficient frequency so that meaningful change can be observed and measurements can be made. They are most useful when they are designed to capture trends through regular collection of data over a period of time. Data collection and reporting should be done regularly to allow useful management, accountability, and policy improvements.

4.3 Collect and Monitor Data

Data collection

Data collection is required to determine indicator values and trends. Availability of data, along with the cost of gathering data over time, are two key issues to be considered here. As mentioned in Section 4.2, data collection involves money and policymakers should collect only what is necessary to adequately monitor a policy's implementation and effectiveness. Data for input and activity indicators are more likely to be collected by the implementing entity and hence relatively easier to access and monitor. Indicators to measure intermediate effects, GHG effects, and non-GHG effects usually relate to activities and entities outside the administration or the implementing agency. For example, the data to assess the uptake of specified technologies within a population will need to be collected from points of sale or possibly from the target population itself. This often makes data collection more challenging.

The process of data collection begins with establishing data needs for each indicator and addressing the following questions:

1. **What:** What specific data are required?
2. **New or existing data:** Can existing data be used? Is additional data collection required?
3. **How:** What methods can be used to collect the new data?

WHAT: WHAT SPECIFIC DATA ARE REQUIRED?

Policymakers may need a wide variety of data relating to, for example, consumption, activity, outputs, population, and the economy to track indicators adequately. For example, energy consumption data include energy used by households for appliances, by trucks for transporting goods, and by offices for heating. Corresponding activity data include numbers of household appliances, ton-kilometers of freight transport, and floor area of heated space (IEA 2014b). Generally, collecting data that are more disaggregated (e.g., by sub-sector, by end use, by unit consumption) is likely to require more resources and effort. Further, collecting disaggregated data from end users is likely to be more resource intensive than from distribution points or points of sale.

Table 5 | **Defining an Indicator for a Hypothetical Renewable Energy Policy**

	EXAMPLE OF AN INDICATOR FOR RENEWABLE ENERGY POLICY
Title	Cost-efficiency indicator
Definition	Cost of generating renewable energy by type of technology
Purpose	Monitor change in the cost of generating renewable energy over a period of time
Rationale	Can be used to assess efficiency using output (power generated) to input (cost) ratio
Method of measurement	Data on generation and input cost can be collected from sources such as power ministry, industry reports, and surveys of power developers
Unit of measurement	Cost per megawatt hour generated (constant USD (2010)/MWh)

NEW OR EXISTING DATA: CAN EXISTING DATA BE USED? IS ADDITIONAL DATA COLLECTION REQUIRED?

This question involves evaluating all available data and existing data collection processes, while assessing information gaps and the new data that should be gathered. Undertaking such a review in the beginning helps avoid duplicating efforts. Existing data, also referred to as secondary data, can either directly address the data needs identified, or serve as a proxy to estimate the desired indicator. The use of existing data, often collected for other purposes, can save resources by reducing new data collection costs. It is, however, important to understand clearly how the existing data are defined and collected in order to assess whether they will serve the intended purpose. Data-sharing mechanisms can be put in place in the form of instruments such as memorandum of understanding (MoUs), legislation, or confidentiality agreements, to collect data efficiently and systematically. For example, decision-makers can develop an agreement where wholesalers, producers, or importers regularly report information on the sale of equipment to assess the uptake of a particular technology.

Secondary data may exist in government and other organizations. In the case of central governments, secondary data may be found in various administrations, such as ministries of energy or finance or transport, or national statistics offices. For example, the finance ministry could be a potential source of information about funds disbursed annually for policy implementation. Statistics offices collect various macroeconomic data concerning population, GDP, and industry data. Data from different administrative levels can be used to generate meaningful transport sector data, such as data from vehicle registration offices, tax authorities, and accident databases (GHGP 2015a). Acquiring existing data from various agencies can be challenging because processes to access data may not be in place or they may be poorly implemented (IEA 2014b).

Non-governmental sources such as industry associations often gather detailed sector-specific information. For example, a global effort by 26 leading cement producers, the Cement Sustainability Initiative, maintains a database of performance indicators by individual companies. Distribution companies tracking shipments can provide information on penetration of certain equipment; car manufacturers keep records of numbers of new vehicles sold every year; and vehicle registers may track activity for the national vehicle stock. However, such information may be confidential or may need to be purchased, and a data-sharing arrangement may need to be negotiated. Civil society and research organizations may also collect data on, for example, extent and number of protected areas and forested areas, deforestation rates, degree of water stress in various regions, efficiency potential in industry sectors, and so on.

