



WORKING PAPER



Aligning energy development and climate objectives in Nationally Determined Contributions

By Andrew Scott, Leah Worrall and Sejal Patel



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About this Working Paper

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Our programme provides technical assistance to governments as well as research-into-action projects that fill gaps in our understanding of climate change impacts and solutions. A further, crucial part of CDKN's programme is knowledge management and policy engagement, an effort to which this Working Paper contributes. We synthesise information on the collective performance of governments, as well as non-state actors, in tackling climate change. We convene online discussions and in-person events to assess how climate actions are serving the most climate-affected people and how climate action could be more ambitious and effective. Find more CDKN thought leadership on www.cdkn.org or follow us on twitter @cdknetwork.

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Solar power, Kenya.

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Key messages

- The effectiveness of national energy policy will be decisive for achieving the objectives of the Paris Agreement and the 2030 Agenda for Sustainable Development. Emissions from the production and consumption of energy need to reduce significantly, but government commitments in their Nationally Determined Contributions (NDCs) fall short of the action required. About half of the NDCs submitted do not include actions to reduce energy emissions and, when included, actions may not reflect all energy emissions or be consistent with national energy policies.
- Ethiopia and Peru were identified as examples of good practice with respect to the treatment of energy emissions in their NDCs and consistency with national energy plans. Ethiopia intends to reduce its total emissions by 64% against a business-as-usual trajectory, while Peru aims to reduce emissions by 30% (both conditional on international support).
- Ethiopia's electricity will continue to be generated principally from hydropower, while Peru will increase the share of renewable energy while retaining significant thermal power generation. In both countries, land-use and forestry emissions will be the main focus of reduction efforts, reflecting the role that geography and natural resource endowments play in determining a country's greenhouse gas emissions. Both countries had an established policy framework for climate change before the Paris Agreement that informed their NDCs.
- Bangladesh and Ghana were selected as countries with relatively low ambition in their NDCs. Independent analysis of alternative emissions reduction pathways suggests that there is potential for both countries to submit more ambitious emissions reduction commitments, which would be consistent with their energy sector development goals. When development co-benefits are taken into consideration, such as job creation and improvements to health, the case for higher ambition is strengthened.
- NDCs vary considerably in their level of ambition, the level of detail they provide and the depth of analysis underpinning their emissions reduction targets. However, the following conclusions can be drawn from the four countries studied.
 - Where climate change is integral to national policies and development strategy, NDC commitments are more likely to be aligned with sectoral plans.
 - Unsynchronised planning calendars and policy development processes for different elements of the national energy system contribute to diverse and sometimes inconsistent energy targets.
 - Opportunities to identify synergies and the development co-benefits of mitigation actions (e.g. for poverty reduction, job creation and health) could be missed due to continued separation of NDC planning and national development planning.
 - The alignment of NDC mitigation targets with national energy policies and plans may be influenced by political (or tactical) factors, which are related to the different audiences for NDCs and national plans.
 - The mitigation potential of access to modern energy services is recognised in the NDCs, particularly with respect to energy for cooking. Substantial change from business-as-usual will be required in countries where cooking energy emissions reductions are significant for NDC objectives.
 - Some countries could be more ambitious in their emissions reduction targets and still meet their energy development objectives. The revision of NDCs, beginning with facilitative dialogue in 2018, provides an opportunity for these countries to realign their NDCs and energy plans.

Introduction

To achieve the goal of the Paris Agreement and keep global temperature rise to less than 2°C above pre-industrial levels, global greenhouse gas emissions must peak as soon as possible, then reduce rapidly to achieve zero net emissions in the second half of this century. A rapid reduction in emissions from the consumption and production of energy will be necessary, since these account for two thirds of global emissions. To transition to low-carbon energy systems, renewable energy sources (hydro, solar, wind, bioenergy and geothermal) need to replace carbon-intensive sources (coal, oil and natural gas), alongside improved efficiency in the consumption and production of energy.

Signatories to the Paris Agreement set out what they intend to achieve by way of emissions reductions in their Intended Nationally Determined Contributions (INDCs), which were submitted to the United Nations Framework Convention on Climate Change (UNFCCC). Upon ratification of the Agreement, these became Nationally Determined Contributions (NDCs), in most cases without change.¹ Plans for the delivery of NDCs are now being formulated by governments.² Collectively, the NDCs fall far short of what will be necessary to achieve the goals of the Paris Agreement.³ However, the Agreement provides an opportunity for countries to review progress and revise their NDCs every five years, beginning with a facilitative dialogue in 2018. It will be a major challenge for the parties to the UNFCCC to ensure that revised NDCs are as ambitious as possible and include all feasible energy emissions savings.

