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The 1 Gigaton Coalition

NORWEGIAN MINISTRY OF FOREIGN AFFAIRS

Narrowing the Emissions Gap: Contributions from renewable energy and energy efficiency activities

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The 1 Gigaton Coalition

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FOREWORD

Many countries have put in place renewable energy and energy efficiency initiatives, but most of them do not measure, report or receive acknowledgement for the resulting reductions in greenhouse gas emissions. Yet these reductions could add up to 1 gigaton per year by 2020, which would help close the emissions gap of 8 – 10 gigatons of carbon dioxide equivalents that must be filled if we are to stay below the politically agreed target of 2°C.

Initiated by the Government of Norway and coordinated by the United Nations Environment Programme, the 1 Gigaton Coalition aims to make these savings visible by measuring emissions reductions, reporting successes and strengthening the case for a global scaling up of energy efficiency policies and renewable energy technologies.

This first report comes in the critical window between the agreement of the 2030 Agenda for Sustainable Development and final negotiations on climate change at COP21. As well as examining the challenges of attributing reductions to individual actions, it provides an overview of energy efficiency and renewable energy activities in developing countries and uses case studies to illustrate their impact on current emission levels.

While this report clearly demonstrates significant benefits of renewable energy and energy efficiency in developing countries, it also highlights untapped potential gains, which the Coalition aims to describe more fully in future reports. For example, REN21's Global Status Report 2015 states that 164 countries have defined renewable energy targets in 2015, including 131 developing and emerging economies, meaning developing countries have a great capacity to contribute to emissions reductions. The extent to which this is being realized is of more than academic interest. Good examples and positive stories about renewable energy and energy efficiency are motivating more and more countries to take action.

Bilateral and multilateral initiatives are making a big impact on narrowing the emissions gap, so the 1 Gigaton Coalition will continue to work with its partners to improve data collection and develop a unified measurement and reporting methodology that is aligned with IPCC and UNFCCC requirements. It will also continue to publish annual reports for use within the UNFCCC and the SE4ALL frameworks, and to provide a respected platform for countries to promote their emission reduction efforts and achievements in the energy sector.

We are pleased at how fast the 1 Gigaton Coalition is growing. Since the official launch at COP20 in Lima, about 100 partners have joined or expressed their interest in joining. The success of the Coalition will clearly depend on the active involvement of its partners and the effective coordination with other initiatives and programmes. Our shared objective is clear: to become a driving force in promoting enhanced action for a sustainable low-carbon and climate resilient future.

We would like to thank all those who have contributed to this first report. It is our hope that through such credible reporting, the Coalition will continue to motivate donors, initiatives and countries to scale up their efforts and help narrow the emissions gap.

H.E. Børge Brende
Minister of Foreign Affairs
Norway

Achim Steiner
UN Under-Secretary-General
and UNEP Executive Director

KEY FINDINGS

ENERGY EFFICIENCY AND RENEWABLE ENERGY ACTIVITIES IN DEVELOPING COUNTRIES IN THE LAST 10 YEARS WILL SIGNIFICANTLY REDUCE CO_2 EMISSIONS FROM ENERGY USE BY 2020. This inaugural report of the 1 Gigaton Coalition is a first effort to assess how various renewable energy and energy efficiency initiatives contribute to narrowing the 2020 emissions gap. This report surveys a sample of these activities to establish a foundation of available information to measure and report greenhouse gas emission savings. It estimates, based on a sample of projects analyzed, that CO_2 emissions could be reduced by 1.7GtCO_2 a year by 2020.

ATTRIBUTING EMISSION REDUCTIONS TO SPECIFIC ACTORS IS CHALLENGING, AS MANY ACTORS OFTEN CONTRIBUTE TO THE SAME PROJECTS. Overlaps between national activities, and bilateral, multilateral and partner initiatives that collaborate to support renewable energy and energy efficiency projects in developing countries make it very difficult to disentangle which emissions reductions should be attributed to individual actors.

THERE IS INSUFFICIENT DATA AND NO COMMON METHODOLOGY TO QUANTIFY THE REDUCTIONS. This gap makes it challenging to aggregate or compare GHG mitigation contributions between different actors. This report outlines some suggestions on how to improve the reporting practices of renewable energy and energy efficiency projects to better quantify their emissions' savings.

THE 1.7 GIGATON IS AN INITIAL ESTIMATE OF WHAT COULD BE ACHIEVED. Emissions savings to be achieved in 2020 could be higher than this initial estimate if challenges related to data collection and methodology are addressed. These improvements would enable countries to quantify their achievements, motivating them to increase their ambitions to support further renewable energy and energy efficiency activities.

THE 1 GIGATON COALITION IS WORKING TO ADDRESS THESE CHALLENGES TO QUANTIFY THE FULL REDUCTIONS GENERATED BY ENERGY PROJECTS. The 1 Gigaton Coalition will collaborate with stakeholders to develop solutions for quantifying emission reductions from renewable energy and energy efficiency initiatives through the Coalition's work plan for 2016 and beyond.

EXECUTIVE SUMMARY

The 1 Gigaton Coalition supports efforts to measure and report reductions of greenhouse gas (GHG) emissions resulting from renewable energy (RE) and energy efficiency (EE) initiatives. Emissions from energy use comprise two-thirds of global GHG emissions,[1] and this sector is crucial for determining the future global climate trajectory. The 1 Gigaton Coalition's objective is to quantify RE and EE contributions to narrowing the emissions gap – the difference between 2020 emission levels consistent with staying within the 2°C climate limit, and the emissions levels expected in that year if country pledges and commitments are met.

This inaugural report of the 1 Gigaton Coalition is a first step to measuring and reporting how RE and EE programs contribute to narrowing the 2020 emissions gap. Decision 1 of COP19 (Decision 1/CP.19) called for all countries to enhance mitigation efforts to 2020, which is a central motivation for this report's focus on RE and EE efforts in developing countries, many of which have been conducted in collaboration with bilateral and multilateral partners. These efforts have not previously been quantified or assessed for their contribution to global climate mitigation. This report reveals data gaps, overlaps and challenges stemming from a lack of unified methodologies, all of which make it difficult to accurately estimate emissions reductions from a range of programs and initiatives.

Mitigation from RE and EE programs in developing countries is substantial. Developing countries are investing in RE generation, particularly solar, wind, and hydropower, and improving EE in many sectors, from lighting to industry. These investments have allowed developing countries to achieve substantial RE and EE expansion, as their economies grow and their energy demand increases.

This inaugural report provides an analysis of developing countries' overall RE and EE initiatives, as well as specific projects and case studies that detail their countries' implementation of EE and RE programs. The report is a first endeavor to understand: 1) how developing countries are undertaking RE and EE programs; 2) the targets and policies used to implement RE and EE projects; 3) the range of partner institutions supporting these efforts; 4) how different actors are measuring the GHG emissions mitigation resulting from these RE and EE initiatives; and 5) the contribution of countries' emissions reductions to global climate mitigation. RE and EE activities in developing countries are conducted in partnership with a range of bilateral, multilateral, and cooperative groups. This report surveys a sample of these activities to establish a foundation of available information to measure and report the individual and total contributions of these efforts to global climate mitigation.

ENERGY EFFICIENCY AND RENEWABLE ENERGY PROJECTS IN DEVELOPING COUNTRIES SUBSTANTIALLY REDUCE GREENHOUSE GAS EMISSIONS.

Reductions are significant. A rough scenario comparison reveals that the current level of EE and RE in developing countries implemented by national governments and the business sector with international assistance lower CO_2 emissions from energy use on the order of 4 Gt CO_2 by 2020 compared to baseline scenarios. This presents the upper limit of the possible impact of implemented activities to reduce the emissions gap.

Various activities contribute to overall reductions – attribution to individual actors is complex and challenging. Several activities that sometimes overlap contribute to the overall reductions. Programs were analyzed in this report to provide an overview of the relative impact of different developing country RE and EE activities. Due to data and methodology challenges, this analysis is indicative rather than comprehensive.

Forty-two bilaterally-supported RE and EE projects, which received US $2.6 billion in financial assistance between 2005 and 2012, will save 6 MtCO_2e in 2020. This modest estimate represents a fraction of the total number of RE and EE efforts that developing countries are undertaking. Accounting for all bilaterally supported projects, which received a total of US $24 billion in financial support between 2005 and 2012, could potentially increase the estimated impact to 58 MtCO_2e in 2020. Given that US $730 billion was invested in renewable power and fuels in developing countries from 2004 – 2014,[2] the 42 projects represent less than one percent of global financial investment, and the total impact could be as great as 1.7 GtCO_2/year.

In addition to assessing the emissions reductions achieved through bilaterally supported RE and EE activities, the report surveys other emissions impacts reported by other implementing actors. Four multilateral development banks report that their RE and EE activities could result in reductions of 1 Gt of CO_2 per year, but a comprehensive aggregation of their efforts is not possible at this time. National governments in developing countries implementing EE and RE policies and programs have not consistently quantified emission reduction impacts. A comprehensive analysis of all national efforts has not been performed – the total would make a substantial contribution to global emission mitigation figures. This report is a first endeavor to quantify the level of EE and RE projects in developing countries.

The aggregate emissions reductions resulting from EE and RE activities in developing countries make a substantial reduction in the 2020 greenhouse gas emissions gap. The gap between the "no new policy" baseline (i.e., assuming no additional efforts) in developing countries and what is compatible with a 2°C trajectory is significant (Figure 1)[3]. Note that this figure relates only to emissions from energy use in developing countries, not all sectors and gases. The 2°C trajectory is indicative as it depends on how reduction efforts are shared between sectors and countries. The 2°C range is an estimate based on scenarios that start emission reductions as of 2010, which were used to originally define the 2020 emissions gap.

EE and RE activities which developing countries have committed to implement by 2020, and which constitute current policy trajectory, could result in emission reductions in the order of 4GtCO_2 compared to the baseline scenario. However, there remains a significant gap between the current policy trajectory and what is needed to limit global temperature rise to 2°C (Figure 1). In addition, full implementation of developing countries' 2020 pledges going beyond the current policy trajectory would lower projected emissions by roughly another 1 GtCO_2 by 2020.

MITIGATION ACHIEVEMENTS REMAIN UNMEASURED AND UNREPORTED

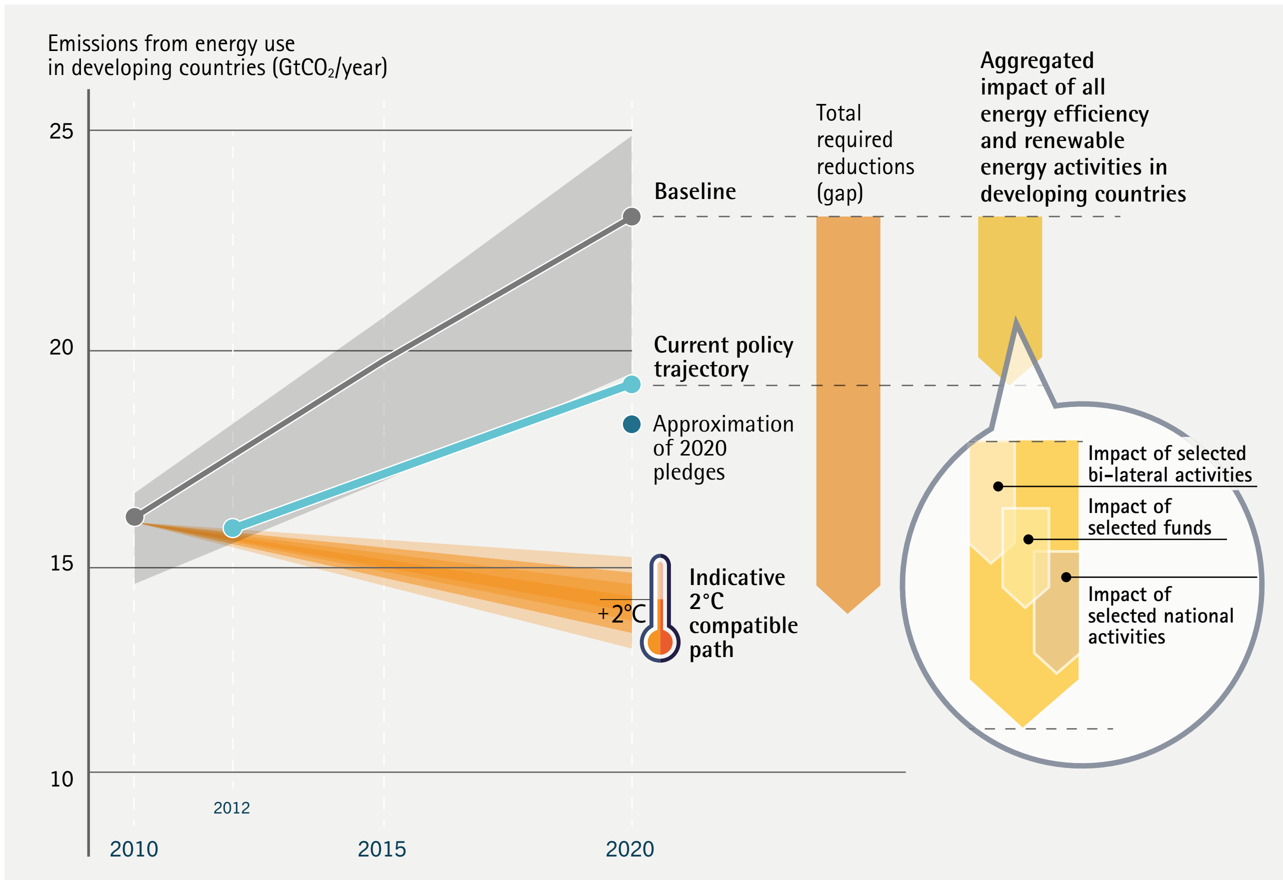
Collecting data on greenhouse gas mitigation in developing countries resulting from RE and EE projects is challenging. There are significant gaps in data on reduced GHG emissions from RE and EE initiatives. In many instances, impact estimates are not matched with details on project methodologies and assumptions used to make these estimates. Overlaps in data among bilateral, multilateral and partner initiatives that collaborate to support RE and EE projects in developing countries further complicate the picture. Bilateral aid agencies frequently contribute towards multilateral development banks, and partner initiatives are often collaborations between governments, private sector organizations, and civil society. Disentangling how emissions reductions should be attributed to specific actors is complex and problematic.

Where data is available, attributing mitigation contributions to individual actors is difficult. Many factors contribute to measurable GHG emission reductions, but these are not readily distilled in a single number that quantifies abatement in tons of carbon. An EE or RE program's successful implementation often depends on capacity-building efforts and on institutional, financing, and technological support. These efforts can all contribute to mitigation, but are often financed by separate partners. It is therefore difficult to attribute emission reductions to specific actors in a particular project, as many projects contribute to the same action.

WORK TO IMPROVE THE REPORTING PRACTICES OF RENEWABLE ENERGY AND ENERGY EFFICIENCY PROJECTS IS NEEDED.

The 1 Gigaton Coalition could be instrumental in addressing these reporting challenges. The findings in this report reveal common challenges in measuring and reporting emissions reductions, including insufficient data and lack of a unified methodology. The 1 Gigaton Coalition works to solve these problems, through its planned activities for 2016 and beyond (including reports, workshops, and meetings), and by assisting developing countries working to better quantify emissions reductions resulting from RE and EE programs.

Figure 1: **CO_2 emissions from energy use in developing countries, under different scenarios.**



Source: 1 Gigaton Coalition

Chapter 1

INTRODUCTION

In the context of the COP21 in Paris, and the recently-approved Sustainable Development Goals, countries are in a unique position in history to combat climate mitigation. Current 2020 climate pledges made through the Cancun Agreement fall 8 – 10 gigatons short of the emission reductions needed to keep global temperature rise below 2°C. The United Nations Environment Programme's (UNEP) annual Emissions Gap assessments have emphasized the urgency needed to close the emissions gap[4]. The most recent Intergovernmental Panel on Climate Change (IPCC) report[5] points to low-carbon energy sources, especially renewable energy generation and increased energy efficiency, as essential solutions for achieving emissions pathways that will keep global warming below the 2°C threshold. It is difficult to overstate the importance of renewable energy development and energy efficiency measures.

Renewable energy (RE) and energy efficiency (EE) programs in developing countries make significant contributions towards closing the GHG emissions gap. Many of these efforts occur in the energy sector, which accounts for roughly two-thirds of global GHG emissions.[6] Developing countries are investing in renewable electricity generation, particularly through solar, wind, and hydropower, and tackling energy efficiency in a range of sectors, from lighting to industry. Insufficient data, however, has thwarted previous attempts to quantify these initiatives' contribution toward meeting global mitigation goals.

The 1 Gigaton Coalition supports platforms to measure and report GHG emission reductions resulting from renewable energy and energy efficiency programs so that these contributions are recognized and counted. The Coalition focuses on cooperation between countries and on bringing developing countries' impacts to light. This voluntary international framework focuses on programs that are not fully understood due to a lack of quantifiable information to assess their impact – these often overlooked activities will save an estimated 1 $GtCO_2e$ by 2020.

This report strives to document: 1) how developing countries are undertaking RE and EE efforts; 2) the range of targets and policies used to implement RE and EE projects; 3) the range of partner institutions that support RE and EE efforts in developing countries; 4) how different actors are measuring GHG emissions mitigation impact resulting from these RE and EE initiatives; and 5) how these emissions reductions in developing countries contribute to global climate mitigation. This inaugural report answers these questions through a high-level analysis of developing countries' overall RE and EE efforts, as well as an analysis of specific projects and case studies that explore developing countries' implementation of EE and RE programs.

With the aim of narrowing the emissions gap through emissions reductions from the energy sector, the 1 Gigaton Coalition is a voluntary international framework, launched at COP-20 in Lima to build upon and intensify country efforts on climate mitigation to 2020, as specified in the COP19 decision (Decision/CP.19 Further Advancing the Durban Platform). While RE and EE programs' impact in developing countries has been documented anecdotally, most of their achievements either have not been quantified or have been assessed using inconsistent and incomparable methods. The 1 Gigaton Coalition supports countries' work to fill this data gap by measuring and reporting GHG emission reductions resulting from RE and EE initiatives. The Coalition's mission is to comprehensively assess government, private sector, and multi-stakeholder emission reduction initiatives that align with national pledges.

As a first step, this inaugural report quantifies the reduced GHG emissions resulting from RE and EE initiatives and programs in developing countries. The analysis is a first step towards understanding RE and EE projects in developing countries' total impact and the role of bilateral, multilateral, and partner initiative aid in these efforts. Due to data scarcity (particularly on EE) and the wide variability in measuring and reporting mechanisms, this report limits its conclusions to the projects and initiatives included in the analysis and does not suggest that these examples can be ascribed for all partner-supported RE and EE efforts in developing countries. To accomplish this level of attribution the methodology introduced in this report will need to be further developed.

This report is comprised of three main parts. First, the report presents an overview of the methodological challenges to attributing reductions to individual actors, whose work often overlaps (Chapter 3). It then assesses the impact that developing countries' RE and EE efforts have had on these countries' GHG emissions (Chapter 4). This analysis is followed by an overview of developing countries' RE and EE activities, based on a survey of policies and targets from 62 countries (Chapter 5.1) and on five country case studies (Chapter 5.2). Finally, it analyzes the GHG reductions of selected partner-supported activities that promote RE and EE in developing countries (Chapter 6). The report ends with recommendations for refining data collection and analysis methods to assess these partnerships' impact on RE and EE efforts in developing countries.

Chapter 2

METHODOLOGICAL OVERVIEW AND CHALLENGES

Attempts to estimate the emissions impact of renewable energy and energy efficiency measures in developing countries encounter a number of challenges, including: overlaps in project reporting; the difficulties of creating business-as-usual scenarios to measure policies against; a lack of publically-available information about renewable energy and energy efficiency projects; and un-harmonized data collection and reporting practices among different project supporters and participants.

Given these gaps, this report employs several strategies to assess renewable energy and energy efficiency measures' emissions impact. In Chapter 3, the report evaluates emissions reductions generated by all renewable energy and energy efficiency activities in developing countries. Chapter 4 reviews broad trends in developing country renewable energy and energy efficiency targets and policies. Five case studies of innovative renewable energy and energy efficiency policies in developing countries help illustrate the strategies countries use to meet these targets. Chapter 5 assesses the emissions mitigation reported by six country partners, the European Commission, nine development banks, and seven initiatives.

Attempts to estimate the effects of renewable energy (RE) and energy efficiency (EE) measures on GHG emissions face several challenges:

OVERLAPS IN PROJECT REPORTING

It is not feasible to accurately attribute mitigation outcomes to individual actors due to the cooperative and collective nature of many RE and EE efforts and the vast field of actors working to implement them. A wide range of actors supports RE and EE initiatives in developing countries, often working in collaboration with each other. Efforts to implement RE and EE projects often receive multilateral support from governments, development banks and funds, and from other organizations in public and private sectors.

Disaggregating multilateral contributions is very difficult. The Climate Investment Fund (CIF), for instance, works to mobilize co-financing and to build policy support for climate projects. CIF support is disbursed through multilateral development banks (MDBs), making the separation of bilateral and multilateral contributions to climate mitigation difficult to trace.[7]

These challenges are described in more detail in Chapter 6, Assumptions and Uncertainties.

COUNTERFACTUAL DEVELOPMENT

To calculate emissions reductions, it is necessary to estimate what would have happened in the absence of bilateral, multilateral or partner collaborations on RE and EE projects. Such counterfactual development (i.e., what would have happened in the absence of such efforts) cannot be accurately determined due to the various assumptions involved in the quantification process.

In most cases, partner countries face difficulties assessing the impact of their actions against the 'business as usual' scenario that would result had their activities not taken place (counterfactual assessments). The Japan Bank for International Cooperation's (JBIC) counterfactual evaluation of the Zafarana Wind Power Plant Project provides an example of best practices and a model for similar assessments.[8]

DATA GAPS AND INCONSISTENCY

Data on many projects is not publicly available. Where data is available, inconsistent reporting makes it hard to collect information in a comparable manner.

Some projects provide reductions in terms of reduced GHG emissions, while others provide intermediate data, such as kilowatt-hours (KWh) produced or saved or gigawatts (GW) of installed energy capacity. It requires further calculations to translate the intermediate data into GHG emissions mitigation and results may vary significantly based on assumptions (e.g., emissions or capacity factors) involved in the calculations.

Some bilateral, multilateral or partner initiatives provide an estimate for overall mitigation impact, but will not publish details on the calculation methodology employed, assumptions made, or implied uncertainties.

Analyses adopt distinct assumptions when assessing greenhouse gas reductions. And in many instances, impact estimates are not given with comprehensive details on project methodologies and assumptions.