Table 6 provides potential data sources for some input, activity, and intermediate effects indicators discussed earlier in the hypothetical example of a renewable energy policy.

HOW: WHAT METHODS CAN BE USED TO COLLECT THE NEW DATA?

Various methods to collect data may need to be combined to collect the information necessary to track specific indicators. New data can be collected through measuring or metering, surveying, modeling, and estimating (IEA 2014b):

- **Measuring:** Measured data refers to direct measurement, such as directly measuring emissions from a smokestack. Direct measurements may be costly or technically infeasible, such as measuring actual emissions from each vehicle during operation. Reducing the number of measurement samples can minimize costs. For example, measurement provides data on the efficiency of individual appliances in the residential sector and on the variation in consumption patterns over time. Energy consumed by individual appliances can be measured by installing meters between electrical outlets and major appliances, such as washing machines, dishwashers, televisions, and cooking devices. The measurements can be taken from a representative set of households over a defined period of time. Measurements can also be made in a test environment.

- **Surveying:** Surveying involves collecting data from a representative sample. Two techniques are generally used—interviews and observation. Interviews are usually conducted using targeted questions. The population sample can include households, vehicle owners, members of an industry association, and so on. Surveys must be designed, tested, and modified as needed, then the survey must be carried out on a truly representative sample of the target population, data collected, and results analyzed. Time and money may be saved if questions can be added to existing surveys, for example, to a national household survey to collect data on the penetration of efficient appliances in

Table 6 | **Potential Data Sources for Indicators for Renewable Energy (RE) Policy**

TYPE OF PERFORMANCE INDICATOR	EXAMPLES	DATA COLLECTION
Input indicators	■ Funds allocated per year to operationalize the policy ■ Funds allocated per type of RE technology ■ Number of staff with necessary expertise hired to implement the policy	Records and reports maintained by the authority implementing the policy, such as the renewable energy ministry or power ministry or non-conventional energy departments
Activity indicators	■ Number of RE certificates issued ■ Number of building permits issued for wind parks ■ Amount of funds disbursed through subsidy scheme for solar home systems ■ Number of states where policymakers were trained to develop a state-level strategic plan to increase the use of RE ■ Number of developers receiving project development assistance ■ Number of transmission lines built to import power and facilitate grid integration ■ Number of new funds created to support the development of RE (also, amount of financial resources allocated/utilized under each fund, e.g., a rural electrification fund to support the development of rural mini-grids)	Progress reports and other forms of communication and reporting by the authority implementing the policy
Intermediate effects indicators	■ Installed capacity of RE technologies by type (e.g., wind, biomass, solar, etc.) (MW) ■ Annual or cumulative production (MWh) ■ Number of individual solar home systems installed ■ Capacity of off-grid rural power supplies from mini-hydro, biomass, wind, and solar PV (MW)	Published government data, internal reports maintained for policy implementation (e.g., for government sponsored lending schemes, solar home systems promotion projects, etc.), published industry or market reports In some instances, data may be obtained from local unpublished sources or industry observers Sampling of installations
	■ Installed costs per kWh for each RE technology ■ Production costs (per kWh) for each technology ■ Unit electricity cost of RE-produced power relative to conventional power costs	Published government data, internal reports, published industry or market reports, utility data, power purchase agreements, etc. In some instances, data may be obtained from industry observers
	■ Manufacturing output of RE industries by product ■ Number of commercial businesses selling, installing, and/or providing maintenance services per type of RE technology ■ Existence of quality assurance and certification procedures for equipment and installation	Government data, internal reports, published industry reports Private sector market surveys already available Surveys carried out by the agency implementing the policy specifically to collect data
	■ Number of financial institutions and volume of lending for RE technologies (also, by type of technology) ■ Total amount of financing (government, commercial, bilateral/multilateral) for RE technologies	Government and donor agencies' data Surveys of commercial banks as well as industry

residences. Observation can be used to collect data at a defined moment in time or period at a given number of locations. The technique is often used in transport-sector monitoring and can include manual observation and technology-based systems, for example, automatic vehicle count and photographic surveillance techniques to determine occupancy rates (GHGP 2015a).