The effectiveness of national energy policy will be decisive to achieving the objectives of both the Paris Agreement and the Sustainable Development Goals (SDGs). Action to reduce energy-related emissions is not currently included in about half of the NDCs submitted to UNFCCC.⁴ When such actions are included, they do not necessarily cover emissions from all sources of energy, and it is not always clear whether pledges in NDCs are consistent with existing national energy policies and plans. When they are, increased investment in renewable energy does not preclude increased emissions from fossil fuel energy.

Access to modern energy services, one of the SDG targets, is mentioned in some NDCs in relation to energy security, adaptation and as a co-benefit of the mitigation objectives of the NDC.⁵ Reduction in the use of biomass for cooking energy is highlighted in some developing country NDCs as a means to achieve both mitigation and development objectives.⁶ However, most NDCs do not address the means by which synergies between the sustainable energy SDG and NDC objectives will be exploited.

The Climate and Development Knowledge Network (CDKN) supported the preparation of INDCs in several countries, and is now assisting in the development of plans to implement them. This paper draws from this experience and further analysis to provide a perspective on the alignment of NDCs and national energy plans. Its purpose is to inform dialogue about objectives for energy-related emissions in developing country NDC implementation plans and revised NDCs, by highlighting opportunities for mitigation action that are consistent with national energy goals. The paper also identifies where revision of energy plans might enhance NDC implementation plans.

Methodology

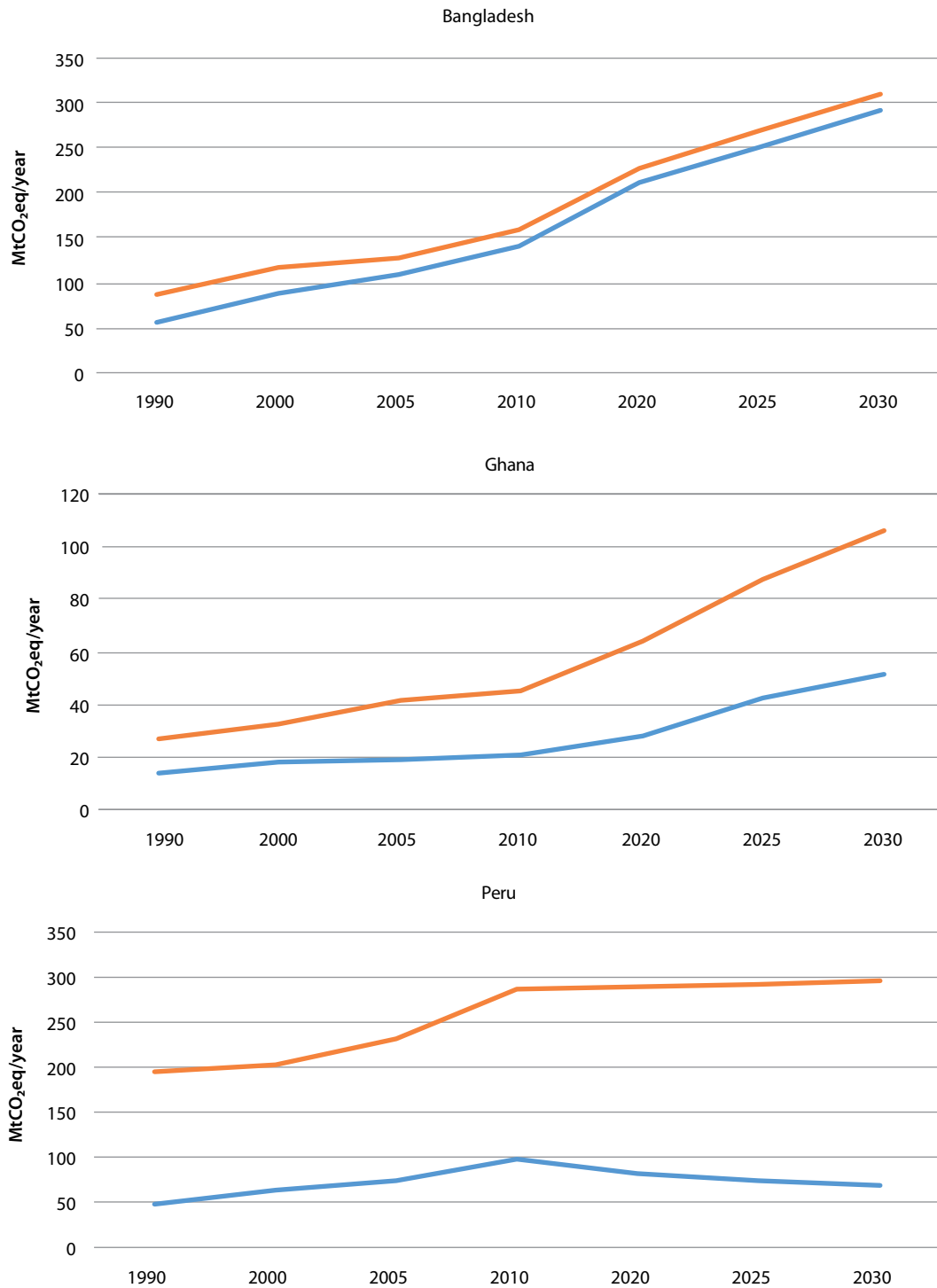
The study objective was to review examples of what might be called good practice in the way energy-related greenhouse gas emissions have been addressed by NDCs, and examples of NDCs that appear to be at odds with the ambition to reduce such energy emissions. To address these questions, the authors reviewed the objectives of the NDCs and national energy plans of four countries. They also reviewed the process followed by each country in preparing their NDC, to understand the extent to which energy plans and policies are reflected in the NDC, and whether this affected the level of ambition to reduce energy emissions.