This report employed several strategies to overcome these methodological challenges, all of which come with inherent advantages and disadvantages:

OVERVIEW

The report provides a broad picture of what GHG emission levels in developing countries would be without EE and RE initiatives driven by national governments with support from other countries, international funds and businesses (➔ Chapter 3). This approach provides an overall estimate of RE and EE in developing countries' global impact without attempting to attribute the reductions to any individual actor or projects.

SURVEY ON NATIONAL ACTIVITIES

The report describes developing countries' EE and RE actions, based on a survey of targets and policies in over 120 countries (➔ Chapter 4.1). This analysis shows where developing countries have adopted RE and EE policies, targets and programs, highlighting the strategies they are utilizing. Using data from the REN21 Renewables 2015 Global Status Report, as well as the REN21 survey conducted on EE for the 1 Gigaton Coalition. Chapter 4.1 provides a global picture of RE and EE activities in developing countries.

COUNTRY CASE STUDIES

Because data are still limited and incomplete, the report provides illustrative examples of EE and RE activities in five countries (➔ Chapter 4.2). These case studies give a narrative of specific projects and innovations developing countries are undertaking to increase energy efficiency and renewable energy. They are quantified to the greatest feasible extent, but the report does not attempt to measure their contribution to national or global mitigation goals.

IMPACT OF SELECTED ACTIVITIES

The report concludes by illustrating the potential for quantifying RE and EE activities' GHG reductions (➔ Chapter 5) in developing countries. This chapter includes a review of the methodology used to calculate GHG emissions reductions. It applies top-down assessments that draw from funder reports and self-reported estimates and bottom-up assessments that aggregate project-level data to understand RE and EE projects' mitigation impacts in developing countries. This analysis suggests that the bottom-up methods yield a greater quantity of data, as well as more reliable data, than top-town practices. Although more onerous and time consuming, only a project-by-project analysis produced information that filtered quantifiable projects from those with only qualitative results (e.g., capacity building). The bottom-up approach also provided details that enabled us to estimate an emissions impact if it was not directly reported (e.g., kWh of power generated from a renewable energy project).

REVIEW OF ACCOUNTING METHODS

In ➔ Chapter 6 an overview is provided of the different approaches that some international financial institutions have used to measure their efforts' GHG emission reductions.

Chapter 3

DEVELOPING COUNTRIES' ENERGY EFFICIENCY AND RENEWABLE ENERGY CONTRIBUTION TO GLOBAL GREENHOUSE GAS EMISSION REDUCTIONS

The current level of energy efficiency (EE) and renewable energy (RE) activities by national governments and the business sector, along with efforts supported by international assistance, will lower CO_2 emissions from energy use in developing countries substantially in 2020, compared to what emissions would otherwise have been. Based on a comparison of the current trend in RE and EE rates with older no-policy reference scenarios from the IPCC database (the reference scenarios used in the 2015 UNEP Emissions Gap Report), the impact could be on the order of 4 $GtCO_2$ in 2020 (full range is 0 to 6 $GtCO_2$).

This chapter provides a rough estimate of the realized aggregated GHG impact of energy efficiency (EE) and renewable energy (RE) policies implemented in developing countries[9] by comparing a current trends trajectory with a baseline. This quantification is not straightforward because it requires the calculation of what would have happened without these activities (the baseline). It is relatively uncomplicated to estimate the expected emissions taking into account current activities. But determining what emissions would have been without these initiatives requires additional assumptions. Developing countries also face challenges of increasing energy access within their resources, which may increase GHG emissions.

The current trends trajectory includes all RE and EE policies implemented in countries to date, and it uses the most recent trend information. This approach is consistent with the definition of the "current policy trajectory" articulated in UNEP's Emissions Gap Report 2015.[10] The "current policy scenario" of the International Energy Agency's World Energy Outlook of 2014 was used as the basis. The more optimistic projections of renewable energy development in China, provided by Bloomberg New Energy Finance (BNEF), were added to this scenario to take into account current rapid developments. It is assumed that the additional production capacity from renewables given by BNEF replace electricity production by all fossil fuels by the same percentage without altering the energy demand assumed by IEA.

For the baseline, the report adopts the same approach as the UNEP Emissions Gap Report series. It uses a range of scenarios, which were collected for the IPCC Fifth Assessment Report. The scenarios are prepared with various models and employ many assumptions, and therefore represent a wide range of possible outcomes. The main difference from the current policy trajectory is that these scenarios do not include EE and RE policies and activities that took place after 2005 and are therefore a good comparison. The current policy trajectory may also include fuel switching from coal to gas, which would decrease emissions but is outside the scope of EE or RE and is assumed to have a small effect. Finally, the baselines may use different assumptions on economic growth, which would also manifest itself in differences in emissions. This is assumed to have a small additional effect, as most of these scenarios already include the economic downturn of 2008 and because the scenarios cover a wide range of models and therefore a wide range of possible future economic growth.

The difference between the baseline and the current policy trajectory is an achieved emissions reduction of approximately 4 $GtCO_2e$ in 2020 with a full range of 0 to 6 $GtCO_2$ (Figure 2).

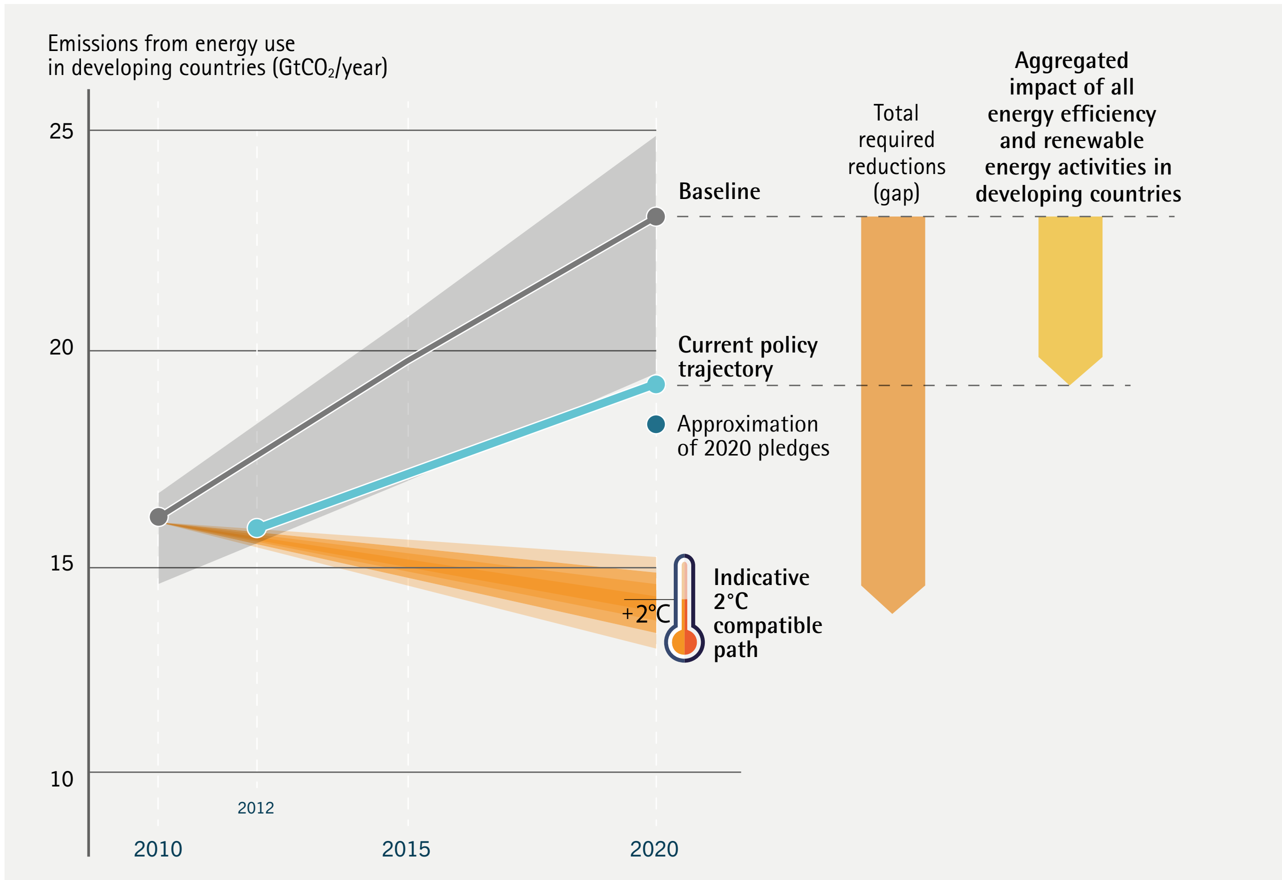
EE and RE activities' aggregate achieved reductions in developing countries are substantial when compared to the total 2020 greenhouse gas emissions gap, i.e. the amount of emissions that need to be reduced for a trajectory that is compatible with limiting global temperature increase to 2°C or 1.5°C. The UNEP Emissions Gap Report 2014[11] states that gap between the no policy baseline and what is compatible with 2°C[12] for the global total (not only developing countries, as above) and for all sectors (not only for energy use, as above) is around 14 $GtCO_2e$ in 2020. This corresponds to a gap of around 9 $GtCO_2$ when considering only energy use in developing countries[13] (Figure 2). This report estimates that EE and RE in developing countries has significantly narrowed this gap.

The gap between the current policy trajectory and what is needed to limit global temperature rise to 2°C is still wide (approximately 10 $GtCO_2e$ in 2020 for all countries and all sectors and roughly half this total for only energy use in developing countries[14], Figure 2).

The full implementation of developing countries' 2020 pledges[15] would lower the projected emissions in 2020 by roughly 1 $GtCO_2$ compared to the current policy trajectory.

EE and RE actions help developing countries implement their 2020 pledges, and these efforts could even enable countries to achieve emissions savings beyond their pledges, further narrowing the emissions gap.

Figure 2: **Contribution of EE and RE in developing countries to emission reductions from energy use.**



Source: 1 Gigaton Coalition

Chapter 4

DEVELOPING COUNTRIES' EFFORTS AND ACHIEVEMENTS IN ENERGY EFFICIENCY AND RENEWABLE ENERGY

Developing countries have increased the ambition of their targets for both renewable energy and energy efficiency over the last decade, during a time when both the global economy and energy consumption have grown concurrently. Of the 164 countries that had established RE targets by mid-2015, 120 were developing countries. Nearly half (69 out of 150 countries) of developing countries with available data have both renewable energy and energy efficiency targets.

Most energy efficiency targets are articulated in terms of energy savings or reductions in energy consumption, while most renewable energy targets relate to an increase in the share of renewables as a percentage of the overall energy mix, or in the installed capacity of a particular type of renewable technology.

Five case studies of innovative renewable energy and energy efficiency programs in developing countries illustrate the strategies some developing countries are using to increase energy savings and expand renewable energy capacity.

4.1 OBJECTIVES

This chapter provides a high-level overview and deep-dive into the efforts of developing countries on renewable energy (RE) and energy efficiency (EE). Utilizing data collected from REN21, a multi-stakeholder global renewable energy and policy network, this report introduces a range of policies and targets many developing countries have adopted in the last few decades. The report also features illustrative efforts and achievements from five emerging economies: Chile, Peru, Rwanda, Kenya, and the Philippines. The case studies provide representative examples of successful projects that have led to measurable GHG mitigation in their respective locations.

These countries were selected based on their affiliation with the 1 Gigaton Coalition, their leadership in pioneering ambitious and innovative RE or EE programs, and their responsiveness to requests for collaboration on this report. Areas of focus for each case study were determined based on independent research including country representatives' feedback on what programs would be most demonstrative. There are many other potential areas of focus, both within these countries and in other developing and emerging countries. The case studies highlight the impacts and diversity of actions countries are taking to promote development through sustainable energy policies.

4.2 POLICY DEVELOPMENT IN ENERGY EFFICIENCY AND RENEWABLE ENERGY IN DEVELOPING COUNTRIES

In the past decade developing countries have rapidly expanded renewable energy (RE) and energy efficiency (EE) policies and targets, as global energy consumption has increased and economic growth has taken off. Globally, 2014 saw a significant expansion in both installed capacity and energy production, with renewable energy investments outpacing net investments in fossil fuel power plants.[16] Renewable installed capacity, excluding hydropower, increased from 560 GW in 2013 to 657 GW in 2014, with wind and solar the dominant sources.

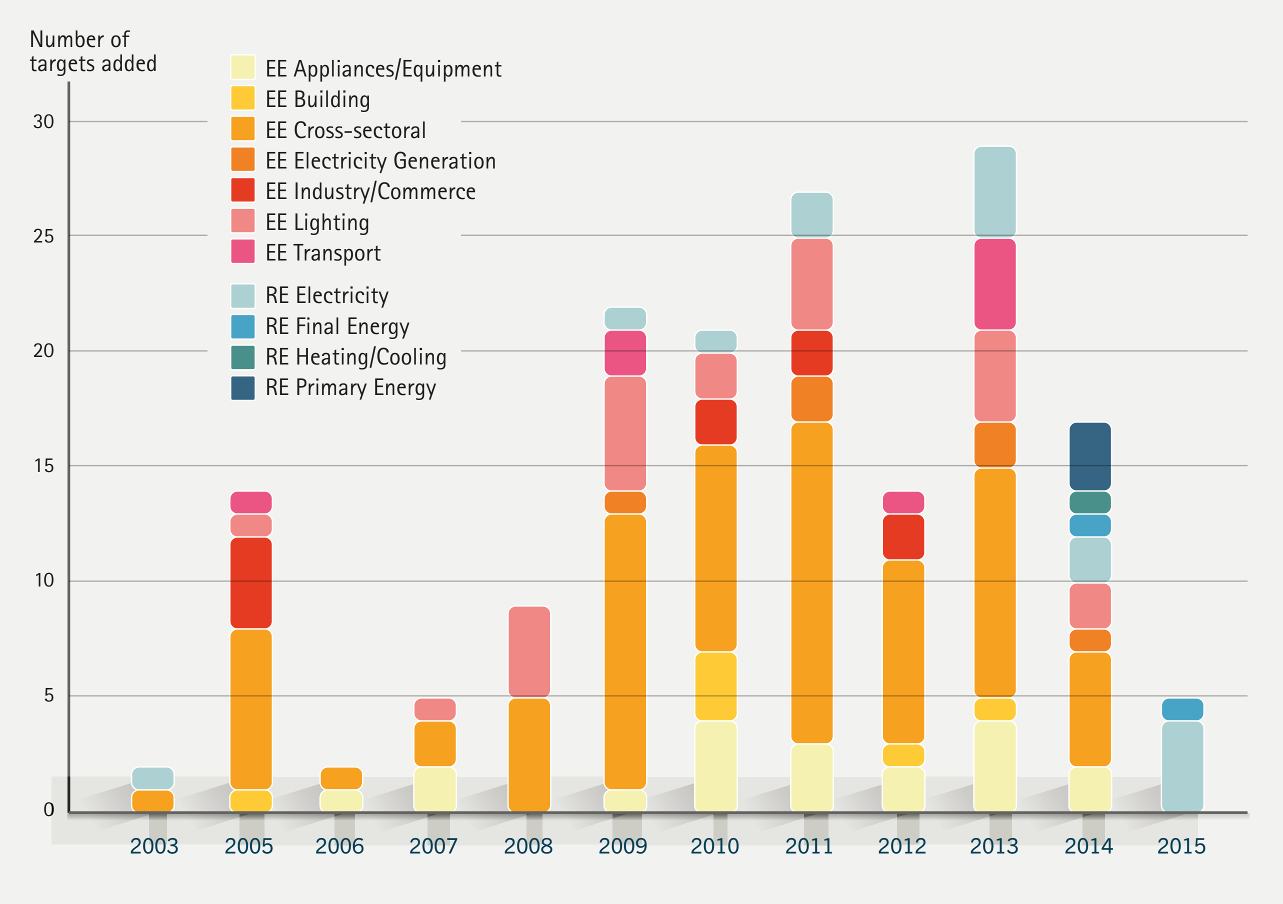
This section characterizes the RE and EE targets and policies that have arisen in developing countries.

4.2.1 TARGETS

Targets for both renewable energy (RE) and energy efficiency (EE) have advanced over the last decade (Figure 3), helping to guide policy creation and implementation. Of the 164 countries that had established RE targets by mid-2015, 120 were developing countries. While the majority of RE targets are related to electricity (Figure 4), some developing countries have also adopted other RE targets that have moved beyond the electricity sector.

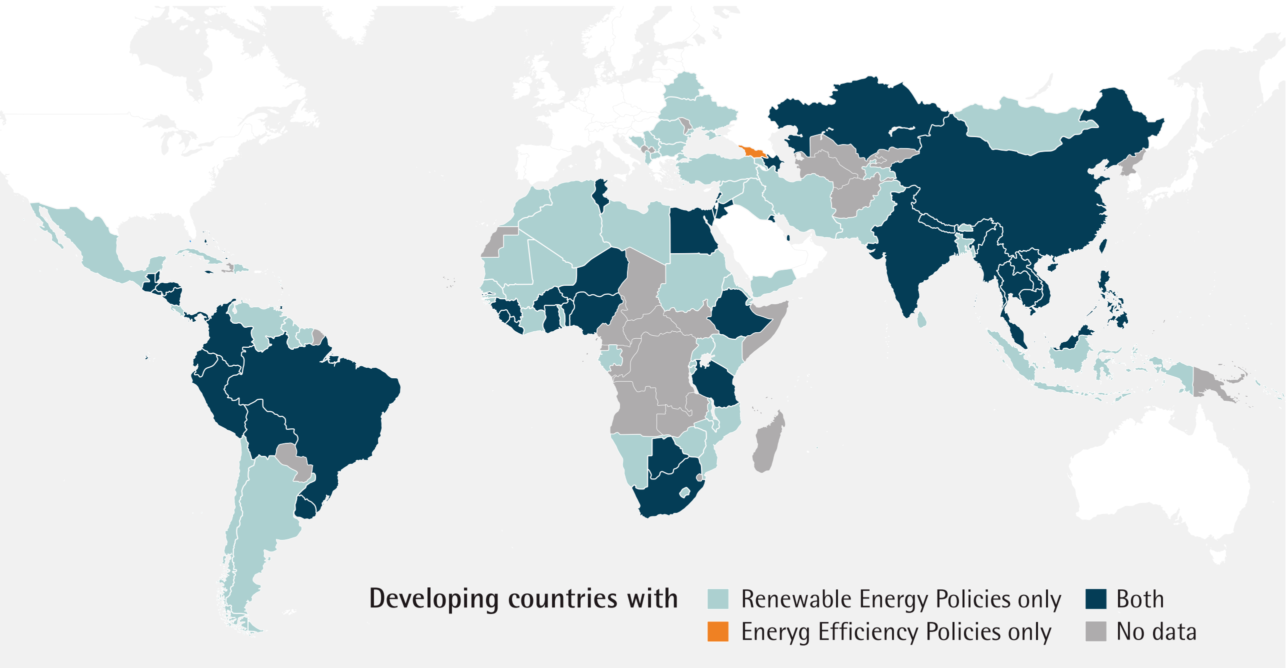
China, Libya and Thailand all have illustrative examples of far-reaching RE targets. China has RE targets, for instance, that address total final energy consumption, as well as heating and cooling and transport. Libya has a RE target for total primary energy supply, and Thailand has adopted RE targets for total final energy consumption, electricity, heating and cooling, and transport. RE targets also have taken many different forms, ranging from "simple government announcements to legally binding obligations with clear, quantifiable metrics and specific compliance mechanisms."[17]

Figure 3: **Growth in renewable energy and energy efficiency targets from 2002 to 2015.**



Note that EE data was not available for 2015. Data source: REN21 Renewables 2015 Global Status Report and 1 Gigaton Coalition Survey.

Figure 4: **Map of developing countries that have adopted only energy efficiency (EE) targets or have both EE and renewable energy targets.**



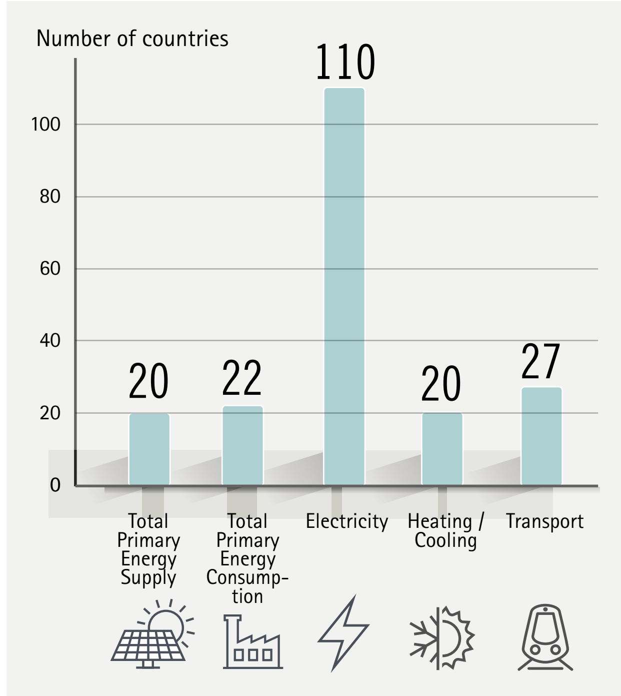
Data source: REN21 Renewables 2015 Global Status Report, 1 Gigaton Coalition Survey, and IRENA, 2015.[18]

Developing countries are increasingly adopting both EE and RE targets. Nearly half (69 out of 150 countries) of developing countries with available data have targets for both RE and EE.

The data available to assess the adoption of RE and EE targets from 1975 to 2015 show a general increase in developing country activity, with a peak occurring in 2013 (Figure 3). RE targets are focused on the electricity sector, while EE targets apply to a range of sectors, from lighting to buildings to industry. Most EE targets in this dataset represent economy-wide, cross-sectoral goals. Targets are found at multiple levels of government, from city and sub-national jurisdictions to regional and national levels, although for developing countries information on many EE targets are from the national level. Some targets are legislated, while others are set by regulatory agencies, ministries, or public officials.