- **Modeling:** Modeling uses input data and assumptions to produce output data relevant to an indicator, for example, GHG emissions at the sectoral or sub-sectoral level, diffusion of an energy efficient product in the residential sector, and so on. Input data may be disaggregated or macro-level, depending on whether the model is bottom-up or top-down. Further, the input data can be obtained using a combination of methods, such as collection from administrative sources or through surveys. For instance, a bottom-up model in the transport sector may rely on fuel consumption and activity data to produce separate estimates of passenger and freight energy consumption. The quality of input data and assumptions will affect the quality of the modeling results.

- **Estimating:** Estimated data refers to proxy data or other data sources used in the absence of more accurate or representative data sources.

The most appropriate data collection method will depend on the indicator and the specific national or local circumstances. Exchanging experiences with those who have already set up their data collection systems can help to narrow down options and find the appropriate solution.

Monitoring

A monitoring plan that documents and institutionalizes the data collection system should be developed during the policy design phase, when the indicators are being developed. It can also be used as the basis for regular reporting to stakeholders, including funders. The accuracy of indicators depends on the measurement approaches used and the quality of data collected, and the monitoring plan should address both these aspects by considering the following elements for each indicator:

MEASURABILITY

- Measurement or data collection methods that describe how the indicator is measured or data are collected
- Sources of data (either existing data sources or additional data collected specifically to develop indicators)
- Units of measurement
- Level of uncertainty in any measurements or estimates, and how this uncertainty will be accounted for
- Sampling procedures (if applicable)
- Monitoring frequency
- Databases, tools, or software systems to be used for collecting and managing data

QUALITY

- Entity(ies) or person(s) responsible for data collection and monitoring activities, and roles and responsibilities of relevant personnel
- Competencies required and any training needed to ensure personnel have necessary skills
- Whether data are verified and, if so, verification procedures used
- Procedures for internal auditing, quality assurance (QA), and quality control (QC)
- Record keeping and internal documentation procedures needed for QA/QC, including the length of time that data will be archived

Several components of the monitoring plan, such as methods for data collection, sampling procedures, institutional arrangements, and available capacities impact the ability to generate accurate and meaningful data. The development of a monitoring plan can therefore be a useful tool to fine-tune the selection of indicators.

5. CONCLUSION

Performance indicators are tools to monitor progress over time; they can track implementation of measures undertaken to achieve policy targets. They provide early warning of failures related to implementation and of risks that the intended policy objectives will not be achieved. Performance indicators can help decision-makers steer the implementation process effectively and make adjustments as necessary to produce desirable results. Indicators are also important to measure success and communicate it to stakeholders.

The purpose of performance indicators is to deliver relevant and clear information at the right time to policymakers and stakeholders in order to enhance policy effectiveness and assess outcomes. This requires careful selection of indicators, with particular note taken of existing constraints on data collection and processing. Data collection involves balancing the desire for ideal information that may be very costly, and utilizing what is available within cost constraints. Indicators should also be clearly defined to enable meaningful tracking and interpretation.

ANNEX 1: DIFFERENT TYPES OF INDICATORS FOR SELECT POLICIES

Table A-1 | **Examples of Indicators for Select Policies**

TYPE OF INDICATOR	INDICATORS FOR FOOD WASTE LANDFILL-DIVERSION POLICY	INDICATORS FOR REFORESTATION POLICY
Input	■ Investment in reuse/recycling, composting, anaerobic digestion, energy recovery, incineration, and landfill facilities	■ Spending on staff and materials (e.g., hardwood stock) for reforestation initiatives under the policy
Activities	■ Permitting and construction of composting and anaerobic digestion (AD) facilities ■ Collection of levies to promote food-waste diversion from landfills ■ Inspections and other enforcement activities	■ Area of forestland surveyed to identify areas needing reforestation ■ Number of forest tree plantings procured for use as replanting stock
Intermediate effects	■ Tons of organic waste landfilled, composted, digested anaerobically, and sent for energy recovery (e.g., combustion, gasification, pyrolysis) ■ Tons of compost and fertilizer produced ■ Amount of energy (electricity, heat, and/or steam) generated through anaerobic digestion or combustion ■ Revenues generated by recycling and recovery operations	■ Number of forest plantings transplanted for reforestation ■ Survival rate of forest plantings transplanted for reforestation ■ Number of forest managers trained (for enhanced forest management policy) ■ Forest biomass ■ Percentage change in annual reforested area ■ Area of forestland under improved management ■ Biomass accumulation
GHG effects	■ Change in emissions (predominately CH_4) from landfill ■ Change in emissions from composting, AD operations, or waste-to-energy ■ Change in emissions as a result of displacing electricity/heat use with energy created by AD or waste-to-energy facilities ■ Change in emissions as a result of co-products (AD fertilizer, animal bedding, compost) displacing use of conventional product use ■ Change in emissions due to the change in food waste transport requirements	■ Change in terrestrial (soil) carbon sequestration
Non-GHG effects	■ Soil and nutrient conservation ■ Change in nutrient runoff through substitution of chemical-based fertilizers with slower release organic fertilizers ■ Job creation as part of new waste treatment and recovery operations ■ Change in soil, water, and air pollution associated with reduced landfill operations	■ Employment generated ■ Soil and nutrient conservation