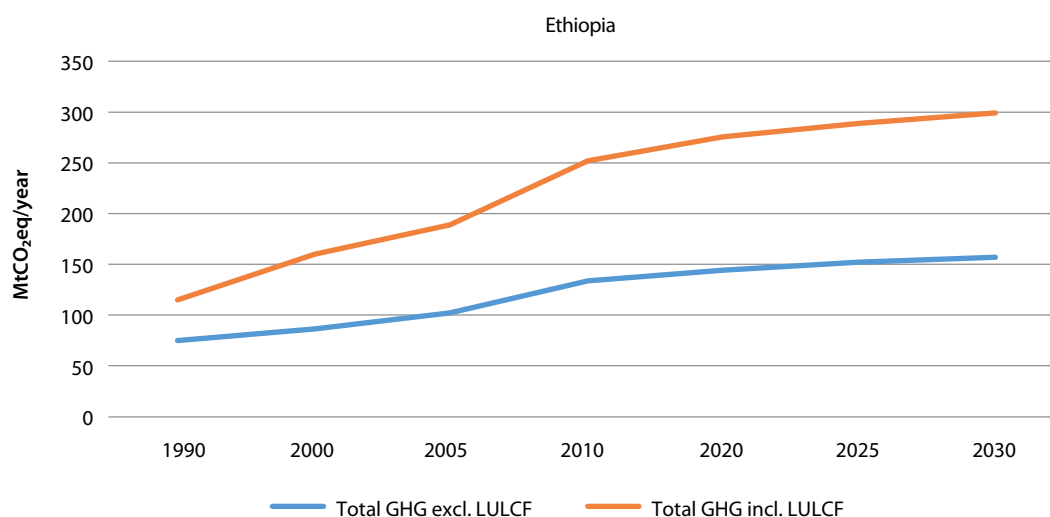
The countries included in the study were purposely selected to illustrate the effect that good practice in NDC formulation can have on the ambition of energy emissions reduction objectives. Ethiopia and Peru were identified as examples of good practice, and Bangladesh and Ghana as examples of countries that could strengthen their ambition for energy-related emissions in revision of their NDCs. The selected countries have had significant CDKN support for policy design in climate compatible development.

CDKN support for INDC preparation has included, in Ethiopia, facilitating inter-sectoral dialogue through working groups. In Peru, CDKN supported the identification and analysis of mitigation options, identification of adaptation measures and stakeholder engagement.

Figure 1 shows the emissions trajectory implied by each country's NDC. It shows a levelling off or decline of emissions (excluding land use, land-use change and forestry emissions or LULUCF) in the two examples of good practice (Ethiopia and Peru), and a continuing increase in such emissions in the countries that could strengthen their ambition (Bangladesh and Ghana).