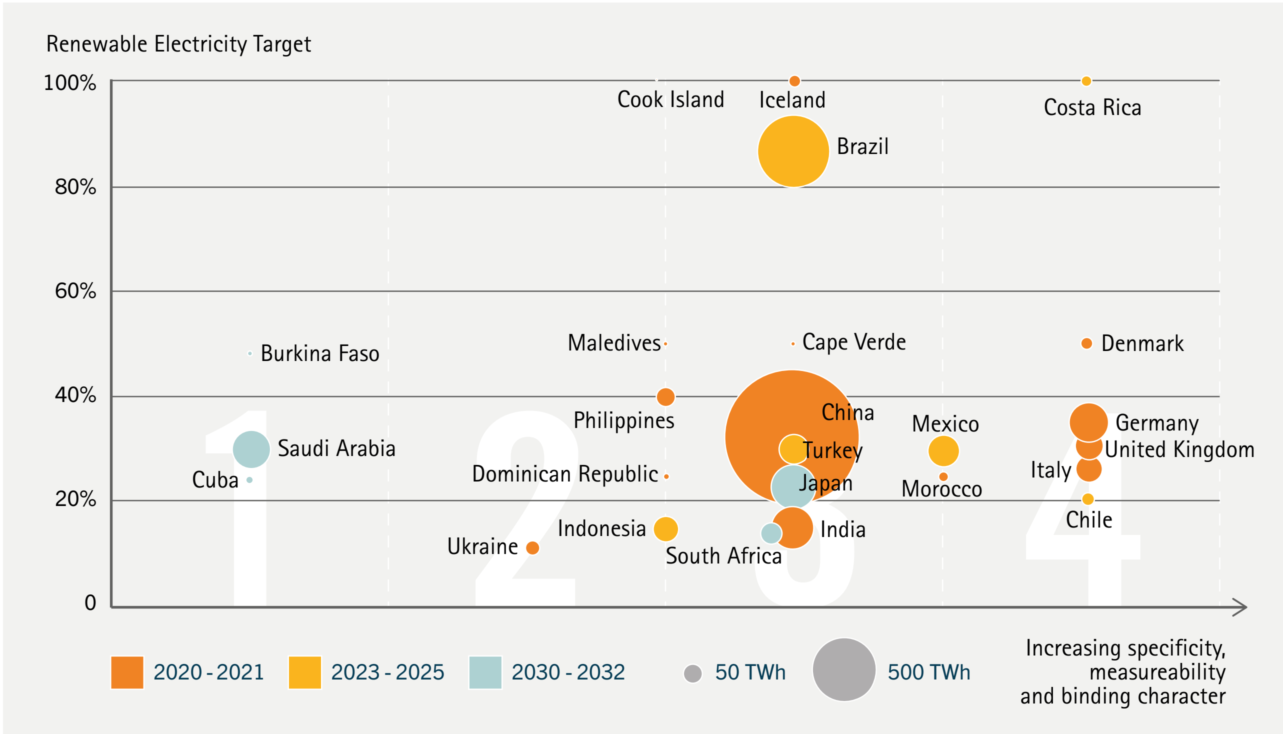
Energy efficiency targets in developing countries span a broad range of timelines, spatial coverage, and goals for efficiency gains. Belize, for example, enacted a target to improve energy efficiency by 1 percent per year from 2010 consumption levels by 2033. In 2009, South Africa adopted a target to improve energy efficiency by 12 percent by 2015. Botswana has adopted a target to make 100 percent of its lighting energy efficient by 2020. Many EE targets are articulated in terms of energy savings or reductions in energy consumption. Brazil, for instance, has a nationwide target to reduce electricity consumption 10 percent by 2030.

Figure 5: **Types of renewable energy targets adopted by 110 developing countries.**



Data source: IRENA, 2015, REN21 Renewables 2015 Global Status Report

Figure 6: **Renewable electricity generation targets by target date and level of specificity.**
The categories specifying the increasing specificity, measurability, and binding character of RE targets is defined by IRENA (2015) as 1) political announcements and vision statements; 2) energy strategies and scenarios; 3) detailed roadmaps and action plans; 4) legally binding renewable energy targets



Source: IRENA, 2015.

Most RE targets in developing countries set an increase in the share of renewables as a percentage of the overall energy mix, or in the installed capacity of a particular type of renewable technology. Algeria, for instance, has a target to generate 27 percent of its final electricity consumption from renewables by 2015. Gambia's goal to generate 35 percent of its electricity from renewable sources by 2020 is on the more ambitious end of the targets reviewed. At the sub-national level, provinces and states are also undertaking RE targets. The Guangdong province in China has set solar electricity generation targets of 1 GW by 2015 and 4 GW by 2020. Not all developing country RE targets, however, relate to solar or wind. India, for example, has set a target to generate 20 MW of electricity from waste-to-energy systems. To date, RE targets overwhelmingly address the electricity sector; very few relate to other sectors, such as transport or industry.

The level of implementation of these RE and EE targets remains unclear. Many countries do not regularly report information on their progress towards achieving these goals. Many developing countries, moreover, do not give specific numeric targets and timelines. As illustrated in Figure 6, Cuba and Burkina Faso have relatively modest goals in terms of RE electricity generation and are just beginning the process of determining the measurability, specificity and binding nature of their targets. In contrast, Chile and Costa Rica aim to generate 100 percent of their electricity from renewable energy by 2023 and 2025 respectively. These goals include specific, measurable and binding targets, similar to those of leading renewable electricity generation developed countries, including Denmark, Germany, the United Kingdom, and Italy.[19]

4.2.2 POLICY INSTRUMENTS

Strong policy support for renewable energy (RE) and energy efficiency (EE) has contributed to growth in RE and improvements in EE globally. Reductions in the cost of renewables, particularly for solar photovoltaic (PV) and wind power, have led to increases in transportation, electrification and heating applications. In developing countries, distributed renewable energy systems have the potential to facilitate countries' transition to modern energy services.[20]

Developing countries achieve their RE and EE targets in a variety of ways. The majority of EE policies fall into the "long-term strategic planning" (Figure 6) category, which indicates a strategy to achieve energy savings of a specified period of time, includes specific goals and typically spans all major sectors. Botswana, for instance, has implemented an energy efficiency strategy, while China has had a national energy conservation law in place since 2008.

Efficiency targets comprise the second-most commonly used policy tool for developing countries. Efficiency targets can be cross-sectoral or sector-specific. In 2011, for example, Viet Nam identified efficiency targets for the lighting sector, to be achieved by 2030. Honduras implemented energy efficiency projects to target the industrial and business sectors in 2005.

Countries also often turn to standards and labelling programmes, which enhance the efficiency of appliances and other products. In 2014, 81 countries had implemented these kinds of programs.[21] Labelling programs often target specific sectors, such as industry or transport. Countries have implemented both voluntary and mandatory versions of these labelling schemes in their efforts to enable consumers to factor energy efficiency into their purchasing decisions.

Energy efficiency mandates or obligations target consumption patterns from a different angle, requiring consumers, suppliers, or generators of energy to meet a minimum and usually gradually increasing, target for EE. These mandates often take the form of energy efficiency portfolio standards (EEPS) and building codes or standards, which set minimum EE standards to guide the construction or retrofit of buildings and other structures.

Energy audits analyze energy flows within an existing building, process or system, to identify ways to reduce energy use without negatively affecting outputs. Similarly, monitoring energy use helps establish a basis for energy management, both within the building industry and in other sectors. Many countries also focus on increasing efficiency in transportation, often through vehicle fuel economy standards, which specify the minimum fuel economy of automobiles to reduce energy consumption.

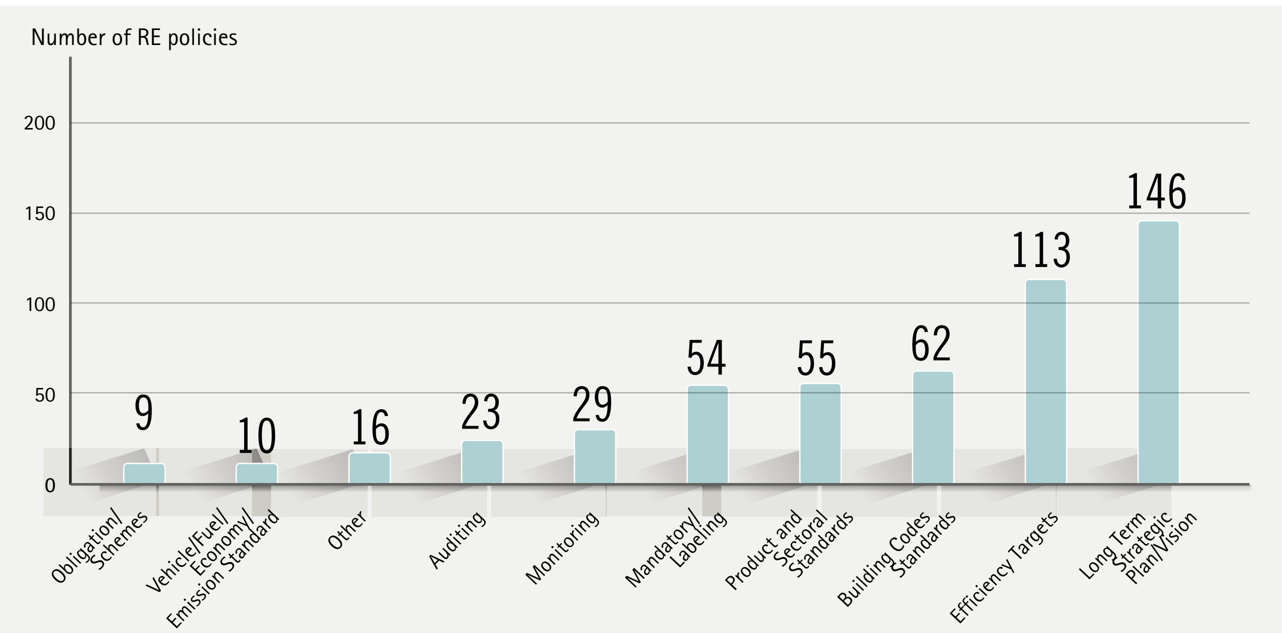
For RE policies, the most commonly used instruments are fiscal incentives (e.g., reductions in sales of non-RE energy, a value-added or other form of taxation; see Figure 5 for more details). Mali exempts solar panels, solar lamps, and other renewables from import levies and duties. India also exempts off-grid rooftop solar PV from taxes. Most of these fiscal incentives use tax reductions or credits to encourage the adoption of renewable energy.

Many developing countries have also opted to introduce feed-in tariffs or premium payments. Feed-in tariffs (FiTs) guarantee renewable energy producers a connection to the electric grid, often through a long-term contract, and a premium payment rate set above market price by the government, to make RE projects more secure financial investments.[22] (Premium payments can also be implemented independent of FiTs). Egypt has FiTs for both solar and wind power, while Malaysia has plans to introduce a FiT for geothermal energy. Thailand also has implemented FiTs for rooftop solar PV installations. Biofuels mandates or obligations are another common RE policy for developing countries. These examples demonstrate the importance of economic and fiscal incentives to encourage the growth of renewables in developing countries.

4.3 SUCCESS STORIES

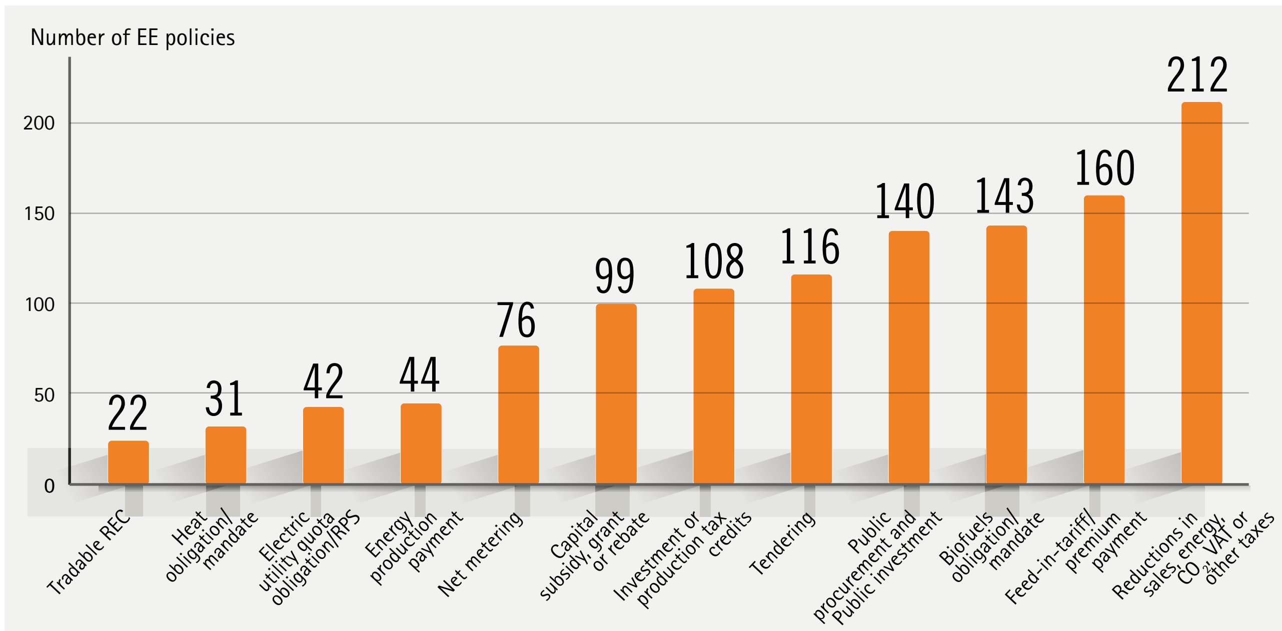
See following pages.

Figure 7: **Types of renewable energy policies for 69 developing countries**



Data source: REN21 Global Status Report, 2015.

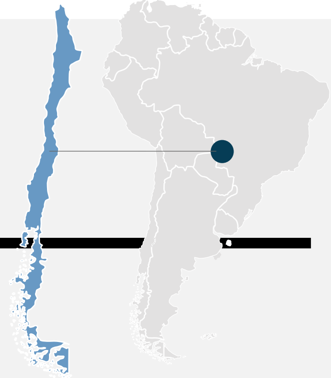
Figure 8: **Types of energy efficiency policies found in 62 developing countries.**

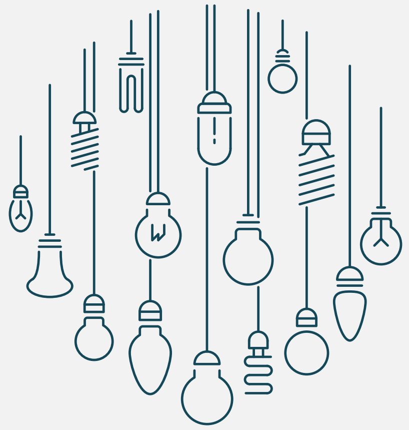


Data source: REN21, 1 Gt Coalition Survey, 2015.

CHILE*

Capital Santiago
Area 743,532 km²
Population 17.7 mio.
Density 24/km²
GDP per capita 14,528 US$





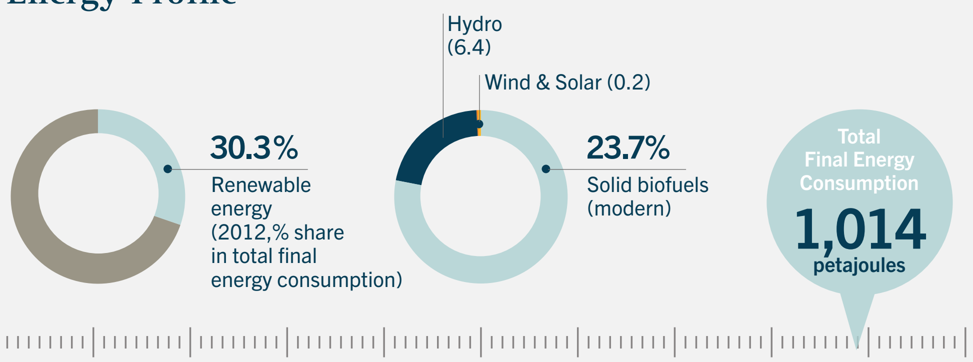
Chile's efficient lighting strategies have enabled it to reduce its annual emissions by 1.2 megatons of carbon dioxide, save 2.8 terawatt-hours (an amount equivalent to four 100 megawatt thermal plants) in annual electricity consumption, and pocket $486.4 million in annual savings.

efficient lighting | **four 100 megawatt** thermal plants avoided | **1.2 megatons** avoided | **486.4 mio US$** saved

Access to electricity

Latin America and Caribbean

Energy Profile



EE Targets

Chile's 2014 **Energy Agenda** aims to establish an energy savings goal of 20 percent by 2025, which would make it possible to save 20,000 gigawatt-hours per year, an emissions reduction equal to the output of 2,000 megawatts of coal-fired installed capacity.

Energy Efficiency

4.2 megajoules per 2011 PPP US$ — **Level of primary energy intensity**

-2.45 in % (2010 – 2012) — **Final energy intensity improvement, compound annual growth rate**

114 petajoules (2010 – 2012) — **Cumulative avoided energy consumption**

Chile's RE Targets

include using renewable energy to make up 20% electricity generation by 2025, and 45% of new capacity until 2025.

4.3.1 CHILE : A COMPREHENSIVE EFFICIENT LIGHTING STRATEGY

Imported fossil fuels currently account for 60 percent of Chile's primary energy supply.[23] Lessening this reliance on fossil fuels is crucial to cushioning the country against global market shocks and reducing its GHG emissions.[24] In addition to an ambitious sweep of legislation that seeks to enable non-conventional renewable energy (RE) to account for 20 percent of the national energy mix by 2025,[25] Chile has enacted energy efficiency (EE) measures to stretch existing capacity further, and stabilize and reduce electricity costs for consumers. Chile's 2014 Energy Agenda aims to establish an energy savings goal of 20 percent by 2025, which would make it possible to save 20,000 gigawatt-hours per year, an emissions reduction equal to the output of 2,000 megawatts of coal-fired installed capacity.[26]

Chile's campaign to adopt more efficient lighting demonstrates EE initiatives' potential energy savings. The initiative's strategy adopts many elements of the integrated policy approach promoted by the United Nations Environment Programme's "en.lighten" program,[27] creating a sustainable lighting market and reducing the emissions generated in a lamp's lifecycle. Between 2008 and 2009, the Chilean Government's "Iluminate con Buena Energia" campaign worked in vulnerable communities, replacing inefficient incandescent bulbs with nearly 3 million compact fluorescent lamps (CFLs), while also raising awareness about the benefits of efficient lighting.[28]

The National Efficient Lighting Strategy scales this policy up. This initiative supports the replacement of incandescent lamps by distributing of light-emitting diodes (LEDs) and CFLs to low-income populations and implementing public awareness campaigns.[29] The Chilean Ministry of Energy, in collaboration with Fundacion Chile,[30] implemented this policy in 2012, after a nationwide public consultation process helped identify the tools and expertise necessary for its success.

Implementing the National Efficient Lighting Strategy has enabled Chile to reduce its annual emissions by 1.2 megatons of carbon dioxide, save 2.8 terawatt-hours in annual electricity consumption (an amount equivalent to four 100-megawatt thermal plants), and generate $486.4 million in annual savings.[31] This program also fosters the development of a comprehensive strategy for safely disposing of old lamps, and the exploration of technological innovations, such as controls and sensors, that provide additional energy savings.[32]

Chile complements it efforts to install more efficient lighting in homes and businesses with policies that make the lighting market more sustainable. Mandatory energy efficiency labelling for incandescent lamps, compact fluorescent lamps and fluorescent tubes enables consumers to factor these products' lives and efficiency into purchasing decisions.[33] Beginning in December 2015, it will no longer be possible to sell light bulbs above 25 watts within the country. Campaigns that promote the benefits of efficient lighting and help low-income families improve their home's energy efficiency have laid the groundwork for broader policy changes.

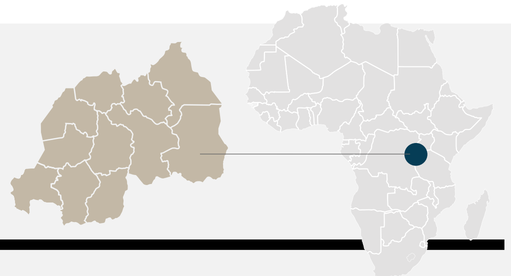
Chile's use of producer-focused standards to foster a sustainable lighting market, and consumer-focused outreach to increase the use of energy-efficient lighting, have great potential to be adopted by other countries. These successful approaches could also inform efficiency efforts in other sectors in Chile. Consumer-focused information incentives could, for example, encourage purchases of energy efficient appliances and equipment.

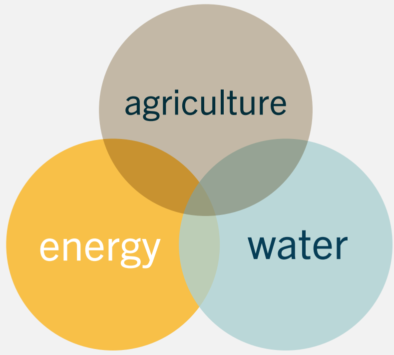
* Demographic information from: The World Bank. (2014). Data. Retrieved from: http://data.worldbank.org/indicator/AG.LND.TOTL.K2.

Energy Profile, access to electricity, and energy efficiency information from Sustainable Energy For All (SE4All). (2015). Global Tracking Framework: Progress Towards Sustainable Energy 2015. Retrieved from: http://www.se4all.org/wp-content/uploads/2013/09/GTF-2105-Full-Report.pdf.

RWANDA*

Capital	**Kigali**
Area	24,670 km²
Population	11.3 mio.
Density	460/km²
GDP per capita	695.70 US$





The Agahozo-Shalom Youth Village (ASYV) solar power plant became the first large-scale solar plant in East Africa when it began generating power in July 2014.
It currently produces 15,000 megawatts per year, and has the capacity to deliver 8.5 megawatts, approximately 6 percent of Rwanda's current capacity. The plant will save an estimated 7,500 – 8,400 tons of carbon dioxide equivalent annually, compared to traditional energy sources, while providing 15,000 – 18,000 homes with electricity.

large-scale **solar plant**

15,000 megawatts/year

7,500 – 8,400 tons avoided

15,000 – 18,000 homes electrified

Access to electricity

18% total

62% urban

8% rural

Sub-Saharan Africa

Energy Profile

86.3% Renewable energy (2012,% share in total final energy consumption)

Solid biofuels (modern)

Hydro

75.3% Solid biofuels (traditional)

Total Final Energy Consumption **54** petajoules

Energy Efficiency

5.6 megajoules per 2011 PPP US$ — **Level of primary energy intensity**

-17.52 in % (2010 – 2012) — **Final energy intensity improvement, compound annual growth rate**

64 petajoules (2010 – 2012) — **Cumulative avoided energy consumption**

Country Targets

Rwanda has set a national target to increase electricity access to 70% by 2017. By 2030, Rwanda hopes that electricity will reach 100 percent of both urban and rural populations, and that renewable sources will power 59 to 73 percent of this target.