Table A-1 | **Examples of Indicators for Select Policies (Continued)**

TYPE OF INDICATOR	INDICATORS FOR ENERGY EFFICIENCY STANDARDS FOR HOME APPLIANCES	INDICATORS FOR PUBLIC TRANSIT POLICY
Input	■ Investment in human resources to implement the policy	■ Investment in bus rapid transit (BRT) infrastructure ■ Staff employed for maintenance of the BRT
Activities	■ Number of appliance standards established ■ Number of appliance manufacturers from which information on sold appliances is collected ■ Number of compliance checks carried out	■ Kilometers of BRT lines constructed ■ Number of BRT buses purchased ■ Number of licenses and permits issued to bus operators for different BRT routes ■ Number of BRT stations built
Intermediate effects	■ Appliance energy consumption per capita (or per dwelling or per appliance) ■ Percentage market share of energy efficient appliances	■ Passenger-kilometers traveled by mode (e.g., subway, bus, train, private car, taxi, and bicycle) ■ Percentage of users shifting to BRT from other modes (e.g., private cars) ■ Percentage share of urban development with transit-oriented development (TOD) design features
GHG effects	■ Change in GHG emissions from the use of efficient appliances in households	■ Change in local pollutants and CO_2 emissions from private transport due to shift to public transport ■ Change in emissions from densification of urban areas close to the BRT corridors ■ Change in emissions from construction ■ Change in emissions from manufacturing construction materials
Non-GHG effects	■ Change in household disposable income resulting from energy savings ■ Level of civil society participation in environmental policymaking processes	■ Road congestion ■ Change in air quality and local pollution

Sources: GHG Protocol (2015a); GHG Protocol (2015b); GHG Protocol (2015c); IEA (2014a); IEA (2014b); Litman (2015).

ANNEX 2: INDICATORS IN SOUTH AFRICA AND THE UNITED KINGDOM

South Africa

South Africa is in the process of designing a monitoring and evaluation (M&E) system to monitor the country's response to climate change and assess the impact of mitigation measures. As part of the M&E system, the Department of Environmental Affairs (DEA) is developing indicators to monitor progress toward achieving the country's vision of a lower-carbon economy. It is envisaged that information related to these indicators will be included in annual climate change reports beginning 2017. The indicators have been developed in consultation with stakeholders. DEA has also started identifying sources of information on which the indicators will be based (Table A-2).

The indicators have been defined at three levels (Thangavhuelelo and Mangwana 2015):

HIGH-LEVEL INDICATORS: These indicators track the country's progress toward the vision of becoming a lower-carbon economy and are monitored annually at the national level. They are aggregated indicators, such as national GHG emissions expressed as CO_2e, carbon intensity of the economy (CO_2e/GDP), energy intensity of the economy (total primary energy supply (TPES)/GDP), per capita GHG emissions (CO_2e/population), proportion of renewables to total primary energy, carbon intensity of energy supply (CO_2e/TPES), and green jobs created (e.g., jobs related to energy efficiency such as installing retrofits, insulation, and jobs in renewable energy industries such as biomass and solar).

SECTORAL, SUB-SECTORAL, AND COMPANY-LEVEL INDICATORS: These indicators are similar to the high-level indicators but are meant to track progress against mitigation targets at the sector, sub-sector, and company level. Descriptive information at the sector, sub-sector, and company levels, such as base year emissions and projected baseline emissions, annual carbon budget, and mitigation plans, will be collected at the beginning of the monitoring program.