Figure 1. Emissions trajectories implied by the NDCs of selected countries





Source: INDC Factsheets⁷

When selecting countries, the authors aimed to achieve a balance across regions and different energy contexts. The four countries selected range from low income to upper middle income (using the World Bank classification).⁸ Their energy systems range from having a high proportion of fossil fuels used for electricity generation, to significant use of renewable energy. Key energy indicators for each country are presented in Table 1.

The study included a review of the NDCs and national energy policy and plan documents for the four selected countries to identify policy objectives and targets for the energy sector. It also involved a review of the analysis and information provided by relevant cross-country studies and databases, including Climate Action Tracker, Ecofys, the International Renewable Energy Agency and International Energy Agency. For Bangladesh and Ghana, options for more ambitious renewable energy deployment targets were identified from studies that have modelled alternative low-emissions energy scenarios.

Table 1. Key energy indicators for selected countries (2014)

Income classification	Ethiopia	Bangladesh	Ghana	Peru
	Low income	Lower middle income	Lower middle income	Upper middle income
Total primary energy supply (TPES) (ktoe)	48,373	35,423	9,034	23,778
TPES per capita (toe)	0.50	0.22	0.20	2.01
Fossil fuels % TPES	6	53	73	77
Renewables % TPES	94	47	27	23
Renewables % total final energy consumption	93	38	50	28
Renewables % electricity generated	99	2	67	55
Per capita electricity consumption (MWh)	0.07	0.31	0.36	1.31
Carbon intensity of energy (tCO ₂ /toe)	0.18	1.76	1.52	2.10
Electrification rate (% population)	27.2	62.4	78.3	92.9
Access to clean fuels and technology for cooking (% population)	2	10	21	68

Note: toe = tonnes of oil equivalent energy; ktoe = thousand tonnes of oil equivalent energy; MWh = megawatt hours.

Sources: International Energy Agency;⁹ Global Tracking Framework 2017.¹⁰

NDCs aligned with the Paris Agreement

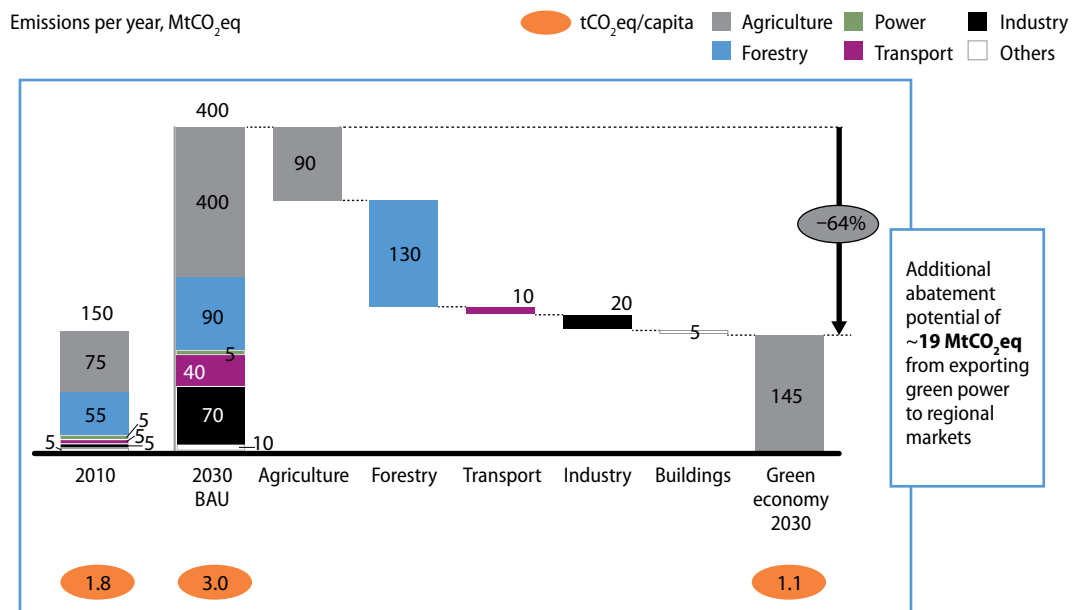
This section reviews the NDCs and energy plans of Ethiopia and Peru, two countries that aim to achieve large reductions in emissions by 2030, relative to their business-as-usual trajectory. While their commitments include some reduction in energy-related emissions, in both cases the energy sector will not be the main source of emissions reductions.