4.3.2 RWANDA: SOLAR POWER SUPPORTS ECONOMIC DEVELOPMENT

Expanding and diversifying Rwanda's energy mix is critical to continue the country's development gains. Rwanda has expanded energy access, growing it from 2 to 18 percent of the population between 1990 and 2012.[34] Most Rwandan citizens, however, still rely on biofuels, consuming them at a rate that puts pressure on the country's forests and endangers the health of those who rely on solid fuels for cooking and heating.[35] Fuel sources like charcoal and firewood accounted for 73.5 percent of the country's 2012 energy consumption, a high rate in comparison with a 62.7 percent average across Sub-Saharan Africa.[36] The country estimates that the current 0.9-megaton biofuel shortfall will grow to 5.9 megatons by 2030 if current trends continue.[37] Renewable energy is poised to play a key role in addressing this potential shortage.

The Agahozo-Shalom Youth Village (ASYV) solar power plant demonstrates the potential for renewable energy sources to facilitate the transition away from biofuels, while also providing economic and environmental co-benefits. The ASYV plant is a public-private partnership that was constructed in less than 12 months and began generating power in July 2014. It is the first large-scale power plant in East Africa, and currently produces 15,000 megawatts per year, with capacity to deliver 8.5 megawatts (approximately 6 percent of Rwanda's current capacity).[38] The plant will save an estimated 7,500 – 8,400 tons of carbon dioxide equivalent annually, compared to traditional energy sources, while providing 15,000 – 18,000 homes with electricity.[39]

The ASYV plant's energy production means that time previously devoted to biofuel collection can be used for other economically productive uses; connecting 15,000 – 18,000 homes would save 10.95 – 13.29 million hours, representing between US $834,000 and $1.79 million per year in increased economic activity.[40] The plant also creates local benefits, creating 200 part-time construction jobs and 30 full-time maintenance jobs.[41] The plant's lease agreement with the Agahozo-Shalom Youth Village helps support the 144-acre orphanage.[42]

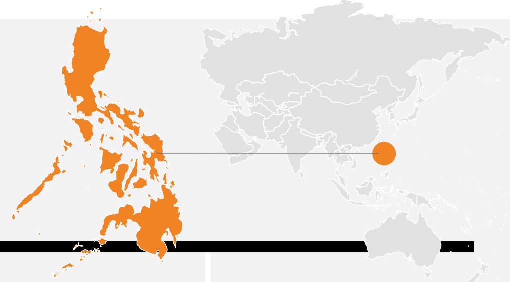
Expand Rwanda's renewable capacity will be crucial to its ability meet its ambitious electricity access targets. By 2030, the country hopes to achieve 100 percent energy access for both urban and rural populations, with 59 to 73 percent of that energy coming from renewable sources.[43] Achieving the 73 percent renewable energy target would cost US $7.5 billion over 15 years, requiring more upfront capital than the US $6.7 billion needed to fund a business-as-usual scenario.[44] However, the Government of Rwanda has stated that the reduced operating and fuel costs would "more than compensate for" the greater upfront capital needed to develop renewable energy resources.[45] Leveraging public-private partnerships, like the one used to the support the ASYV plant, and taking greater advantage of support available through programs like the Green Climate Fund, could put this goal within closer reach.

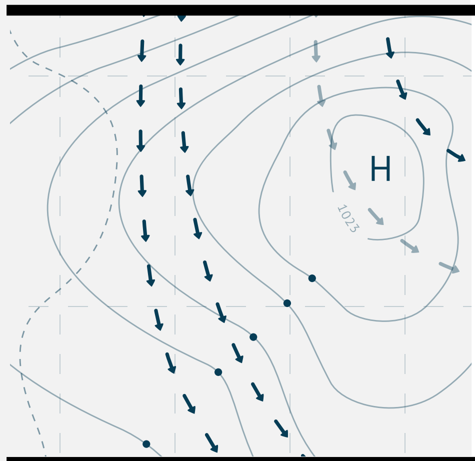
* Demographic information from: The World Bank. (2014). Data. Retrieved from: http://data.worldbank.org/indicator/AG.LND.TOTL.K2.

Energy Profile, access to electricity, and energy efficiency information from Sustainable Energy For All (SE4All). (2015). Global Tracking Framework: Progress Towards Sustainable Energy 2015. Retrieved from: http://www.se4all.org/wp-content/uploads/2013/09/

PHILIPPINES*

Capital	**Manila**
Area	298,170 km²
Population	99.1 mio.
Density	332/km²
GDP per capita	2,870.50 US$





The Wind Energy Resource Atlas of the Philippines found that areas with good to excellent wind resources could generate approximately 76,000 megawatts of installed capacity, or approximately 195 billion kilowatt hours, per year.

76,000 megawatts potential

195 billion kilowatt hours/year

EE Targets

The Energy Efficiency and Energy Conservation Roadmap sets a goal of energy savings equivalent to **10%** across energy demand sectors by 2030.

Access to electricity

88% total

94% urban

82% rural

Southeastern Asia

Energy Profile

29.4% Renewable energy (2012,% share in total final energy consumption)

RE Targets

The Philippines hopes to nearly **triple** installed renewable energy capacity, from 5,438 megawatts in 2010 to **15,304 megawatts by 2030**.
The Philippine Wind Power Development Roadmap outlines a plan to increase wind capacity to 700 MW by 2020, and to **2,345 MW by 2030**.

Total Final Energy Consumption **999** petajoules

Energy Efficiency

3.1 megajoules per 2011 PPP US$ — **Level of primary energy intensity**

-4.4 in % (2010 – 2012) — **Final energy intensity improvement, compound annual growth rate**

1,576 petajoules (2010 – 2012) — **Cumulative avoided energy consumption**

4.3.3 THE PHILIPPINES: MAPPING OPPORTUNITY AND REDUCING INVESTOR RISK: THE WIND ENERGY RESOURCE ATLAS

Greater growth in renewable energy (RE) is pivotal to ensuring a stable and sustainable energy supply in the Philippines. The high costs of importing fuel (in 2010, oil imports totaled US $8.78 billion[46]) and the need to meet an energy demand strong enough to trigger rolling power outages[47] make RE a compelling option for the Philippines.

The Philippine government has implemented a number of policies and targets to harness the country's significant RE resources. The Renewable Energy Act of 2008 and the 2011 National Renewable Energy Program have helped spur investment in wind, solar, geothermal, hydro, biomass, and ocean energy. The Philippines has a target to nearly triple installed RE capacity, from 5,438 megawatts (MW) in 2010 to 15,304 MW, half of the country's projected energy demand,[48] by 2030.[49]

Wind power is abundant and cost-competitive, and therefore central to achieving this RE target.[50] While the Philippines produced 337 MW of wind power in 2012, making it the largest wind producer in Southeast Asia,[51] there is opportunity to expand its contributions. Wind and solar power comprised less than 0.2 percent of the country's primary energy mix in 2012.[52] The Philippine Wind Power Development Roadmap outlines a plan to increase wind capacity to 700 MW by 2020, and to 2,345 MW by 2030.[53]

The Wind Energy Resource Atlas of the Philippines, which maps and rates wind energy potential across the islands, has been a crucial part of building the capacity to realize these goals. Determining a site's wind profile is often the most time-consuming and expensive aspect of a wind energy project, and creating more reliable wind data can drastically reduce the time taken to conceptualize and commission a project.[54]

The Atlas was first released in 2001, through a collaboration between U.S. agencies,[55] private companies and organizations,[56] and Philippine organizations.[57,58] Its data has helped document the potential of wind energy, identify key wind corridors and sites with high wind energy potential, and bring comprehensive quantitative wind energy data to both utility-scale and off-grid wind energy.[59]

The Atlas has also helped spur complementary research to create a more complete profile of wind potential. The Atlas creators recommended additional on-the-ground validation of the map, to account for fluctuations over different years and seasons, and to address the unique effects of the Philippines' ocean gusts and the steep topography on air currents.[60,61] A 2003 report[62] found that applying additional screening criteria for power density and transmission line costs to the Atlas maps reduced potential wind power generation from 10,000 "good to excellent" sites, capable of producing 76,000 MW, to 1,038 sites, capable of producing 7,404 MW.[63,64] Ground-truthing the map to account for these logistical and environmental variations is crucial to further reducing the investment risks associated with developing new wind farms.

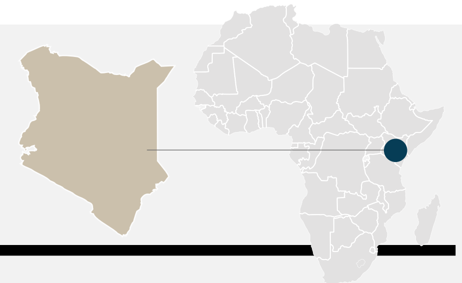
The Philippines' newest iteration of wind mapping tools incorporates these lessons. A technical assistance grant from the United Nations Development Programme (UNEP) supports the Philippine Department of Energy's installation of 14 wind meteorological masts in strategic locations. These masts will collect at least 10 years of reference data, which will be made publicly available in the Philippine Wind Energy Database.[65]

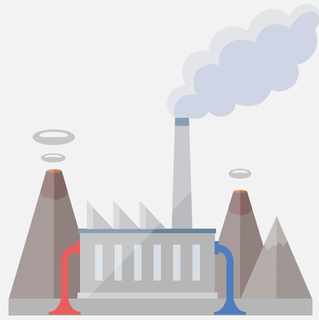
A partnership between the Asian Development Bank, the United States Department of Energy's National Renewable Energy Laboratory, and Philippines' Department of Energy uses data from wind energy developers to validate wind map models. This program overcomes developers' concerns about protecting proprietary site-specific data[66] by aggregating this information. Collating this information makes it possible to share it publicly, along with data about land use, infrastructure, and load centers. The Philippines' wind mapping efforts demonstrate powerful new ways to harness existing knowledge to build RE capacity.

* Demographic information from: The World Bank. (2014). Data. Retrieved from: http://data.worldbank.org/indicator/AG.LND.TOTL.K2.
Energy Profile, access to electricity, and energy efficiency information from Sustainable Energy For All (SE4All). (2015). Global Tracking Framework: Progress Towards Sustainable Energy 2015.
Retrieved from: http://www.se4all.org/wp-content/uploads/2013/09/

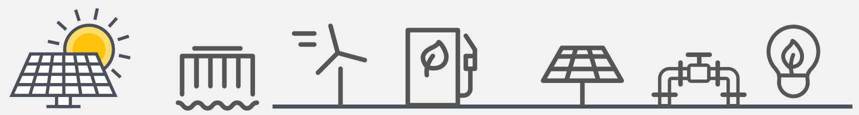
KENYA*

Capital	**Nairobi**
Area	569,140 km²
Population	44.8 mio.
Density	79/km²
GDP per capita	1,358.30 US$





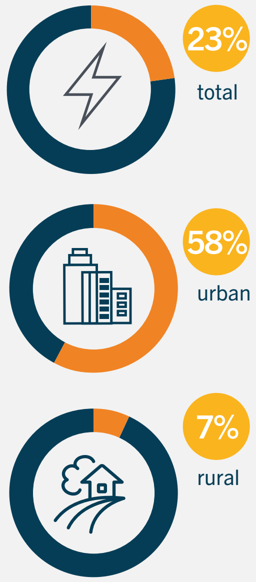
As of March 2014, the Ministry of Energy had received 112 applications across all renewable energy types, including 750 megawatts of approved solar projects.



750 megawatts approved

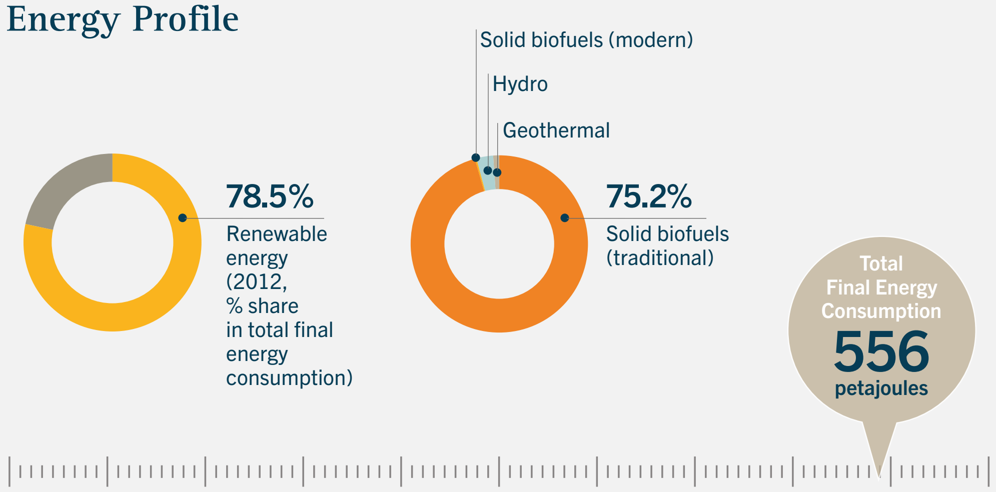
112 applications across all renewable technologies

Access to electricity



Sub-Saharan Africa

Energy Profile



RE Targets

Kenya's Vision 2030 ambition is to be a middle income country in 18 years' time: this will require system capacity to grow to 15,000 MW by 2030. The Updated Least Cost Power Development Plan (ULCPDP) 2011 – 2031, which is the official long-term electricity planning document of the Ministry of Energy, identifies various generation sources to meet this demand with a **25 percent surplus**, forecasting 19,220 MW of capacity in 2030; 5,110 MW from geothermal, 1,039 MW from hydro, 2,036 MW from wind, 1,635 MW from MSD, 1,980 MW from gas, 2,000 MW from imports, 2,420 MW from coal and 3,000 MW from nuclear.

Energy Efficiency

9.3
megajoules per 2011 PPP US$
Level of primary energy intensity

-2.88
in % (2010 – 2012)
Final energy intensity improvement, compound annual growth rate

149
petajoules (2010 – 2012)
Cumulative avoided energy consumption

4.3.4 KENYA: FINE-TUNING A FEED-IN-TARIFF FOR RENEWABLE ENERGY

Kenya's hosts "one of the most diverse and rapidly modernising electricity sectors" in East Africa.[67] The country's growing population and expanding economy will drive an anticipated 13.5 percent increase in annual electricity demand between 2012 and 2030, pushing peak usage rates from 1.5 gigawatts (GW) to 15 GW,[68] and increasing total consumption from 5,600 GW to 50,300 GW.[69] To meet this demand, installed capacity will need to increase from current levels of 2298 megawatts (MW)[70] to approximately 23,000 MW by 2030.[71]

Renewable energy (RE) will be crucial to keeping up with this rapid growth in demand. It also provides the added benefits of increased energy security, through decreased energy imports, and reduced costs of generation.[72] In 2014, RE formed 68 percent of the country's electricity supply.[73] The Kenyan government plans to expand the role of renewable resources further, most immediately through the construction of four wind parks with a cumulative capacity of 550 MW,[74] and the addition of 100 new solar photovoltaic systems to the existing 1,217 systems operating in public institutions.[75] By 2030, Kenya hopes to install an additional 5,000 MW of geothermal capacity.[76]

These plans rely on significant participation from the private sector.[77] Private investors could play a key role in helping to avoid "funding bottlenecks"[78] that have slowed the rollout of RE projects in the development pipeline. To encourage others to add to the US $50 billion Kenya has earmarked for new power source construction between 2013 and 2033,[79] the government introduced one of Africa's first RE feed-in tariffs (FiT) in 2008.[80] The FiT offers RE producers long-term power purchase agreements (PPAs) for the sale of electricity, reducing the risk associated with developing new power sources.

A 2010 revision expanded the policy beyond wind, hydropower, and bioenergy-generated electricity, to include geothermal, solar, and biogas,[81] and extended PPAs from 15 to 20 years.[82] In 2011, the FiT had drawn 49 expressions of interest from private investors.[83] After a 2012 revision increased the FiT rate, participation in the program increased substantially.[84] The 2012 amendments also standardized PPAs, established grid-connection guidelines for small-scale renewables (of up to 10 MW), and revised the implementation guidelines to include standardized application, monitoring, and reporting frameworks.[85] As of March 2014, the Ministry of Energy had received 112 applications across all renewable energy types, including 25 solar projects capable of generating 750 MW.[86]

After successfully raising private interest, Kenya is now working to accelerate implementation. To date, the FiT has enabled a 0.6MW solar PV rooftop project in Nairobi, sponsored by Strathmore University;[87] a 0.920 MW hydropower plant, owned by the Kenya Tea Development Agency; a 0.5 MW hydropower project in Nyeri, operated by Gikira; a 2 MW biogas power plant in Naivasha, owned by Tropical Power; and a 2 MW biomass (gasification) plant in Baringo, owned by Cummins Generation.[88]

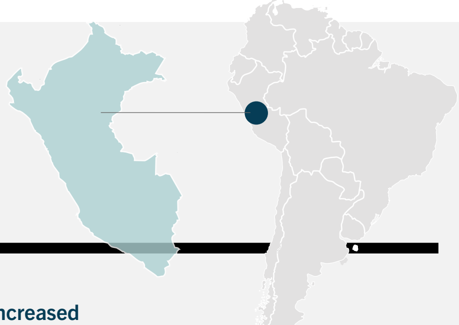
In addition to generating clean energy, the process of implementing these projects has created a "roadmap" to guide regulator and government engagement with future capital investments.[89] Strengthening transmission and distribution networks, and implementing other policies to help investors navigate regulatory requirements, could accelerate the momentum of the FiT even further.

* Demographic information from: The World Bank. (2014). Data. Retrieved from: http://data.worldbank.org/indicator/AG.LND.TOTL.K2.

Energy Profile, access to electricity, and energy efficiency information from Sustainable Energy For All (SE4All). (2015). Global Tracking Framework: Progress Towards Sustainable Energy 2015. Retrieved from: http://www.se4all.org/wp-content/uploads/2013/09/

PERU*

Capital **Lima**
Area 1,280,000 km²
Population 30.9 mio.
Density 24/km²
GDP per capita 6,550.90 US$



Between 2006 and 2013, **Peru's Project for Increased Rural Electrification** leveraged $129.55 million (USD) to help finance 105,045 new electricity connections with electricity distribution companies, 7,100 of which relied on renewable energy.

These PV systems will **reduce approximately 5,626 tons of CO_2** over the course of their lifetimes.

RE Targets

Peru aims to have **6%** electricity generation from renewable energy (excluding hydro) by 2018, and 60% electricity generation from all renewable energy source (including hydro) by 2018.

129.55 mio US$ invested

105,045 new electricity connections

Regulated tariff for photovoltaic systems (PV)

Access to electricity

92% total

98% urban

75% rural

Latin America and Caribbean

Energy Profile

28.2% Renewable energy (2012,% share in total final energy consumption)

Hydro
Liquid Biofuels
Solar

13.6% Solid biofuels (traditional)

Solid biofuels (modern)

Total Final Energy Consumption **651** petajoules

Energy Efficiency

2.8 megajoules per 2011 PPP US$ — **Level of primary energy intensity**

-3.37 in % (2010 – 2012) — **Final energy intensity improvement, compound annual growth rate**

452 petajoules (2010 – 2012) — **Cumulative avoided energy consumption**

EE Targets

The **Energy Efficiency Referential Plan 2009 – 2018** aims to reduce consumption by 15% until the year 2018 in relation to the projected demand for that year, without negatively affecting production and neither services of the different economy sectors nor the comfort of the residential sector.

4.3.5 PERU: USING INNOVATIVE FINANCING TO DRIVE RURAL ELECTRIFICATION

Peru has dramatically expanded the reach of electricity over the past 15 years, extending it from 73 to 92 percent of the population between 2000 and 2014.[90] However, scattered settlements and challenging terrain hinder infrastructure development in rural areas, where the proportion of the population with energy access is 75.2 percent.[91] Low household energy consumption and low purchasing power has discouraged investment in rural electricity services.[92]

Peru's National Rural Electrification Plan aims to reduce this deficit by increasing energy access to 6.2 million people between 2013 and 2022, a number that would achieve nearly universal access.[93] In 2014, 437 rural electrification projects, representing a US $417.8 million investment, reached 1.2 million people.[94] Renewable energy plays a key role in achieving this target, with the Peruvian Ministry of Energy and Mines deploying a combination of grid extension and mini-grids driven by hydro, solar, and wind power to pursue it.

The Project for Increased Rural Electrification (Proyecto para el Mejoramiento de la Electrificación Rural mediante la aplicación de Fondos Concursables or FONER) drove much of this progress and will play a crucial role in building upon it. To help overcome barriers to financing rural electrification, FONER subsidizes investment costs to encourage companies to provide electricity to rural households, health clinics, schools, businesses and public facilities. Pilot projects tested different strategies for better aligning and supply and demand, by identifying key target markets and working with communities and entrepreneurs to include potential energy uses, such as the production of baked goods, milk production, ceramics, and textiles in energy development plans.[95,96]

The program also "fully integrated" RE options into Peru's targets for rural electricity services for the first time, introducing a regulated tariff for photovoltaic (PV) systems, and ensuring that solar energy customers could take advantage of existing electricity subsidies.[97] Between 2006 and 2013, it leveraged US $129.55 million to help finance 105,045 new electricity connections with electricity distribution companies. These connections include 7,100 households, representing 31,540 people, receiving energy from solar home systems.[98,99] These PV systems will reduce approximately 5,626 tons of CO_2 over the course of their lifetimes.[100]

The program drew on lessons from other countries' approaches to rural electrification, establishing detailed estimates of projects' financial viability and potential benefits, along with a simple and transparent methodology for selecting potential projects.[101] Based on the success of the program, the Government of Peru is currently implementing a second phase of the project, applying US $82.7 million of funding towards RE projects, including 19 grid extensions and 29 solar photovoltaic projects,[102] to provide electricity services to an additional 42,500 households, small enterprises, and community facilities.[103]

As it embarks on the second phase of its implementation, continued high-level support from the Peruvian President and Minister, along with coordination between local and regional governments, will remain integral to the program's success.[104] Identifying and implementing national standards for renewable energy technologies in wind, biomass, and geothermal could help replicate the impact of the solar PV system standards that Peru's national standardization body has developed.[105] In rural environments, where finding the costs and capacity to repair and maintain infrastructure is often challenging;[106] guidelines and standards could both help prevent future damage and accelerate the repair of current damage.

* Demographic information from: The World Bank. (2014). Data. Retrieved from: http://data.worldbank.org/indicator/AG.LND.TOTL.K2.

Energy Profile, access to electricity, and energy efficiency information from Sustainable Energy For All (SE4All). (2015). Global Tracking Framework: Progress Towards Sustainable Energy 2015. Retrieved from: http://www.se4all.org/wp-content/uploads/2013/09/

Chapter 5

ANALYZING BILATERAL AND MULTILATERAL ENERGY EFFICIENCY AND RENEWABLE ENERGY ACTIVITIES IN DEVELOPING COUNTRIES

An examination of bilateral support provided by six countries and the European Commission found that 254 projects targeting renewable energy and energy efficient projects were implemented between 2005 and 2012. Forty-two of these projects included information that made it possible to calculate their greenhouse gas emissions impact. This report estimates that these 42 projects will save a total of 11.4 TWh and reduce CO_2 emissions by 6 $MtCO_2$ annually in 2020. Given that these 42 projects represent less than one percent of financial assistance to all projects that happened during 2004 – 2014, the total impact of bilateral support for renewable energy and energy efficiency projects could be 1.7 $GtCO_2$/year.