MITIGATION-MEASURE INDICATORS: These indicators collect information related to individual mitigation actions, that is, policies, programs, and projects, to assess their impact, and may include disaggregated indicators. Examples might include initiatives such as bus rapid transit systems or the renewable energy independent power-producer program. Descriptive information regarding the mitigation measure, including the intended emissions impact and sustainable development benefits, will be determined at the beginning of the monitoring program. Indicators

Table A-2 | **Examples of Information Sources to Develop Indicators**

INFORMATION NEEDED	SOURCE OF INFORMATION
GDP, population	Statistics South Africa
Emissions	Department of Environmental Affairs (DEA)
TPES, renewable energy generated/installed	Department of Energy
City-level data	Energy and climate change reporting system for cities (e.g., Tshwane GHG web-based M&E system, Carbon Climate Registry maintained by ICLEI)
Green jobs-related data	Department of Economic Development, Extended Public Works Programs coordinated by Department of Energy
Company-level information	Individual companies or industry associations (such as National Business Initiative or Business Unity of South Africa)

Source: Thangavhuelelo and Mangwana (2015).

related to implementation, impacts, and effectiveness will be measured annually. For example, amount of funding disbursed in a year, number of wind turbines erected, net GHGs reduced, MWh of electricity generated from a wind farm, tons of waste composted, green jobs created, or number of green jobs created per unit of investment.

United Kingdom (UK)

The United Kingdom has set a long-term target to reduce GHG emissions to 80 percent below 1990 levels by 2050, and has defined an emissions reduction path from 2008–2022 with emission limits for interim periods (2008–2012; 2013–2017; 2018–2022) (Committee on Climate Change 2009; Committee on Climate Change 2013). It has also developed emissions reduction scenarios that show how these targets could be met. The country monitors its progress by tracking emissions as well as other indicators related to implementation of mitigation measures.

These indicators include (Committee on Climate Change 2009; Committee on Climate Change 2013):

1. **Headline indicators:** For example, aggregated indicators such as sector-level emissions for power, buildings and industry, and transport; emissions intensity of power generation (g/kWh), carbon efficiency of vehicles (gCO_2/km), etc.

2. **Supporting indicators:** These include disaggregated indicators to assess progress in implementing the measures necessary to achieve sustainable emissions reductions. Examples include indicators related to:

   - Increasing low-carbon power generation capacity, for example, additional wind (onshore and offshore) capacity (GW), capacity planned and under construction (GW)
   - Enhancing energy efficiency of buildings, for example, year of finalization of heat- and energy-saving strategy, uptake of loft, cavity wall, and solid-wall insulation (million homes, total additional installations compared to 2007 levels)
   - Increasing market penetration of electric cars, for example, new electric cars registered each year (number of cars), stock of electric cars in vehicle fleet

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ENDNOTES

1. According to the GHG Protocol *Policy and Action Standard*, policies and actions refer to interventions taken or mandated by a government institution, or other entity. Examples include laws, directives, regulations, standards, subsidies, information instruments, voluntary agreements, etc.

2. See *Climate Policy Implementation Tracking Framework* for a complete discussion of various steps involved in tracking policies. This working paper focuses only on one step—developing indicators—to further develop the guidance provided in the *Climate Policy Implementation Tracking Framework* on this issue.

3. These indicators may also be used for policies not designed with GHG mitigation as their principal objective, for example, waste management policies and renewable energy policies, to track progress and assess their GHG and sustainable development impact.

4. For more information on this approach, refer to the GHG Protocol *Policy and Action Standard*. Such analysis can also form a valuable basis for defining meaningful indicators that contribute to a better understanding of whether or not observed changes are a result of policy.

5. The performance indicator types and definitions used here are consistent with those used in the GHG Protocol *Policy and Action Standard* and in the *Climate Policy Implementation Tracking Framework*. It is however common to come across other categories and terms in the policy effectiveness literature, for example, process indicators; actions indicators; results indicators (input indicators, outcome indicators, impact indicators); and sustainable development indicators (environmental, social, and economic indicators).

6. These steps have been taken directly from the GHG Protocol *Policy and Action Standard*. For further details, refer to the comprehensive guidance on estimating GHG effects of policies provided in the standard.

7. Acronyms such as SMART and CREAM are often used to describe the quality of performance indicators. SMART refers to indicators being specific, measurable, achievable at a reasonable cost, relevant, and time-bound. CREAM refers to clear, relevant, economic, adequate, and subject to monitoring. The principles summarized here cover these qualities.

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

Our Challenge
Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision
We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach
COUNT IT
We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT
We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT
We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.