Ethiopia

Ethiopia was the first least-developed country to submit its INDC to the UNFCCC, presenting itself as a leader on climate change.¹¹ The INDC, now NDC, states that Ethiopia intends to keep its total annual greenhouse gas emissions below 145 megatonnes carbon dioxide equivalent (MtCO₂eq) by 2030. This represents a 64% reduction on the projected business-as-usual emissions.¹² The NDC emphasises that Ethiopia is “maximising its mitigation potential and contributing towards the achievement of the objective of the Convention, whilst simultaneously supporting its sustainable development goals”.¹³

The intended emissions reduction includes 90 MtCO₂eq from agriculture, 130 MtCO₂eq from forestry, 20 MtCO₂eq from industry, 10 MtCO₂eq from transport, and 5 MtCO₂eq from buildings.¹⁴ In other words, the bulk of Ethiopia’s intended emissions reductions will come from agriculture and forestry, which accounted for 85% of the country’s emissions in 2010 (see Figure 2). These reductions are to be achieved largely by improvements in livestock production practices, forest protection and reforestation, and carbon sequestration through land use.

Figure 2. Emissions reductions in Ethiopia’s NDC



Note: Emissions per year given as rounded numbers; ‘Others’ category represents currently estimated emissions from buildings and waste.¹⁵ BAU = business-as-usual.

Less than 14% of the intended emissions reductions will be energy-related. These will be achieved by expanding electricity generation from renewable energy and deploying modern, energy-efficient technologies in the transport, industry and buildings (construction and operation of buildings) sectors. Emissions from electricity generation will be kept close to zero, and reductions made on business-as-usual projections for the other three sectors.

The NDC is based on Ethiopia’s Climate Resilient Green Economy (CRGE) strategy, which was adopted in 2011. “The CRGE is Ethiopia’s strategy for addressing both climate change adaptation and mitigation objectives.”¹⁶ It aims to reduce emissions and build climate resilience while achieving middle-income status before 2025.

The CRGE is implemented through the national five-year development plan, now known as the Growth and Transformation Plan (GTP). The main energy sector objectives in the first GTP (2011-2015) were “to provide sufficient and reliable power sources at all times for economic and social development as well as for irrigation activities, [and] to accelerate and complete the construction of the ongoing hydropower electric generation projects”.¹⁷ The plan set a target to increase renewable energy generation capacity from 2 gigawatts (GW) to 8–10 GW by the end of 2015.¹⁸

During the first GTP, but before formulation of the NDC, Ethiopia revised its national energy policy to align energy policy with the CRGE and protect the country against the adverse effects of climate change.¹⁹ Two of the six objectives of the energy policy are to “Promote efficient, cleaner, and appropriate energy technologies and conservation measures” and “Ensure environmental and social safety and sustainability of energy supply and utilization”.²⁰

The second GTP covers the period 2016-2020. It was developed in 2015, alongside the INDC. This may explain why the NDC and its commitments are not mentioned in the second GTP (GTP II) document. The greenhouse gas reduction objectives listed in GTP II derive from the CRGE. Similarly, links in the NDC to the CRGE strategy are more explicit than those to GTP II. This may reflect the broader challenge of mainstreaming climate change into national development planning. However, GTP II states that “Emission targets will be strict on all green economy sectors, specifically on soil, livestock, forestry, energy, transport, industry and urban development”.²¹ This correlates closely with the mitigation sectors identified in the NDC.

The objectives for the energy sector in GTP II are “to expand power transmission considering environmental conservation issues, make service delivery reliable and efficient and transform institutions”.²² The plan to 2020 has 12 targets for the energy sector. These include targets for centralised renewable energy generation capacity and the number of units for decentralised renewable energy. The only target that specifically mentions greenhouse gas emissions is for ethanol production, a relatively small part of the country’s overall energy mix.²³

Ethiopia has one of the world’s lowest levels of access to modern energy services. In 2014, 27% of Ethiopia’s 98 million people had access to electricity, and only 2% had access to clean cooking technologies.²⁴ The targets in GTP II for new connections and off-grid electricity imply an objective of 54% with access to electricity by 2020, and about 10% with access to clean cooking technologies. The emissions reductions associated with these objectives, resulting from reduced consumption of kerosene and wood fuel, would contribute to the overall emissions target in the NDC. Current government plans would not achieve the SDG target of universal access to electricity by 2030, but targets for beyond 2020 have yet to be set.