5.1 OBJECTIVES

There has been substantial growth in the amount of investment from both developed and developing countries as well as multilateral funds and initiatives. Whether these investments are leading to measurable reductions in GHG emissions, however, is a question that has yet to be answered. Developed countries mobilized approximately US $62 billion of public and private climate finance in 2014.[107] This figure represents an increase from US $52 billion mobilized in 2013 and the average of US $57 billion funded over the last two years. In developing countries alone, RE investment increased 36 percent from 2013 to US $131.3 billion, coming close to the total for developed countries, which was US $138.9 billion in 2014.[108] Global investment in EE efforts cannot be feasibly quantified on a global scale.

Global organizations, funds and initiatives are also contributing towards renewable energy and energy efficiency efforts in developing countries. Beyond developed countries' contribution, an estimation of RE investment in developing countries by global organizations, projects and transactions reached US $131 billion in 2014, according to Bloomberg New Energy Finance.[109] Public funds encompass bilateral finance contributions, such as Official Development Assistance (ODA); multilateral climate finance, through major multilateral development banks like the World Bank; and other initiatives. Research based on Creditor Reporting System (CRS) data from the Organization for Economic Cooperation and Development (OECD) reveals that the bilateral financial assistance on energy projects from six partner countries and the European Commission over the period of 2005 to 2012 sums up to 24 billion, which is more than one-third of global climate finance generated in 2014. While the international community has more than a decade of experience aiding developing country efforts to address climate change, an understanding of the overall impact of these efforts on GHG emissions is missing. Are bilateral, multilateral and partner initiatives leading to measurable reductions in GHG emissions?

This section considers three overarching questions: 1) how are RE and EE supporters, including partner countries, organizations, development banks and funds, implementing RE and EE projects through bilateral and multilateral activities in developing countries; 2) what is the GHG mitigation impact of these efforts; and 3) how is this mitigation impact measured.

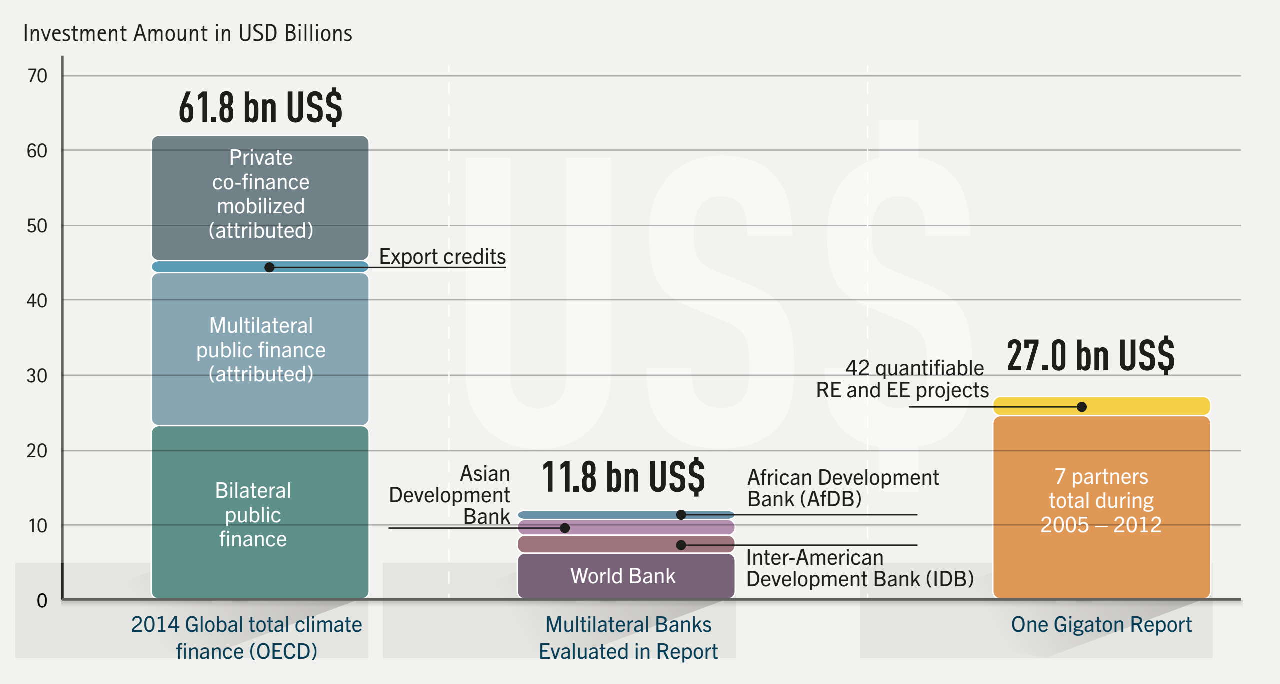
To answer these questions, the report evaluates the impact of bilateral and multilateral support to RE and EE projects in developing countries from 2005 – 2012. Development support from six partner countries and the European Commission, nine development banks and seven model initiatives are considered. Two approaches were used to collect data for evaluating the impact of these support initiatives:

1. Top-down research on individual supporters' self-assessments (e.g. annual reports) of the aggregated GHG emissions mitigation impact through bilateral assistance on RE and EE projects;
2. Bottom-up research on detailed project level evaluations from various project documentations (including pre-activity and post-activity evaluations).

Neither approach aimed to be comprehensive. Instead, these methods can help map the landscape and quantify the impact of bilateral and multilateral support for climate change mitigation through RE and EE projects in the developing world.

The analysis provided in this section is a first step to understanding how bilateral, multilateral, and partner initiatives evaluate climate mitigation impact. This research found a general lack of transparency and impact assessment detail in the survey of bilateral and multilateral support from a top-down perspective (see Chapter 6 for further discussion of Assumptions and Uncertainties). Annual bilateral agency reports tend to reflect big-picture outcomes and provide specific numbers for financial investments, but rarely include emissions impact information. Applying a bottom-up, project-by-project approach yielded more detailed information to assess climate mitigation. Although more time-intensive and subject to variations in reporting methods, the bottom-up approach provided adequate information to estimate GHG mitigation for 42 RE and EE projects in 40 developing countries. These projects' mitigation impact illustrates RE and EE efforts' contributions in developing countries to bridging the 2020 emissions gap.

Figure 9: **The amount of public and private assistance to developing countries over the last two years (2013 – 2014) has increased, and currently averages around US $57 billion per year (Source: OECD, 2015).**



BOTTOM-UP DATA COLLECTION CRITERIA

To address the methodological challenges explained in Chapter 3, bottom-up data collected at the project level was confined by the following criteria. These boundaries allowed for quantification of each project's mitigation impact and identification of reporting overlaps to the extent possible (see ➔ Chapter 6 for discussion of Assumptions and Uncertainties):

SCOPE OF DATA

- Project geographic locations (the report only evaluates projects in developing countries, and did not include developed countries in our analysis);
- Implementing agencies (the report limits the scope of its analysis to representative implementing agencies within each type of partner group);
- Project timeframe and status (the analysis considers projects within the historical timeframe of 2005-2012, and determines the projected impact of annual emissions in 2020);
- Project objectives and technologies deployed (the analysis excluded RE projects that do not result in a measurable reduction in GHG emissions; for example, those that relate solely to energy access or did not include an RE or EE component);
- Indicators used to measure project impact (the analysis excluded projects without any quantifiable mitigation information); and
- Reporting and verification mechanisms (the analysis noted whether a project specified reporting and verification mechanisms or methodologies that could then be cross-checked or verified).

TYPES OF QUANTITATIVE DATA

- Direct data on realized or projected GHG emissions mitigation, reported by implementing agencies or supporters; and
- Lower tiers of data, such as the power generation capacity of RE facilities, and annual megawatt-hours generated from renewable sources (these data sources were used to calculate GHG mitigation impact when direct mitigation data was not available).

5.2 SELECTED BILATERAL ACTIVITIES

Germany, United Kingdom, Denmark, France, Japan, Norway and the European Commission were selected as illustrative bilateral supporters for RE and EE project support in developing countries. These seven bilateral supporters supported a total of 5,723 energy projects in developing countries during the period of 2005 to 2012.[110] An estimated 3,686 of the 5,723 energy projects were supported through bilateral assistance, based on data from OECD CRS.[111]

In total, 254 RE and EE projects out of 523 bilateral energy projects were analyzed. These 254 initiatives span 80 developing countries and regions[112] and exclude large hydropower projects with a capacity greater than 50 MW, to align with the selection criteria employed by REN21's Renewables 2015 Global Status Report.

5.2.1 REPORTING STRUCTURES

As Table 1 suggests, the number of bilateral RE and EE projects identified for GHG emissions mitigation quantification varies significantly across the six countries and the European Commission that the report considered. The lack of project details and quantifiable information is the primary reason for the variation in impact assessment between bilateral partners. Over half of the 42 quantifiable RE and EE projects are supported by Japan and France, indicating that these two countries are leaders in measuring and reporting project details. Table 2 presents a summary of the seven partners' data availability on RE and EE projects.

All of the six countries and the European Commission provide information on RE and EE projects through searchable online portals. Japan, France and the United Kingdom also provide detailed project reports that consistently include information such as mitigation targets, megawatt-hours generated by RE projects, or energy savings achieved by EE projects.

With the largest number of quantifiable projects, Japan provided comprehensive information throughout the lifecycle of RE and EE projects. For example, JICA provides four types of documents, in addition to a searchable portal,[113] to track projects supported by Japanese ODA loans at each stage of their development. These documents include: 1) pre-activity evaluations for all ODA loan projects,[114] released immediately after the conclusion of loan agreements; 2) mid-term reviews[115] undertaken five years after the conclusion of agreements, to verify whether project plans are maintaining their relevancy; 3) post-activity evaluation[116] reports, issued

Table 1: **The contributions and projects from the seven partners**

Partner Country/ Region	# Bilateral and Multilateral Energy Projects from 2005-2012 a	# Bilateral energy projects from 2005-2012 b	Assistance on Bilateral Energy Projects from 2005-2012 (US $ Millions) b	# Bilateral energy projects identified in the bottom-up approach c	# Bilateral RE and EE Projects Identified in the Bottom-up Research c	# Bilateral RE and EE Projects Identified for GHG Emissions Mitigation Quantification c
Germany	1,493	1434	7,951	133	34	3
Japan	2,111	1377	7,833	124	46	14
UK	396	151	620	15	19	4
EC	318	158	4,700	32	20	4
Norway	1,066	339	814	97	81	1
France	239	133	2,170	84	29	11
Denmark	100	94	344	38	25	5
Sum	**5,723**	**3686**	**24,432**	**523**	**254**	**42**

a. Open Data for International Development. Retrieved from: http://aiddata.org/.
b. OECD Creditor Reporting System (CRS). Retrieved from: https://stats.oecd.org/Index.aspx?DataSetCode=CRS1
c. Desk research from public information, i.e. websites and reports of major bilateral assistance agencies

Table 2: **Publicly available information on RE and EE projects**

Partner Country/ Region	Major Agencies Coordinating Bilateral Support	Online Searchable Portal for RE and EE Projects	Detailed Project Documentation
Germany	International Climate Initiative (IKI)	Yes	Yes, but level of specificity varies widely
Japan	Japan International Cooperation Agency (JICA)	Yes	Yes
UK	Department of International Development (DFID)	Yes	Yes
EC	European Commission		No
Norway	The Ministry of Foreign Affairs (MFA)	Yes	No
France	French Development Agency (AFD)	Yes	Yes, but level of specificity varies
Denmark	DANIDA	Yes	No

two years after project completion, to assess the relevance, effectiveness, efficiency, impacts and sustainability of a project; and 4) post-activity monitoring[117] reports, issued seven years after project completion, to determine whether or not the project's impacts will persist. JICA also developed a Climate Finance Impact Tool to measure the mitigation of GHG emissions from Japan's bilateral support, and to explain methodologies used to quantitatively evaluate projects.[118]

France's AFD portal similarly lists the impact of the RE and EE projects the agency supports, often adding data on the social impact of projects (e.g., the number of jobs created) to quantified information about emissions reductions or renewable energy generation or capacity. Data availability and time frame information vary depending on the project, and methodologies used to derive emissions reduction calculations are not publicly available.

The United Kingdom's DFID publishes project reports and measures project impact both quantitatively and qualitatively. Annual reviews include detailed output scoring based on indicators such MW installed or GWh generated per year, as well as lessons learned in incentivizing investment, operational recommendations and suggested steps for roll-out. Among the 19 bilateral RE and EE projects supported by the UK, four projects included quantifiable mitigation information. The relatively low number of quantifiable projects reflects the fact that many of the 19 projects were focused on capacity building and were measured qualitatively. Even for quantitatively measured projects, indicators are not solely geared towards quantifying climate mitigation impact. For example, projects can be measured by the number of local households adopting clean energy products, or the percentage of RE systems installed in local communities, which do not necessarily reflect direct GHG reduction impacts.

The remaining five bilateral supporters either provide reports for only a portion of projects or do not publish any reports at all, making it difficult to measure the program's collective climate impact through bilateral support.

UNITED STATES' SUPPORT OF RE AND EE EFFORTS

The United States is also an active supporter of climate change mitigation and adaptation in developing countries, employing a range of institutions and partnerships to mobilize private finance and aid countries in transitioning to clean energy economies.[119]

The Global Climate Change Initiative is the U.S. commitment to work with global partners to foster low-carbon growth, curb emissions from deforestation and promote sustainable, resilient societies. In 2011 and 2012, the U.S. allocated US $5.5 billion in climate finance, comprised of US $3.1 billion in Congressionally appropriated assistance, US $496 million of export credit, and US $1.8 billion of development finance. The Private Finance Advisory Network (PFAN), which helps promising clean energy entrepreneurs in developing countries, is estimated to reduce more than 2 million tons of carbon pollution per year. The US Environmental Protection Agency has provided technical expertise and capacity-building support through bilateral arrangements, such as the Energy Efficiency Promotion program with China and India.

The Clean Technology Fund (CTF) is one of the main beneficiaries of US support; it received US $714.6 million during fiscal year 2010-2012. In emerging economies, according to 2014 United States Climate Action Report, the CTF catalyzes clean energy investments through renewable energy and energy efficiency projects in the transportation, industrial and agricultural sectors. This year, CTF has approved US $2.3 billion to support 41 projects in 18 countries. The United States Climate Action Report estimates that CTF has leveraged US $18.8 billion in co-financing, including US $5.8 billion from multilateral development banks and US $13 billion from additional sources, which has resulted in 525 million metric tons of CO_2 savings, equal to the emissions reductions of removing 99 million cars from the road each year.

5.2.2 QUANTITATIVE IMPACT

Due to the data challenges described in Chapter 3, only 40 RE and 2 EE projects among the 523 bilateral energy projects reported quantifiable mitigation impacts. Many of the unquantifiable projects have capacity building goals. The Eco-Industrial Parks in Andhra Pradesh project[120] in India, for instance, supported the process of structural change towards improved environmental performance by offering advice to four existing industrial parks. Mitigation impact resulting from such projects is usually evaluated qualitatively and therefore was not included in the quantitative impact of this report.

Data to assess the GHG mitigation impact of 42 bilaterally supported RE and EE projects in 27 developing countries and regions was generally available in two forms. In some cases, partner-supported projects directly reported GHG savings from a particular project (i.e., 16 out of the 42 projects report their mitigation impact in CO_2 emissions avoided). In other cases, emissions reductions were not directly reported but could be estimated using secondary information (i.e., a RE project that would generate 10 MWh of clean electricity generation).

To estimate carbon mitigation potential for projects that only reported installed capacity numbers for RE (e.g, 50 MWh of wind power generation), we estimated carbon savings using country-specific emission factors (to estimate BAU in the absence of the project) and renewable energy generation capacity factors (to estimate emissions offset from a project). Country-specific capacity factors for each RE technology along with country-specific grid electricity emission factors were developed.[121] The CO_2 emissions offset from the RE technology are calculated by taking the MWh saved and multiplying by the country-specific grid emission factors, assuming RE technologies generate 0 emissions and completely offset fossil-fuel generated grid emissions. Annual emissions savings were estimated for the year 2020. Emissions factors were not calculated on a case-by-case level due to the limited data (i.e. detailed energy portfolio of a local area), but these methods are consistent with the UNFCCC's Clean Development Mechanism (CDM) and the GEF methodologies[122] (see Appendix II for additional methodological details, a full list of the 42 projects identified for CO_2 emissions mitigation quantification and comparison with CDM's mitigation estimations on six projects).

This report finds that the 42 projects save a total of 11.4 TWh and reduce CO_2 emissions by 6 $MtCO_2$ annually in 2020. Out of the 10 projects with greatest CO_2 reduction, six are supported by Japan, and five are based on geothermal technology. These projects are not meant to be representative of the total suite of RE and EE projects; rather they are illustrative providing examples of what information is available and what is not.

Table 3: **Scaling up the mitigation impact based on financial assistance and emissions mitigation from the 42 quantifiable RE and EE projects supported by the seven partners and global investment on RE in developing countries from 2004 – 2014, assuming all the projects supported by the $730 billion are in operation in 2020**

Scaling up Mitigation Impact	Assistance (Millions USD)	GHG emissions mitigation impact ($MtCO_2$/year)
Global new investment in renewable power and fuels in developing countries during 2004 – 2014[a]	730,000	**1,713**
Financial assistance on energy projects supported bilaterally by the seven partners during 2005 – 2012	24,432	**57**
42 Quantifiable RE and EE projects supported bilaterally by the seven partners	2,556	**6**

a. Data source: Frankfurt School-UNEP Centre/BNEF. (2015). Global Trends in Energy Investment. Retrieved from: http://fs-unep-centre.org/sites/default/files/attachments/key_findings.pdf. All figures in this report, unless otherwise credited, are based on the output of the Desktop of Bloomberg New Energy Finance – an online portal to the world's most comprehensive database of investors, projects and transactions in clean energy. The Bloomberg New Energy Finance Desktop collates all organizations, projects and investments according to transaction type, sector, geography and timing. It covers many tens of thousands of organizations (including start-ups, corporate entities, venture capital and private equity providers, banks and other investors), projects and transactions.

SCALING UP: WHAT IS THE GLOBAL POTENTIAL?

Given that a sum of US $730 billion was invested in renewable power and fuels in developing countries during 2004 – 2014[123], the 42 projects this report analyzed represent less than one percent of all RE and EE projects implemented during 2004 – 2014. Scaling up the global total mitigation potential of these projects based on the total investment could be 1.7 $GtCO_2$ in the year 2020 (Table 3).

5.3 SELECTED MULTILATERAL ACTIVITIES

5.3.1 DEVELOPMENT BANKS AND FUNDS

Development banks, including the World Bank, African Development Bank, Asian Development Bank, and the Inter-American Development Bank, operate as implementing agencies for RE and EE projects in developing countries. The OECD estimates that multilateral development banks contributed to the substantial increase in the volume of aggregate public and private climate finance from developed countries in 2014.[124] Nonetheless, the level of information provided and consistency with which multilateral development banks and funds have reported results are varied and inconsistent, with wide disparities in how greenhouse gas emission accounting methods are used and applied. There are also large variations in the quality of the underlying data.[125] Nakhooda et al. (2014) in their report, "Climate finance – is it making a difference?" note, "it has not been possible to quantify authoritatively their [funds'] cumulative impacts on mitigation or adaptation, because of the difficulties of comparing reported results across funds."[126]

Despite these methodological and reporting challenges, multilateral climate funds play a valuable matchmaking role, bringing diverse groups of stakeholders and developed and developing countries together to jointly tackle climate change. The collective "ownership," in a sense, of these funds has allowed for greater disclosure and evaluation of multilateral development bank activities and funds. The Global Environment Facility (GEF), for instance, draws upon the capabilities of several international institutions and provides detailed, project-level information regarding the greenhouse gas mitigation

Table 4: **A selection of multilateral development banks and reported greenhouse gas mitigation impact of projects related to climate change and energy.**

Bank Name	Number of member countries	Established Year	Focus	GHG Emissions Mitigation Impact	Mitigation Finance in 2014 (US Millions)	Estimated GHG Emissions Mitigation Impact per year ($MtCO_2$)
Asian Development Bank (ADB)	67 member countries	1966	Economic development in Asia	13.5 $MtCO_2$ from energy projects in 2010 – 2014 period (Project page on ADB's website)	2,137	13.5
African Development Bank (AfDB)	78 member countries	1963	Economic development and social progress of African countries	2011 – 2013 period, AfDB abated 524,000 tons CO_2/yr from energy projects, and plans to abate 2,598,000 tons CO_2/yr from energy projects from 2014 – 2016. (Annual Report 2013)		
World Bank	188 countries - The International Bank for Reconstruction and Development (IBRD);	1944	Reduction of poverty globally	In recent years, World Bank investments have helped to reduce 903 million tons of CO_2 emissions annually through special climate instruments. (World Bank Annual Report 2014)	6,122	903
Inter-American Development Bank (IDB)	48 member countries	1959	Developing finance for Latin America and the Caribbean	IDB's direct investments in renewable energy (hydropower and wind energy) will potentially mitigate close to 10 million tons of CO_2eq per year. (Climate Change at the IDB:Building Resilience and Reducing Emissions)	2,352	10
				Sum	**11,771**	**929**

potential of approved efforts. The GEF also includes a searchable portal to display the co-financing of individual projects.[127] However, the portal's existing information does not allow for disaggregation to avoid double counting between these funds and bilateral efforts.

For example, the Energy Conservation Project in China is listed on the GEF's searchable portal with details on co-financing. Project funding includes a US $22 million GEF grant, US $5 million EC grant, US $65 million IBRD loan, and US $44 million government grant and loan. While the World Bank's project portal also lists this project, details on financials differ slightly. The World Bank's contribution is US $63 million, the EC's grant is listed at US $4.5 million, and public financing is not mentioned. If both the GEF and World Bank measure GHG emissions impact resulting from this project, and report the result through an aggregate number together with other mitigation projects, then double-counting seems to be inevitable.

Tables 4 and 5 provide descriptions of a range of multilateral development banks and investment funds that support RE and EE projects in developing countries. The information from multilateral development banks varies in scope and detail. The World Bank has committed US $5.2 billion to RE and EE projects in developing countries, although its estimates of climate mitigation impact are done prior to project implementation. It is unclear whether a post-proj-

Table 5: **Selection of funds supporting RE and EE projects in developing countries.**

Due to the variable reporting time frames funds use to evaluate GHG mitigation impact, an aggregate sum of annual emission savings is not calculated. This analysis did not aggregate the estimated greenhouse gas mitigation impact of fund investments for several reasons. Many of the funds contribute directly to projects implemented by multilateral development banks. ADB, for instance, points to the fact that the CIF contributes US $1,683 million and the GEF US $124 million to their programs and projects.[132] Additionally, information regarding a project's implementation status, co-financing from other partners, and assumptions undertaken when determining mitigation reductions are often unavailable. These information gaps make it difficult to identify and separate potential overlaps and attribute a project's impacts to an individual entity. Chapter 6: Assumptions and uncertainties discuss these issues in more detail. Despite these challenges, Tables 4 and 5 clearly demonstrate development banks and funds' commitments to present information on their RE and EE investments, although the level of specificity varies.

Fund Name	Contributors	Fund Size (Most Recent Public Data)	Multilateral or Bilateral	Established Year	Operating Locations	Quantified GHG Emissions Mitigation Impact	Estimated GHG Emissions Mitigation Impact Per Year ($MtCO_2e$) a
Global Environment Facility (GEF)	39 contributor countries	US $12.5 billion in grants and US $58 billion leveraged in co-financing	Multilateral	1991	Over 100 developing countries	Based on available data on approved projects, the total expected from climate change mitigation focal area projects is 10.8 billion tons, including 2.6 billion tons of CO_2 equivalent emissions in direct emissions reduction, and 8.2 billion tons in indirect reduction. (Fifth Overall Performance Study of the GEF: Final Report)	130[a]
Climate Investment Funds (CIF) – Scaling Up Renewable Energy in Low Income Countries Program (SREP)	14 contributor countries have pledged a total of $8.1 billion to the CIF	US $796 million (a funding window of the $8.1 billion CIF)	Multilateral	2009	27 countries and regions	Projects with direct co-benefits of reducing GHG emissions: 58,366,565 ton CO_2eq over project lifetime (2014 SREP Results Report)	2.9[a]
Climate Investment Funds (CIF) – Climate Technology Funds (CTF)	14 contributor countries have pledged a total of $8.1 billion to the CIF	US $5.5 billion	Multilateral	2008	16 countries and regions	The annual target of total GHG emissions mitigation as of December 31, 2014 is 47 million tCO_2e, with average cost effectiveness at $4.08/$tCO_2e$. (CTF Semi-Annual Operational Report)	47
UK's International Climate Fund (ICF)	United Kingdom	£3.87 billion	Bilateral	2011		UK's Green Investment Bank(GIB) was identified as a delivery option for ICF. The GIB's total capital commitments of £635.4m in its first year of operation was associated with transactions that are expected to reduce emissions by 43 megatons of CO_2e over the project lifetimes. (Delivery options for the	2.15[a]
Norfund	Norway	US $ 1.6 billion	Bilateral	1997	Southern and Eastern Africa, South-East Asia and Central America	In 2013, the total GHG emissions mitigation resulting from renewable energy is 1,141,654 tCO_2. (Evaluation of the Norwegian Investment Fund for Developing Countries (Norfund))	1.1 (CO_2, not included in the aggregate number) [a]
Global Energy Efficiency and Renewable Energy Fund (GEEREF)	3 contributing countries (European Union, Germany and Norway) and private sector investors	220 million	Multilateral	2006	7 countries and regions	GEEREG is a fund-of-funds. No direct information on GHG mitigation impact is available.	NA
Germany's International Climate Initiative (IKI)	Germany	1.45 billion	Bilateral	2008	About 80 countries	Unclear	NA

ect process is also conducted to validate these estimates.[128] The Inter-American Development Bank (IDB) makes direct investments in renewable energy (hydropower and wind) and states that such investments have the potential to mitigate close to 10 million tons of CO_2 per year.[129] In total, the estimated annual GHG emissions mitigation impact from the four development banks gets close to 1 Gt of CO_2.

Investment funds such as the Climate Investment Funds (CIF), Global Energy Efficiency and Renewable Energy Fund (GEEREF), and the United Kingdom's International Climate Fund (ICF) generally provide more information regarding the estimated mitigation impact of its projects than the multilateral development banks. The Climate Technology Fund (CTF), for example, estimates its annual GHG mitigation impact at 47 million tons of CO_2e, at the end of 2014.[130] In its semi-annual report, the CTF also includes an estimate of its program's "average cost effectiveness" at US $4.08 tons/$CO_2e$.[131]

5.3.2 MULTI-STAKEHOLDER PARTNERSHIPS

Several initiatives representing multi-stakeholder partnerships, with both public and private actors, are extending beyond financial support and playing a more active role in partnering with developing countries to innovate and influence policy. The following section features some examples of initiatives that have been operating in developing countries as models for demonstrable mitigation impact.

RENEWABLE ENERGY AND ENERGY EFFICIENCY PARTNERSHIP (REEEP)

REEEP INVESTING IN CLEAN ENERGY MARKETS

www.reeep.org

At the 2002 World Summit on Sustainable Development in Johannesburg, participating countries launched some 220 'Type II Partnerships'[133] to tackle a range of sustainable development challenges. Over 10 years later, REEEP has had an impact on clean energy markets and carbon emissions around the world by working in close collaboration with a range of public and private sector partners, and often behind the scenes at the early stages of policy development.

REEEP's most significant impacts on global greenhouse gas emissions resulted from early-stage interventions in the policy-making processes of rapidly growing economies such as China, Mexico and Brazil. While it is exceedingly difficult to accurately measure the impacts of national and regional policy changes over their lifetimes, REEEP and external evaluators estimate that, through consequent implementation of REEEP interventions, more than 13 billion tons of CO_2 may have been avoided between 2005 and 2012. Between 2013 and 2020, this number is expected to have grown to over 26 billion, with another 11 billion tons avoided beyond 2021. In total, mitigation impact is nearly 52 billion tons of actual and projected CO_2 avoided (see also endnote on methodology[134]). The numbers presented here as sume full implementation of each of those policies and, as such, illustrate the tremendous mitigation potential of consistent, well-implemented political action.

Time Frame	CO_2 emissions avoided [in tons][135]
2005 – 2012	13,512,487,545
2013 – 2020	26,356,406,191
2021 and Beyond[136]	11,976,265,119
Total	**51,845,157,855**[137]

In China, for example, REEEP was able to play a role in shaping Chinese policymaking on clean energy issues, in large part due to a close relationship with the Chinese Renewable Energy Industry Association (CREIA). In the Changjiang River Basin, findings from a REEEP-led study on clean energy in buildings will be included in the 13th Five-year Plan. Another REEEP initiative with the Centre for Renewable Energy Development resulted in the publication of a Renewables-driven roadmap for energy generation in China, expected by independent assessors to reduce 725 million tons of CO_2 per year over 20 years.

RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY (REN21)

REN21 Renewable Energy Policy Network for the 21st Century

www.ren21.net

REN21 is the global renewable energy policy multi-stakeholder network that connects a wide range of key actors. REN21's goal is to facilitate knowledge exchange, policy development and joint action towards a rapid global transition to renewable energy. REN21 brings together governments, nongovernmental organisations, research and academic institutions, international organisations and industry to learn from one another and build on successes that advance renewable energy. To assist policy decision making, REN21 provides high quality information, catalyzes discussion and debate and supports the development of thematic networks.

ENERGISING DEVELOPMENT (ENDEV)

energising development

www.endev.info

Created in 2005, EnDev is an international partnership for energy access, financed by six donor countries: the Netherlands, Germany, Norway, Australia, United Kingdom and Switzerland. It is currently implemented in 24 countries in Africa, Asia and Latin America, with a focus on least developed countries.

EnDev promotes sustainable access to modern energy services that meet the needs of the poor: energy that is long-lasting and affordable, while at the same time fulfilling certain minimum quality criteria. A number of different technologies is used, depending on the context of each individual project. The most widely promoted technologies are improved cookstoves for cooking and small-scale solar technologies for lighting and electricity.

EnDev has a thorough monitoring system that provides donors, partners and management with verified data and reliable assessments. Outcome figures (e.g., stove sales or number of grid connections) are collected every six months. The monitoring system is conservative: different discounts are applied because (1) not all of EnDev's work is sustainable; (2) not all access is additional (some would have happened anyway without EnDev); and (3) free riders take advantage of the system and are difficult to take into account. The monitoring system also records information on duplicate donor funding to adjust outcomes accordingly.

By end of 2014, EnDev had facilitated sustainable access for more than 13.9 million people, more than 30,000 small and medium enterprises and more than 16,000 social infrastructure institutions. In 2014 emission reductions were 1.1 million tons per year. Since its beginning, EnDev has contributed to avoided emissions of 5.8 million tons of CO_2, although this figure is a conservative estimate based on the deductions described above.

LESSONS LEARNED

In many cases households do not have a single cooking or lighting solution, but instead use a combination of fuels and technologies for different tasks. A household may, for example, use a gas-fired stove for coffee preparation in the morning, the improved cookstove for the main meal and the traditional cookstove for larger family gatherings. The modern solutions do thus not fully replace the traditional solutions, but may rather add to a range of solutions. This makes conservative monitoring all the more important in order not to over-estimate climate mitigation impact.

It is often difficult for an energy access programme such as EnDev to reliably determine all parameters required for avoided emission calculation. Some values must be approximated (e.g., fraction of non-renewable biomass for a specific region) because a detailed study is beyond the scope of EnDev. There are also climate-related benefits of energy access (e.g., awareness building) that are challenging to reliably quantify.

CLIMATE TECHNOLOGY CENTRE AND NETWORK (CTCN)

CTCN

ctc-n.org

The CTCN provides technical assistance in response to developing country requests submitted via their nationally-selected focal points called National Designated Entities (NDEs). Upon receipt of such requests, the CTC quickly mobilizes its global network of climate technology experts to design and deliver a customized solution tailored to local needs.

CLIMATE AND CLEAN AIR COALITION (CCAC)

www.ccacoalition.org

Established in 2012, the Climate and Clean Air Coalition (CCAC) is a voluntary partnership uniting governments, intergovernmental and nongovernmental organizations, representatives of civil society and the private sector committed to improving air quality and slowing the rate of near-term warming in the next few decades by taking concrete and substantial action to reduce short-lived climate pollutants (SLCPs), primarily methane, black carbon, and some hydrofluorocarbons (HFCs). Complementary to mitigating CO_2 emissions, fast action to reduce short-lived climate pollutants has the potential to slow expected warming by 2050 as much as 0.5 Celsius degrees, significantly contributing to the goal of limiting warming to less than two degrees C.

Reducing SLCPs can also advance priorities that are complementary with the 1 Gigaton Coalition's work, such as building country capacity and enhancing energy efficiency. A prime example of this alignment is the SNAP Initiative, which supports eight countries to develop a national strategy for SLCPs to identify and implement the most cost-effective pathways to large-scale implementation of SLCP measures. This initiative has resulted in a number of countries, including Mexico, Cote d'Ivoire and Chile, submitting INDCs that integrate SLCP mitigation.

UNITED FOR EFFICIENCY (U4E)

united4efficiency.org

The UNEP-GEF United for Efficiency (U4E) supports developing countries and emerging economies to leapfrog their markets to energy-efficient lighting, appliances and equipment, with the overall objective to reduce global electricity consumption and mitigate climate change. High impact appliances and equipment such as lighting, residential refrigerators, air conditioners, electric motors and distribution transformers will account for close to 60 percent of global electricity consumption by 2030. The rapid deployment of high-energy efficient products is a crucial piece of the pathway to keep global climate change under 2 degrees Celsius. A global transition to energy efficient lighting, appliances and equipment will save more than 2,500 TWh of electricity use each year reducing CO_2 emissions by 1.25 billion tons per annum in 2030. Further, these consumers will save 350 billion US$ per year in reduced electricity bills.

U4E builds upon and includes the en.lighten initiative, which is expanding its scope to include LEDs and street lighting. Founding partners to U4E include the United Nations Development Programme (UNDP), the International Copper Association (ICA), the environmental and energy efficiency NGO CLASP, and the Natural Resources Defense Council (NRDC). Similar to en.lighten, U4E also partners with private sector manufacturers, including ABB, Electrolux, Arçelik, BSH Hausgeräte GmbH, MABE, and Whirlpool Corporation.

EN.LIGHTEN INITIATIVE

www.enlighten-initiative.org

The en.lighten initiative is a public-private partnership between the United Nations Environment Programme (UNEP) and companies OSRAM and Philips Lighting, with support from the Global Environment Facility (GEF). The initiative's main aim is to support countries in their transition to energy efficient lighting options. en.lighten has taken a regional approach to standards implementation. Through this method, countries are able to share the costs for innovation and testing centers, as well as recycling and waste schemes to manage disposal of the new products (e.g. lights containing mercury). To date, the en.lighten initiative accounts for 66 partner countries with a number of ongoing regional and national activities and projects. Over the next two years, the en.lighten initiative – as the lighting chapter of United for Efficiency – will focus its support for countries to leapfrog to LED lighting and assisting countries and cities to implement efficient street lighting policies and programs.

COVENANT OF MAYORS (COM)

www.covenantofmayors.eu

Created as part of the European Union Climate and Energy package, the Covenant of Mayors (CoM) is a coalition of local and regional authorities that voluntarily commit to reduce GHG emissions by 20 percent or more by 2020. CoM Membership is growing steadily, from 241 in 2008 to 6,610 as of October 2015, representing 34 percent of Europe's population. To increase the participation of large cities and implement all planned sustainable energy actions, the CoM has been extended to align with the EU's 2030 climate and energy package, which includes a 40 percent reduction target for greenhouse gas emissions.

Members of the Covenant commit to submit a sustainable energy action plan and a baseline emissions inventory that identifies the sectors included in the reduction target, with a focus on energy efficiency and local renewable energy sources. To date, signatories submitting monitoring data demonstrate a 23 percent reduction in greenhouse gas emissions. Per capita emissions have been lowered from 5.4 ton CO_2e per capita in the reference emissions inventory to 4.1 ton CO_2e per capita in 2015. These results demonstrate positive trends toward achieving a goal of 3.9 ton CO_2e per capita by 2020.

SUSTAINABLE ENERGY FOR ALL (SE4ALL)

www.se4all.org

UN Secretary-General Ban Ki-moon launched the Sustainable Energy for All (SE4All) initiative in September 2011 to catalyze an equitable and sustainable transformation in the world's energy systems. SE4All's three objectives are: to ensure universal access to modern energy services; double the global rate of improvement in energy efficiency; and double the share of renewable energy in the global energy mix by 2030. By bringing together the global convening power of the United Nations and the World Bank, SE4All has the ability to leverage large-scale investments and mobilize bold commitments[139].

THE INTERNATIONAL RENEWABLE ENERGY AGENCY (IRENA)

www.irena.org

The International Renewable Energy Agency (IRENA) is an intergovernmental organization that supports its 143 Members and 30 States in Accession,[138] in their transition to a sustainable energy future. The Agency has developed a number of activities that support member countries to analyze, monitor, advise and access information on policies, technologies, resources and financial options to reduce greenhouse gas emissions through the deployment of renewable energy. These activities include, inter alia:

- IRENA's renewable energy roadmap (REmap 2030) to assess the deployment options for renewable energy technologies up to 2030, and the associated mitigation potential.
- IRENA's advice on designing and implementing policy frameworks to support renewable energy deployment and maximize environmental and socioeconomic benefits.
- IRENA's support for off-grid renewable energy system deployment focusing on policies, technology design and capacity building.
- IRENA's renewable readiness assessments (RRAs) that help countries to assess local conditions for renewable energy deployment and identify priority actions to unleash renewable energy potentials.

IRENA is the facilitator of the IRENA/Abu Dhabi Fund for Development (ADFD) project facility, which supports renewable energy projects in developing countries. To date, ADFD has funded 11 projects. For each project, IRENA requires project developers to provide the potential broader development impacts including environmental benefits. A preliminary assessment suggests total avoided emissions of 0.1 $MtCO_2$ emissions per year.

Chapter 6

ASSUMPTIONS AND UNCERTAINTIES

Determining individual actors' contributions to overall climate mitigation goals is complicated by a host of uncertainties. Many factors contribute to mitigation reductions, but these components may be financed by different actors and are inherently difficult to quantify. Different institutions use varying methodologies, which make it difficult to compare and aggregate impacts. Additional calculations were necessary in many cases to determine the mitigation impact of specific bilateral projects. These uncertainties should be taken into account when considering the mitigation estimates produced in this report.

Attributing the contribution of individual actors to global climate mitigation is challenging. Many factors lead to a measurable expression of mitigation reductions, which are often expressed in tons of carbon. A particular technology's success, including for capacity building efforts, as well as various institutional, financing, and technological support can all contribute to mitigation, but these measures are often financed by separate partners. It is difficult to attribute emission reductions to specific actors in a particular developing country, as many projects may contribute to the same cause.

There is no common methodology to resolve these disputes regarding attribution or to link GHG mitigation contribution to any one particular actor. Even when a unified methodology exists at the project level, the assumptions vary significantly depending on the project. Institutions have each applied different methodologies to evaluate their climate mitigation impact, which leads to incomparable metrics and an unclear picture of overall impact.

Nine International Financial Institutions have formed an IFI Working Group, and are working on the harmonization of project-level GHG accounting.[140] This IFI Working Group has stated that "they will work together to agree as far as possible on a common estimate of the GHG emissions"[141]. The IFI Working Group identified energy and transport as priority sectors for developing project-level methodology and is currently developing joint guidance notes (RE and EE projects) which will reduce the variance in GHG reporting while providing flexibility related to data quality.[142]

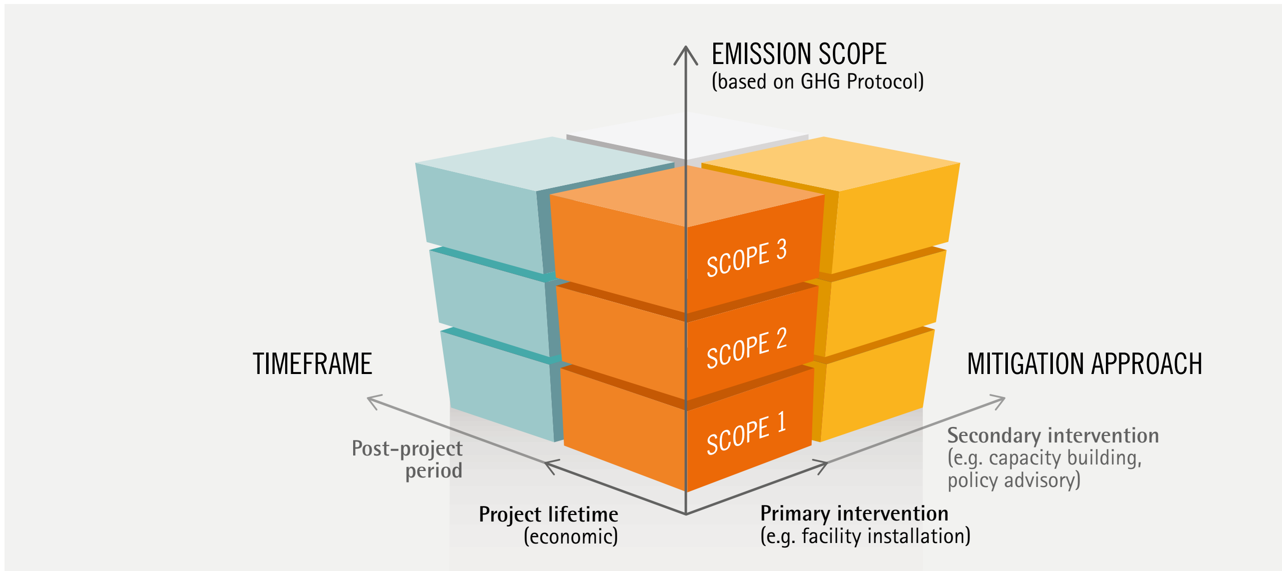
6.1 SPECIFIC REPORTING CHALLENGES

Development finance institutions provide examples demonstrating differences in accounting and reporting. Figure 10 illustrates a classification of GHG mitigation accounting concepts and boundaries, based partly on guidelines prepared for the GEF evaluation office.[143] Climate mitigation projects can be implemented on different geographic scales, domains, and time horizons, and thus deliver mitigation impacts in different ways. Differences in accounting can occur in these three dimensions: emission accounting scope, project intervention types, and mitigation accounting timeframe.[144] The attribution of mitigation impacts for co-financed projects is also challenging to disentangle.

6.1.1 ACCOUNTING SCOPE

Most institutions require accounting of emissions that encompass Scope 1 emissions, those generated directly by a project's activities, and Scope 2 emissions, emissions from purchased electricity, heat or steam. AFD, however, requires all projects to report Scope 3, or other "indirect" emissions, that are not included in Scopes 1 and 2.[145]

Figure 10: **GHG mitigation accounting concepts and boundaries. Source: authors, partly based on (Wörlen, 2012)[146]**



6.1.2 MITIGATION APPROACH

Estimating emissions reductions from secondary intervention projects[147] (e.g. capacity building, institution building or policy advisory) relies heavily on assumptions and expert judgment. The level of uncertainty and accuracy in indirect intervention projects differs from direct emissions reductions; as a result, it is not considered appropriate to aggregate the two different types of reductions.[148] Some examples presented in the methodology document of German bilateral aid agency GIZ, however, indicates that the agency aggregates the emissions reductions from both direct and indirect intervention projects.[149]

In some cases, the data provided requires additional calculations to estimate emission reductions. Simple country-specific emission factors to link energy as well as activity and intensity data (if needed) to GHG emissions on a sectoral basis were developed for this purpose. Using such a standardized approach ensures consistency that is also compatible with country analysis. It further develops a range reflecting the different methodologies that can be used to estimate the GHG effect and highlighting the uncertainty in this analysis.

6.1.3 ACCOUNTING TIMEFRAME

Development finance institutions use different reporting timeframes, which is a chief reason this report does not aggregate estimated GHG savings from the banks and funds it considers. Some institutions, such as AFD, use accounting periods similar or equivalent to the technical lifetime of the projects. On the other hand, GIZ uses a 10-year period for most projects, with the exception of energy efficiency measures, which are assessed over a 20-year period.

Unlike other finance institutions, GEF's evaluation methodology considers emission reductions that occur after the project period or lifetime. For example, some mitigation projects may incorporate finance mechanisms that will continue supporting direct investments in the project, after its implementation period, and may lead to additional emission reductions. Partial credit guarantee facilities, risk mitigation facilities and revolving funds are examples of these types of financial mechanism. The additional emission reductions that result from these mechanisms are referred to as "direct post-project reductions" under GEF methodology.[150]

6.1.4 ATTRIBUTION OF MITIGATION IMPACTS IN CASE OF CO-FINANCING

Most development assistance projects are financed by more than one source. When these projects are evaluated, project impacts may need to be attributed to various actors that financed the project, in order to avoid double counting when participating institutions aggregate emission reductions over a larger portfolio or a number of donors.[151]

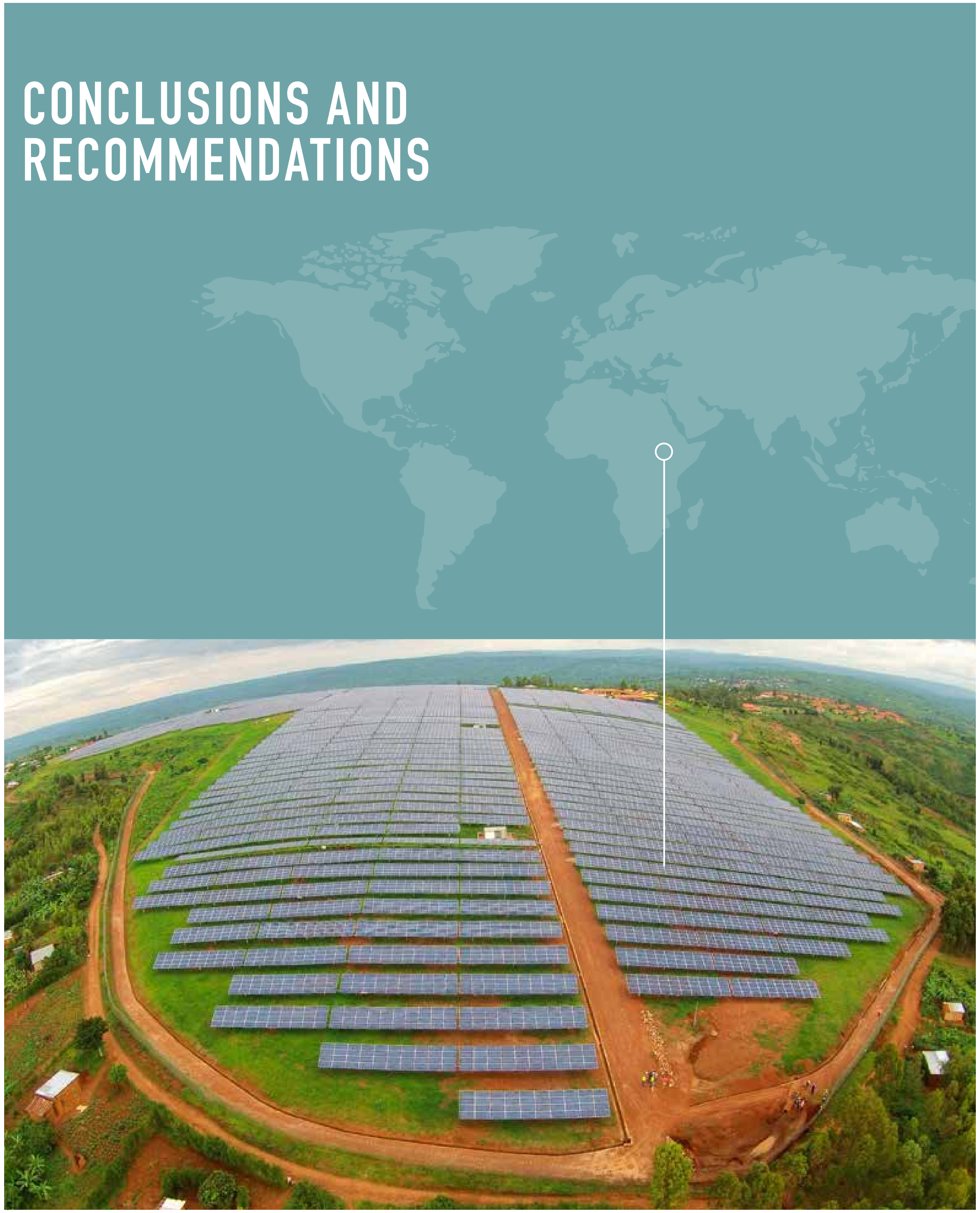
Most development finance institutions have not prepared guidelines to account for co-financing.[152] For example, AFD counts project mitigation impacts without pro-rating to the amount of funding AFD commits, because it aims to understand not just the emissions attributable to AFD's financing activity but the total emissions impact of a project.[153] Some multilateral development banks, such as the International Finance Corporation (IFC) and the European Investment Bank (EIB), have recently set guidelines for accounting emission reduction credits or emission reduction impacts that pro-rate emissions reductions to the amount of financing contributed.[154]

Table 6: **Overview of GHG mitigation accounting methods developed by bilateral aid agencies and multilateral development institutions.**

Institution		JICA (2011)	"International Financial Institutions" (International Financial Institutions, 2012)				GEF approach-based		
			AFD (2011)	IFC (2011a, 2011b)	EIB (2014)	EBRD (2010)	GEF (2015)	GIZ (GTZ, 2008)	CTF (CIF, 2009)
Emission accounting Scope	1	Y	Y				Y		
	2	Y	Y				Y		
	3	N	Y	Optional	Optional	N	N		
Project intervention types	Primary	Y	Y				Y		
	Secondary	N	N				Y	N	N
Mitigation accounting timeframe	Mitigation accounting period (years)	N.D.	Dams: 50 Transport infra-structure: 30 Others: 20	Limited to financing term (10 years for equity and other products with indefinite timelines)	N.D.	N.D.	Investment lifetime (sector and technology specific, no more than 20 years after the projects ended)	EE: 20 Others: 10	Investment lifetime (for RE, 10 for off-grid PV and bagasse 10, and 20 for others)
	Post-project life reduction	N	N				Y	Y	N
Attribution of mitigation impact for co-financed projects		N.D.	N.D.	N	Pro rata to the amount of finan-cing	N.D.	N.D.		N

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS



This inaugural 1 Gigaton Coalition report contributes to our understanding of how renewable energy (RE) and energy efficiency (EE) actions in developing countries are helping to reduce greenhouse gas emissions. Such efforts to adopt low-carbon and renewable energy pathways are critical to narrowing the global 2020 emissions gap.

RE and EE activities in developing countries are conducted in partnership with a host of bilateral, multilateral, and cooperative initiatives. This report has surveyed a range of these activities to build a foundation to understand what information is available to assess the projects' individual and collective contributions to global climate mitigation.

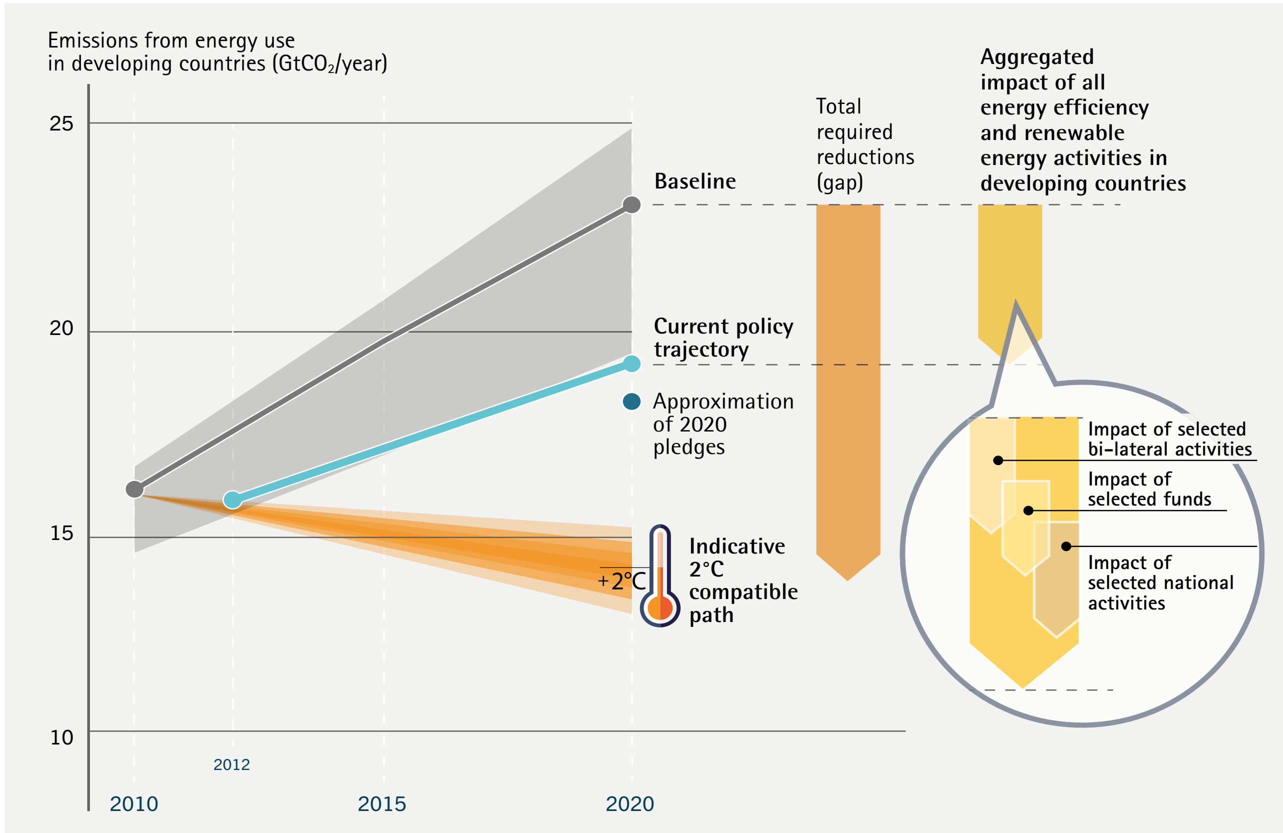
ENERGY EFFICIENCY AND RENEWABLE ENERGY PROJECTS IN DEVELOPING COUNTRIES SUBSTANTIALLY REDUCE GREENHOUSE GAS EMISSIONS

A rough top-down scenario comparison reveals that the current level of EE and RE activities in developing countries implemented by national governments and the business sector with international support will lower CO_2 emissions from energy use on the order of 4 Gt CO_2, compared to business as usual scenarios.

Various activities contribute to these reductions. The selection of initiatives in this report is neither comprehensive nor additive (i.e., meaning they almost certainly overlap, and it is not feasible to disentangle exactly how) but provides an overview of the impact of different RE and EE activities in developing countries (Figure 11).

- A bottom-up assessment of 42 bilaterally-supported RE and EE projects with US $2.6 billion of financial assistance calculated a 6 $MtCO_2e$ savings in 2020. This estimate represents a fraction of the total number of RE and EE efforts in developing countries. Considering all projects that are bilaterally supported with at least US $24 billion, the total impact could be 58 $MtCO_2$ in 2020. Given that a sum of US $730 billion was invested in renewable power and fuels in developing countries during 2004 – 2014[155], the 42 projects represent less than one percept of financial support for these projects, and the total impact could be in the order of 1.7 $GtCO_2$/year.
- Four multilateral development banks report that their RE and EE activities could add up to 1 Gt of CO_2 per year, but a reliable aggregation is not possible at this moment.
- National governments implement policies and activities for EE and RE. These have not been separately quantified, and could make a substantial contribution to the overall impacts.
- The aggregate emissions reductions of EE and RE activities in developing countries substantially reduce the 2020 greenhouse gas emissions gap. The gap between the no-policy baseline and what is compatible with 2°C for energy use in developing countries is roughly 9 $GtCO_2$[156] (Figure 3). The gap between the current policy trajectory, however, and what is needed to limit global temperature rise to 2°C is still large (approximately 5 $GtCO_2$ for energy use in developing countries, Figure 3). The full realization of developing countries' 2020 pledges would lower the projected

Figure 11: **CO_2 emissions from energy use in developing countries, under different scenarios.**



emissions in 2020 by roughly 1 $GtCO_2$, compared to the current policy trajectory. EE and RE actions help developing countries to implement their 2020 pledges, and these efforts could even enable the countries to achieve emissions reductions beyond their current pledges and further narrow the emissions gap.

INFORMATION ON ACHIEVED EFFECTS REMAINS SCARCE AND INCONSISTENT

A lack of complete and consistent information on achieved mitigation reductions makes it difficult to assess EE and RE projects' individual and aggregate impacts. Bilateral aid agencies, for example, frequently provide detailed project-by-project information that includes clear mitigation achievements, paired with implementation and completion dates. This type of "bottom-up" information gives a degree of confidence when estimating aggregate impact. This report's analysis demonstrates the potential to use country-specific emission factors to estimate the greenhouse gas mitigation achievements of projects on an individual, case-by-case basis. Large data gaps remain, however, both within and across bilateral aid agencies. Only 42 projects – accounting for approximately one percent of the financial support for RE and EE projects in developing countries from 2004-2014 – had enough information to estimate emissions reductions.

Multilateral banks, funds, and partner initiatives do not make comprehensive information available in reporting greenhouse gas mitigation achievements. While some institutions reported emissions savings, this information was not frequently paired with clear descriptions of the methodologies applied or assumptions made.

The inability to disentangle overlaps and possible double counting between various actors confounded the analysis of mitigation impact. Bilateral aid agencies and investment funds, for example, frequently contribute to multilateral development banks. It is often unclear how these contributions factor into projects, except in rare cases like the GEF, which does provide information on project co-financing.

Due to insufficient data and wide variability in measuring and reporting mechanisms, these conclusions apply only to the projects and initiatives included in this report. This analysis does not suggest that they are generalizable to all partner-supported renewable energy and energy efficiency efforts in developing countries. Subsequent reports, workshops, and meetings will further develop and hone the methodology introduced in this report. Additional research to provide consistency and data availability in country-specific emission factors for renewable energy technologies would greatly enhance emission reduction calculations' accuracy and credibility. This information would also facilitate the comparison of activities between countries and regions.

There are efforts underway to unify climate finance measurement and tracking. Multilateral development banks, for example, have spent the last four years developing a harmonized framework that provides a clearer picture of the nearly US $75 billion contributed to climate finance between 2011 and 2013.[157] National, regional, and international development institutions, including Japan's International Cooperation Agency (JICA), are coordinating agencies through the International Development Finance Club (IDFC) to create a standard process for consistently tracking the financial flows of its members. Tracking financial currents is an important and necessary step towards harmonizing data management practices. Developing principles for measuring and reporting the greenhouse gas reductions is a critical next step. The 1 Gigaton Coalition aims to facilitate this process, through the publication of annual reports that map data gaps and feature methodological improvements and best practices.

SUGGESTIONS FOR IMPROVING THE REPORTING PRACTICES OF RENEWABLE ENERGY AND ENERGY EFFICIENCY PROJECTS

The following steps are recommended:

- **GREATER INFORMATION SHARING IN MEASUREMENT AND REPORTING** from bilateral, multilateral and partner initiatives supporting RE and EE projects, particularly regarding methodological assumptions made and uncertainties associated with estimating greenhouse gas mitigation impact.
- **COMMON REPORTING GUIDELINES AND FRAMEWORKS** to guide future data collection efforts on RE and EE projects. The climate finance community has been developing platforms and common frameworks to more consistently and transparently track financial flows, yet these efforts have not been matched with appropriate guidance to assess mitigation potential and impact.
- **COUNTRY- AND REGION-SPECIFIC EMISSION FACTORS AND DATA** to improve the accuracy of emissions impact estimates. These emission factors should be tailored to technology type and allow for "counterfactual" scenario assessment.
- **STRENGTHEN DATA COLLECTION ON HEATING,** cooling, and transport particularly in developing countries, as most data collected refers to renewable energy uptake in the electricity sector.
- **COLLECT DATA ON THE CO-BENEFITS** of RE and EE projects in developing countries, encouraging developing countries to assess local economic, public health, and social benefits associated with these programs and to work towards the integration of RE and EE in multiple dimensions of society.
- **UNDERSTAND SOUTH-SOUTH COOPERATION ON RE AND EE.** While this initial report only considered partner support primarily from developed to developing countries, South-South cooperation is growing. Future efforts should seek to understand the impact of South-South cooperation on renewable energy and energy efficiency projects.

These measures will highlight the best practices and track the aggregate impact of gains in RE and EE initiatives in developing countries.

APPENDIX I: RE AND EE TARGETS IN DEVELOPING COUNTRIES

Data sources: IRENA, 2015 and REN21, 2015.

Country	Renewable Energy – Total Primary Energy Supply	Renewable Energy – Total Final Energy Consumption	Renewable Energy – Electricity	Renewable Energy – Heating Cooling	Renewable Energy – Transport	Energy Efficiency Target	Summary
Afghanistan							No Data
Albania	✓	✓					RE Only
Algeria		✓	✓	✓			RE Only
Angola							No Data
Antigua and Barbuda			✓				RE Only
Argentina			✓				RE Only
Armenia			✓				RE Only
Azerbaijan	✓		✓			✓	Both
Bahamas			✓			✓	Both
Bangladesh			✓				RE Only
Belarus			✓	✓			RE Only
Belize			✓			✓	Both
Benin			✓		✓	✓	Both
Bhutan			✓	✓			**RE Only**
Bolivia			✓			✓	**Both**
Bosnia and Herzegovina		✓					RE Only
Botswana		✓				✓	**Both**
Brazil		✓	✓			✓	**Both**
Bulgaria			✓	✓	✓		RE Only
Burkina Faso			✓		✓	✓	Both
Burundi		✓					RE Only
Cabo Verde							No Data
Cambodia			✓			✓	Both
Cameroon							No Data
Central Africa Republic							No Data
Chad							No Data
Chile			✓				RE Only
China		✓	✓	✓	✓	✓	Both
Colombia			✓			✓	Both
Comoros							No Data

APPENDIX I: **RE AND EE TARGETS IN DEVELOPING COUNTRIES**

continued

Country	Renewable Energy – Total Primary Energy Supply	Renewable Energy – Total Final Energy Consump-tion	Renewable Energy – Electricity	Renewable Energy – Heating Cooling	Renewable Energy – Transport	Energy Efficiency Target	Summary
Congo							No Data
Costa Rica			✓				RE Only
Cote d'Ivoire	✓		✓		✓		RE Only
Cuba			✓				RE Only
Dem. Rep. Congo							No Data
Djibouti			✓				RE Only
Dominica			✓				RE Only
Dominican Republic			✓				RE Only
Ecuador			✓			✓	Both
Egypt	✓		✓			✓	Both
El Salvador			✓			✓	Both
Eritrea			✓				RE Only
Ethiopia			✓			✓	Both
Equitorial Guinea							No Data
Fiji		✓	✓				RE Only
French Guiana							No Data
Gabon		✓	✓				RE Only
Gambia			✓		✓	✓	Both
Georgia						✓	EE Only
Ghana			✓		✓	✓	Both
Grenada	✓		✓			✓	Both
Guatemala		✓	✓			✓	Both
Guinea			✓		✓	✓	Both
Guinea-Bissau			✓		✓		RE Only
Guyana			✓				RE Only
Haiti							No Data
Honduras			✓			✓	Both
India			✓	✓		✓	Both
Indonesia	✓		✓		✓		RE Only
Iran			✓				RE Only
Iraq			✓				RE Only

APPENDIX I: **RE AND EE TARGETS IN DEVELOPING COUNTRIES**

continued

Country	Renewable Energy – Total Primary Energy Supply	Renewable Energy – Total Final Energy Consump-tion	Renewable Energy – Electricity	Renewable Energy – Heating Cooling	Renewable Energy – Transport	Energy Efficiency Target	Summary
Israel		✓	✓			✓	Both
Jamaica		✓	✓			✓	Both
Jordan	✓		✓	✓		✓	Both
Kazakhstan			✓			✓	Both
Kenya			✓	✓			RE Only
Kiribati			✓				RE Only
Kosovo							No Data
Kuwait			✓			✓	Both
Kyrgyz Republic							No Data
Laos		✓				✓	Both
Lebanon		✓	✓	✓		✓	Both
Lesotho			✓				RE Only
Liberia			✓		✓	✓	Both
Libya	✓		✓	✓			RE Only
Macedonia		✓					RE Only
Madagascar		✓	✓		✓		RE Only
Malawi	✓		✓				RE Only
Malaysia			✓			✓	Both
Maldives			✓				RE Only
Mali	✓		✓		✓		RE Only
Marshall Islands			✓				RE Only
Mauritania	✓						RE Only
Mauritius	✓		✓				RE Only
Mexico			✓				RE Only
Micronesia			✓				RE Only
Moldova							No Data
Mongolia	✓		✓				RE Only
Montenegro							No Data
Morocco			✓	✓			RE Only
Mozambique			✓	✓			RE Only
Myanmar			✓		✓	✓	Both

APPENDIX I: **RE AND EE TARGETS IN DEVELOPING COUNTRIES**

continued

Country	Renewable Energy – Total Primary Energy Supply	Renewable Energy – Total Final Energy Consump-tion	Renewable Energy – Electricity	Renewable Energy – Heating Cooling	Renewable Energy – Transport	Energy Efficiency Target	Summary
Namibia			✓				RE Only
Nauru		✓					RE Only
Nepal			✓			✓	Both
Nicaragua			✓			✓	Both
Niger	✓		✓		✓	✓	Both
Nigeria			✓		✓	✓	Both
North Korea							No Data
Pakistan			✓				RE Only
Palau							No Data
Panama	✓		✓			✓	Both
Papua New Guinea							No Data
Paraguay							No Data
Peru			✓			✓	Both
Philippines			✓			✓	Both
Qatar			✓		✓	✓	Both
Romania		✓	✓	✓	✓		RE Only
Rwanda			✓				RE Only
Saint Kitts and Nevis			✓			✓	RE Only
Saint Lucia							No Data
Saint Vincent and the Grenadines	✓		✓			✓	Both
Samoa	✓						RE Only
Sao Tome and Principe							No Data
Senegal			✓		✓		RE Only
Serbia		✓	✓				RE Only
Seychelles			✓				No Data
Sierra Leone			✓	✓	✓	✓	Both
Singapore			✓	✓		✓	Both
Solomon Islands			✓				RE Only
Somalia							No Data

APPENDIX I: **RE AND EE TARGETS IN DEVELOPING COUNTRIES**

continued

Country	Renewable Energy – Total Primary Energy Supply	Renewable Energy – Total Final Energy Consump-tion	Renewable Energy – Electricity	Renewable Energy – Heating Cooling	Renewable Energy – Transport	Energy Efficiency Target	Summary
South Africa			✓		✓	✓	Both
South Sudan							No Data
Sri Lanka			✓		✓		RE Only
Sudan			✓				RE Only
Suriname			✓				RE Only
Swaziland							No Data
Syrian Arab Republic	✓		✓	✓			RE Only
Tajikistan			✓				RE Only
Tanzania			✓			✓	Both
Thailand		✓	✓	✓	✓	✓	Both
Timor-Leste			✓				RE Only
Togo		✓	✓		✓		RE Only
Tonga			✓				RE Only
Trinidad and Tobago			✓			✓	Both
Tunisia			✓	✓		✓	Both
Turkey	✓		✓				RE Only
Turkmenistan							No Data
Tuvalu			✓				RE Only
Uganda			✓	✓	✓		RE Only
Ukraine		✓	✓				RE Only
Uruguay	✓		✓			✓	Both
Uzbekistan							No Data
Vanuatu			✓				RE Only
Venezuela			✓				RE Only
Viet Nam	✓		✓		✓	✓	Both
Western Sahara							No Data
Yemen			✓	✓			RE Only
Zambia							No Data
Zimbabwe					✓		RE Only

APPENDIX II: **REDUCTIONS PER PROJECT**

To estimate energy generated by installed RE technologies and the implied CO_2 emissions mitigation annually, the research team developed country-specific capacity factors for each RE technology and country-specific grid electricity emission factors[158] and multiplied these by either the installed capacity per technology estimated by the project; or the annual energy production per technology directly resulting from the project. The annual emissions savings were estimated for the year 2020.

> **CO_2 direct = E * c**
>
> **CO_2 direct = direct GHG emission savings of project implementation in tons of CO_2**
>
> **E = annual energy saved or substituted, e.g., in megawatt hours (MWh);**
>
> **c = country-specific grid electricity emission factors, e.g., in t/MWh**

To estimate the carbon mitigation potential of projects in 2020, the research team estimated carbon savings using country-specific emission factors (to estimate BAU in the absence of the project) and renewable energy generation capacity factors (to estimate the emissions offset from a project). For projects that only provided information on installed capacity of a RE technology project, the research team first estimated annual energy saved based on country-specific capacity factors. We used EIA 2008 – 2012 RE capacity factors for hydro, solar, and wind technologies in certain regions to develop average RE capacity factors. For solar thermal, geothermal and biomass technologies, the research team used a 2010 NREL study that provides the capacity factors from up to six studies and averaged the available data. This method was also applied to hydro from Central and South American countries where data was unavailable from EIA. For RE projects that did not specify a RE technology, the research team used an average capacity factor for all RE technologies.

The CO_2 emissions offset from the RE technology are calculated by taking the MWh saved and multiplying by the country-specific grid emission factors, assuming RE technologies generate 0 emissions and completely offset fossil-fuel generated grid emissions. The two EE projects reported energy savings in MWh, so CO_2 emissions offset from these projects were estimated by directly multiplying the MWh saved by the grid emission factors. CO_2 emissions generated through the construction of RE facilities are excluded, since they are generally less than emissions from power plant construction.

Table A1: **40 RE and 2 EE Projects Identified for GHG Mitigation Impact Quantification**

Partner Country	Location	Bilateral Activities	Technology	Assistance in M US $	Capacity (MW)	Energy (MWh/year)	Calculated Emissions Reduction ($MtCO_2$/year)	Source
Denmark	Ghana	Enviscan-Market Analysis for establishment of 5MW power plant utilising renewable resource of biomass in Ghana	Biomass	0.08	5	36,378	0.008	http://openaid.um.dk/en/projects/DK-1-232191
Denmark	Philippines	Ilocos Norte, Bangui Bay Wind Farm Project, Phase II	Unspecified	5.45	8.25	34,680	0.018	http://openaid.um.dk/en/Projects/DK-1-109907
Denmark	Ghana	Orion-Feasibility Study for Solar Energy Park	Solar PV	0.06	75	131,487	0.028	http://openaid.um.dk/en/Projects/DK-1-210940
Denmark	Egypt	Project : Wind farm at the Gulf of Suez	Wind	37.36	60	147,266	0.074	http://openaid.um.dk/en/projects/DK-1-3389

Table A1: **40 RE and 2 EE Projects Identified for GHG Mitigation Impact Quantification –** continued

Partner Country	Location	Bilateral Activities	Technology	Assistance in M US $	Capacity (MW)	Energy (MWh/year)	Calculated Emissions Reduction ($MtCO_2$/year)	Source
Denmark	Egypt	Zafarana Wind Farm Project, Component III	Wind	59.01	120	441,504	0.221	http://openaid.um.dk/en/projects/dk-1-118025
EC	Samoa	Rehabilitation of existing and building new hydropower plants in Samoa	Hydro	5.07	6.3	20,985	0.007	https://ec.europa.eu/europeaid/projects/rehabilitation-existing-and-building-new-hydro-power-plants-samoa_en
EC	India	SCOPE BIG - Scalable CSP Optimised Power Plant Engineered with Biomass Integrated Gasification	Solar Thermal	8.8	3	10,344	0.014	https://ec.europa.eu/europeaid/projects/scope-big-scalable-csp-optimised-power-plant-engineered-biomass-integrated-gasification_en
EC	Burundi	Service d'Électricité Solaire avec des Microréseaux en Afrique / SESMA-Burundi	Solar PV	1.62	0.15	263	0.00013	https://ec.europa.eu/europeaid/projects/service-delectricite-solaire-avec-des-microreseaux-en-afrique-sesma-burundi_fr
EC	Egypt	Wind Farm in Gulf El Zayt	Wind	22	200	490,885	0.246	https://ec.europa.eu/europeaid/projects/wind-farm-gulf-el-zayt_en
France	Turkey	Accompanying banks and local enterprises and encouraging sustainable economic growth	Unspecified	126.5	78	297,120	0.257	http://www.afd.fr/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/fiches-2015-va/TURKEY_lines-of-credit_energy.pdf
France	South Africa	Cape Central Electric Denorthern	Solar Thermal	6.6	100	344,789	0.369	http://www.afd.fr/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/fiches-2015-va/AFD-SOUTHAFRICA_energy_Durban.pdf, http://www.afd.fr/lang/en/home/projets_afd/AFD-et-environment/changement_climatique/Projets_climat_1
France	China	Constructing a wind farm and promoting renewable energy development	Wind	30.14	na	80,000	0.078	http://www.afd.fr/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/fiches-2015-va/CHINA_yunnan_wind-unit_energy.pdf

Table A1: **40 RE and 2 EE Projects Identified for GHG Mitigation Impact Quantification –** continued

Partner Country	Location	Bilateral Activities	Techno-logy	Assistance in M US $	Capacity (MW)	Energy (MWh/year)	Calculated Emissions Reduction ($MtCO_2$/year)	Source
France	Kenya	Developing geothermal energy and encouraging low-carbon growth	Geothermal	165	280	2,194,258	**0.729**	http://carte.afd.fr/afd/fr/projet/developper-la-geo-thermie-au-kenya
France	Indonesia	Encouraging energy control and the production of "clean" ener	Unspecified	200	90	378,332	**0.259**	http://carte.afd.fr/afd/fr/projet/encourager-la-pro-duction-dener-gies-renouvelables
France	Ethiopia	First wind farm in Mekele Ethiopia	Wind	49.5	120	294,531	**0.035**	http://carte.afd.fr/afd/fr/projet/ener-gie-eolien-ethio-pie-mekele
France	Peru	Funding construction of solar power plants and responding to growing demand for energy	Solar PV	7.5	44	90,638	**0.022**	http://www.afd.fr/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/fiches-2015-va/PERU_TSolar_Propar-co_energy.pdf
France	China	Increasing hydroelectric production and creating jobs	Hydro	35.2	50	162,167	**0.158**	http://www.afd.fr/lang/en/home/pro-jets_afd/AFD-et-en-vironment/change-ment_climatique/Projets_climat_1, http://www.afd.fr/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/fiches-2015-va/CHI-NA_hydroelectrici-ty_Chongqing.pdf
France	Kenya	Opening lines of credit for local banks and supporting private-sector renewables projects	Unspecified	35.86	22	99,231	**0.033**	http://www.afd.fr/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/fiches-2015-va/KEN-YA_credit_line_Nai-robi.pdf
France	Reunion	Photovoltaic greenhouses	Solar PV	36.85	24.9	43,654	**0.026**	http://carte.afd.fr/afd/fr/projet/cen-trales-photovoltai-ques-agrinergie
France	India	Promote energy efficiency in small and medium-sized Indian companies	Energy Efficiency	55	NA	84,300	**0.112**	http://carte.afd.fr/afd/fr/projet/promouvoir-leffi-cacite-energeti-que-dans-les-pe-tites-et-moy-ennes-entreprises-indiennes
Germany	Jordan	Improving energy efficiency in the water sector:	Energy Efficiency	2.48	NA	1,500	**0.001**	http://www.iee-jor-dan.net/en, http://www.international-climate-initiative.com/en/projects/projects/details/292/; http://www.iee-jor-dan.net/en/results

Table A1: **40 RE and 2 EE Projects Identified for GHG Mitigation Impact Quantification –** continued

Partner Country	Location	Bilateral Activities	Techno-logy	Assistance in M US $	Capacity (MW)	Energy (MWh/year)	Calculated Emissions Reduction ($MtCO_2$/year)	Source
Germany	Morocco	Quarzazate I Solar Power Plant	Solar Thermal	16.5	160	551,662	**0.403**	http://www.international-climate-initiative.com/en/projects/projects/details/ouarzazate-i-solar-power-plant-210/?b=3,5,0,9,0,0&kw=
Germany	Brazil	Solar Pilot Project, Florian"Polis	Solar PV	4.14	1	2,060	**0**	http://www.international-climate-initiative.com/en/projects/proj-ects/details/solar-pi-lot-project-florianpo-lis-179/?b=3,4,0,9,0,0&kw=
Japan	Iraq	Deralok Hydropower Plant Construction Project	Hydro	141.07	30	39,446	**0.032**	http://www.jica.go.jp/english/news/press/2009/100331_05.html
Japan	Indonesia	Engineering Services for Kamojang Geothermal Power Plant Extension Project	Geo-thermal	8.26	60	470,198	**0.322**	http://www.jica.go.jp/english/news/jbic_archive/auto-contents/english/news/2006/000041/index.html
Japan	Egypt	Gulf of El Zayt Wind Power Plant Project	Wind	322.57	220	539,974	**0.27**	http://www.jica.go.jp/english/news/press/2009/100331_02.html
Japan	Egypt	Kuraymat Integrated Solar Combined Cycle Power Plant Project	Solar Thermal	88.52	150	517,183	**0.259**	http://www.jica.go.jp/english/news/jbic_archive/auto-contents/english/news/2006/000004/index.html
Japan	Egypt	Kuraymat Integrated Solar Combined Cycle Power Plant Project (II)	Solar Thermal	78.35	Same as above	Same as above	**Same as above**	http://www.jica.go.jp/english/news/press/2008/081224_01_ref.html
Japan	Bolivia	Laguna Colorada Geothermal Power Plant Construction Project (Phase 1 of First Stage)	Geothermal	20.71	49.75	389,873	**0.209**	http://www.jica.go.jp/english/news/press/2014/140703_01.html
Japan	Indonesia	Lumut Balai Geothermal Power Plant Project	Geo-thermal	223.82	110	862,030	**0.59**	http://www.jica.go.jp/english/news/press/2010/110329.html
Japan	Peru	Moquegua Hydro Electric Power Plants Construction Project	Hydro	57.64	17.7	88,438	**0.021**	http://www.jica.go.jp/english/news/press/2014/141107_01.html
Japan	Kenya	Olkaria 1 Unit 4 and 5 Geothermal Power Project	Geothermal	244.98	140	1,097,129	**0.365**	http://www.jica.go.jp/english/news/press/2009/100331_04.html
Japan	Bangladesh	Renewable Energy Development Project	Solar PV	94.08	46.632	44,964	**0.029**	http://www.jica.go.jp/english/news/press/2012/130311_02.html

Table A1: **40 RE and 2 EE Projects Identified for GHG Mitigation Impact Quantification –** continued

Partner Country	Location	Bilateral Activities	Techno-logy	Assistance in M US $	Capacity (MW)	Energy (MWh/year)	Calculated Emissions Reduction ($MtCO_2$/year)	Source
Japan	Algeria	Sahara Solar Energy Research Center (SSERC)	Solar PV	Not available	2	3,506	**0.002**	http://www.ssb-foundation.com/
Japan	Kenya	Sondu-Miriu Hydropower Project Sang'oro Power Plant	Hydro	46.65	21.2	91,059	**0.03**	http://www.jica.go.jp/english/news/jbic_archive/auto-contents/english/news/2007/000003/index.html
Japan	Laos	The Project for Rehabilitation of the Nam Ngum 1 Hydropower Station	Hydro	9.33	17.5	58,293	**0.032**	http://www2.jica.go.jp/en/evaluation/pdf/2009_0200400_4.pdf
Japan	Indonesia	Ulubelu Geothermal Power Plant Project	Geother-mal	168.39	110	862,030	**0.59**	http://www.jica.go.jp/english/news/jbic_archive/auto-contents/english/news/2005/000032/index.html
Norway	Namibia	NAM-14/0001 - Scatec Solar AS- feasibility study -solar energy	Solar PV	0.05	50	87,658	**0.043**	http://udtilskudd.regjeringen.no/#/en/agreement?agreementNo=-NAM-14/0001
UK	Tanzania	Green Mini Grids - Tanzania [GB-1-204365]	Unspeci-fied	Not distributed yet	44	198,462	**-**	http://devtracker.dfid.gov.uk/projects/GB-1-204365/
UK	Nigeria	NIAF 2 - Nigeria Infrastructure Advisory Facility Phase 2 [GB-1-201433]	Unspeci-fied	118.48	10	45,105	**0.02**	http://devtracker.dfid.gov.uk/projects/GB-1-201433/
UK	Uganda	On Grid Small Scale Renewable Energy in Uganda [GB-1-203624]	Unspeci-fied	9.82	20	90,210	**0.054**	http://devtracker.dfid.gov.uk/projects/GB-1-203624/
UK	Bangla-desh	Providing Clean Energy to the Rural Poor of Bangladesh [GB-1-202976]	Solar Thermal	12.77	4.47	15,412	**0.01**	http://devtracker.dfid.gov.uk/projects/GB-1-202976/
Sum				2,556	2,551	11,439,004	**6.0**	

The six CDM Projects:

Partner Country	Location	Bilateral Activities	CDM Projects	CDM Reductions ($MtCO_2$/year)	Calculated Reductions ($MtCO_2$/year)	Reported Reductions by the supporter ($MtCO_2$/year)	Link to CDM Project Portal
France	China	Constructing a wind farm and promoting renewable energy development	Yunnan Dali Zhemoshan Wind Power Project	0.06	0.08	**0.06**	https://cdm.unfccc.int/filestorage/0/5/Q/05QLH4RVEG-3SKM2D7BCZW8AN-PI9UYJ/PDD.pdf?t=QTN8bng5cmN2f-DAtc1zB8eRbSqdOXV9g-FJCh
Japan	Indonesia	Lumut Balai Geothermal Power Plant Project	Project 7430: Project Kamojang Unit 5 PT. Pertamina Geothermal Energy	0.58	0.59	NA	https://cdm.unfccc.int/Projects/DB/KBS_Cert1348556937.17/view
Japan	Indonesia	Ulubelu Geothermal Power Plant Project	Project 5773: Project Ulubelu Unit 3 – 4 PT. Pertamina Geothermal Energy	0.58	0.59	NA	https://cdm.unfccc.int/Projects/DB/Germanischer1328626849.48/view
France	Kenya	Developing geothermal energy and encouraging low-carbon growth	Project 8646: Olkaria IV Geothermal Project	0.65	0.73	**0.74**	https://cdm.unfccc.int/Projects/DB/JCI1355128868.24/view
Japan	Kenya	Olkaria 1 Unit 4 and 5 Geothermal Power Project	Project 8643: Olkaria I Units 4&5 Geothermal Project	0.64	0.36, CDM used a one time higher emissions factor - 0.633 tCO_2/MWh	**0.69**	https://cdm.unfccc.int/Projects/DB/JCI1355122750.69/view
Germany	Morocco	Ouarzazate I Solar Power Plant	Project 8946: Ouarzazate I Concentrated Solar Power Project	0.28	0.40	**0.23**	https://cdm.unfccc.int/Projects/DB/DNV-CUK1355978226.77/view
Sum				2.79	2.75		

Grid Electricity Country-specific Emissions Factors

Country	Electricity-sector Emissions Factor (tCO_2/MWh)	Source
Algeria	0.664	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Armenia	0.128	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Bangladesh	0.637	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Barbados	0.833	http://www.gh.undp.org/content/dam/ghana/docs/Doc/Susdev/UNDP_GH_SUSDEV_2010GHGinvento-ry_PDF.pdf
Bolivia	0.535	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Brazil	0.093	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Burundi	0.49	http://www.gh.undp.org/content/dam/ghana/docs/Doc/Susdev/UNDP_GH_SUSDEV_2010GHGinvento-ry_PDF.pdf
Cape Verde	0.49	http://www.gh.undp.org/content/dam/ghana/docs/Doc/Susdev/UNDP_GH_SUSDEV_2010GHGinvento-ry_PDF.pdf
China	0.975	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Egypt	0.501	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Ethiopia	0.119	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Ghana	0.215	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
India	1.333	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Indonesia	0.685	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Iraq	0.821	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Jordan	0.644	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Kenya	0.332	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Laos	0.552	http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=2136
Liberia	0.49	http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=2136
Maldives	0.31	http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=2136
Mayotte	0.445032	Mozambique
Morocco	0.731	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Namibia	0.49	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Nauru	0.31	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Nepal	0.003	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Nigeria	0.44	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Pakistan	0.473	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Paraguay	0	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Peru	0.238	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Philippines	0.527	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Reunion	0.596	https://ig-tools.com/files/CF_for_IG_Tools.pdf
Samoa	0.31	http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=2136
South Africa	1.069	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Sri Lanka	0.417	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
Tanzania	0.267	http://ecometrica.com/assets/Electricity-specific-emission-factors-for-grid-electricity.pdf
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GLOSSARY

The entries in this glossary are adapted from definitions provided by authoritative sources, such as the Intergovernmental Panel on Climate Change and UNEP.

ADDITIONALITY: A criterion that stipulates that emissions savings achieved by a project must not have happened anyway had the project not taken place.

BOTTOM-UP MODEL: A method of analysis that looks at the aggregated emissions impact from individual renewable energy and energy efficiency projects.

BUSINESS AS USUAL: The scenario that would have resulted had additional mitigation efforts and policies not taken place (with respect to an agreed set).

DOUBLE COUNTING: The situation where the same emission reductions are counted towards meeting two actors' pledges (for example, if a country financially supports an initiative in a developing country, and both countries count the emissions towards their own national reductions).

EMISSION PATHWAY: The trajectory of annual global greenhouse gas emissions over time.

SCENARIO: A description of how the future may unfold based on specific propositions, such as uptake of renewable energy technologies, or the implementation of energy efficiency standards.

TOP-DOWN MODEL: A method of analysis that examines initiatives that support renewable energy and energy efficiency projects in developing countries to determine the impact of the initiative's aggregate of activities.

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13 As approximation, because the split between sectors and countries depends on assumptions of how to share the efforts of reductions.

14 As approximation, because the split between sectors and countries depends on assumptions of how to share the efforts of reductions.

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(1) Technology types have a typical life span and those life spans are used to calculate the number of CO_2 emissions avoided by the use of Renewable Energy and the implementation of energy efficient solutions over the life span of the technology and scale of implementation as a result of the project itself.
(2) Project implementers provide projections for CO_2 emission avoidance in their project application forms, REEEP evaluates them and measures their accuracy based on in-house expertise and determines if they are realistic, which triggers the approval for the grant among many other evaluation criteria.
(3) At project completion, an external expert is contracted to evaluate the success of the project, its planned activities, outputs and outcomes, including policy influence and technology implementation; at this point the CO_2 emissions avoided are documented by the external expert based on reviews of project documentation and interviews with the implementer.
(4) Post project completion (typically 2-3 years later), an impact assessment is then conducted via external experts who follow a similar process for the evaluation but look at longer term impacts of the project, particularly impacts on prosperity, technology development and further scale, as well as impacts at the country level from policy and regulatory projects.
(5) The external expert's assessment of the CO_2 emission reduction to date and projections for the future then overwrites the initial estimation of CO_2 reductions at project start; REEEP uses the external expert's figures when made available, and the project projections until that time.
(6) CO_2 emission calculations are documented in the short term and estimated in the long term by REEEP's network of experts and computed with in-house expertise to arrive at realistic figures; beyond unbiased external expertise, and in-house expertise to accept how realistic the calculations are, REEEP does not directly verify on the ground.
(7) While CO_2 emission reductions are a key priority for REEEP, so are many other indicators of success which have been implemented along with our Enhanced Monitoring and Evaluation Strategy and Framework, developed between 2013 and 2014, implemented in 2015 – such indicators focus on prosperity and are aligned with the SDGs

135 Values are cumulative savings over the lifetime of the projects and cannot be directly compared to annual reductions

136 Most projections beyond 2021 fall between the period of 2021 and 2032; however a handful of high impact policy projects reach beyond 2033 to 2050.

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ACRONYMS

AFD	Agence Française de Développement
ADB	Asian Development Bank
BAU	Business as usual
BNEF	Bloomberg New Energy Finance
CEC	Commission of the European Communities
CEFPF	Clean Energy Financing Partnership Facility
CIF	Climate Investment Fund
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CCAC	Climate and Clean Air Coalition
CFL	Compact fluorescent lamps
CREIA	Chinese Renewable Energy Industries Association
CTCN	Climate Technology Centre and Network
DFID	United Kingdom's Department for International Development
EC	European Commission
EE	Energy efficiency
EIA	Energy Information Administration of the United States of America
EIB	European Investment Bank
FiT	Feed-in tariff
FONER	Proyecto para el Mejoramiento de la Electrificación Rural mediante la aplicación de Fondos Concursables (Peru's Project for Increased Rural Electrification)
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environment Facility
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit (German Corporation for International Cooperation)
Gt	Gigaton
GW	Gigawatt
KfW	Kreditanstalt für Wiederaufbau (Development Bank, Germany)
kWh	Kilowatt hours
LED	Light Emitting Diode
IDB	Inter-American Development Bank
IEA	International Energy Agency
IKI	International Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
MDB	Multilateral development banks
NDEs	National designated entities
NREL	National Renewable Energy Laboratory of the United States of America
ODA	Official development assistance
OECD	Organisation for Economic Cooperation and Development
PFAN	Private Finance Advisory Network
PPA	Power purchase agreement
PV	Photovoltaic
RE	Renewable energy
REN21	Renewable Energy Policy Network for the 21st Century
REEEP	Renewable Energy and Energy Efficiency Partnership
SE4ALL	Sustainable Energy For All
UNFCCC	United Nations Framework Convention on Climate Change
US $	United States Dollars

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