Emissions pathway

The business-as-usual emissions trajectory outlined in the NDC and first presented in the CRGE shows total emissions reaching 400 MtCO₂eq by 2030 (Figure 2). The INDC target of 145 MtCO₂eq by 2030 takes account of the intention to switch existing thermal power generation to renewables, and in future generate all the country’s electricity from renewable sources. Because most of Ethiopia’s electricity is currently generated by hydropower, this switch will provide only 3% of the emissions reductions required to meet the NDC target. To increase the contribution of Ethiopia’s energy system to mitigation objectives, it will be necessary to look beyond the power sector.

Under business-as-usual, energy-related emissions in industry would increase 14-fold to 70 MtCO₂eq by 2030, from 5 MtCO₂eq in 2010. The NDC proposes a 16% reduction from the business-as-usual increase, which would result in industrial emissions being 10 times higher in 2030 than they were in 2010. By 2030, industrial emissions would account for over one third of the country’s total emissions, despite the NDC proposal to ‘leapfrog’ to modern and energy-efficient technologies in the industrial sector.

Emissions from the transport sector would increase to 40 MtCO₂eq by 2030 under business-as-usual, compared with around 5 MtCO₂eq in 2010. The NDC target includes a 25% reduction in transport emissions against business-as-usual, and a 30 MtCO₂eq total by 2030, representing approximately 20% of total emissions. As well as electrification in railways and urban planning, expansion of biofuel production is expected to contribute to mitigation in the transport sector.

Forestry emissions reductions are expected to account for the greatest share. The analysis in the CRGE suggests that more than half of the forestry emissions reductions would be achieved through changes in cooking technologies, including fuels. Over 90% of the country’s primary energy supply is currently biomass, a reflection of the very low proportion of the population having access to improved cooking technologies. Fuelwood consumption accounts for 46% of forestry emissions and, under business-as-usual, emissions from forest degradation (cutting for fuelwood) would increase to 45 MtCO₂eq by 2030.²⁵ The adoption of efficient fuelwood stoves is expected to contribute emissions reductions totalling 34.3 MtCO₂eq, as well as benefiting the health of women and girls. To achieve this, GTP II includes a target of 11.45 million improved stoves to be in use by 2020. This equates to a 20-fold increase in the number of efficient stoves over a five-year period, and will be a major challenge to deliver.

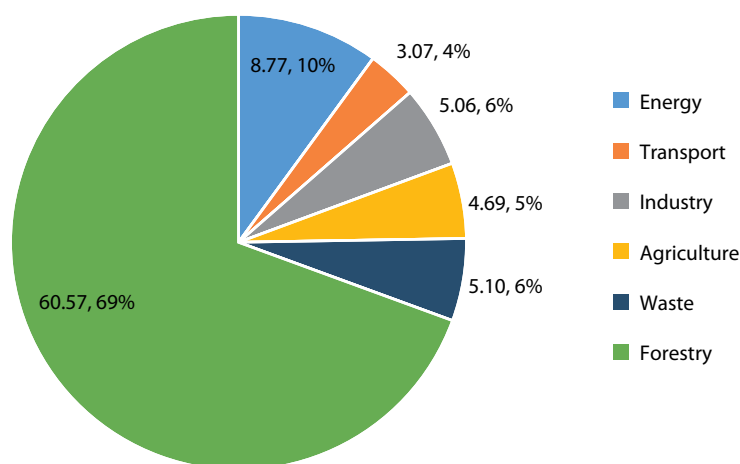
Peru

The NDC submitted by Peru to the UNFCCC on 28 September 2015 contained an unconditional target to reduce total greenhouse gas emissions by 20% below business-as-usual by 2030. The conditional target, which is subject to the provision of international financial support, was to reduce emissions by 30% below business-as-usual by 2030.²⁶ These reduction targets can be compared with the expected 75% increase in total emissions, from 170.6 MtCO₂eq in 2010 to 298.3 MtCO₂eq in 2030.²⁷ Excluding LULUCF, business-as-usual emissions are predicted to increase from 78.0 MtCO₂eq to 139.3 MtCO₂eq, a rise of 79%.

Analysis by Climate Action Tracker suggests that 70% of Peru’s emissions reductions would come from the forestry sector and 30% from energy, transport, industry and waste.²⁸ According to the NDC, energy, transport, industry and waste accounted for 46% of Peru’s total emissions in 2010,²⁹ and would account for 47% of the total in 2030 under business-as-usual.³⁰ The agriculture and LULUCF sectors are therefore expected to contribute disproportionately to the delivery of Peru’s emissions reduction targets.

The analysis of mitigation opportunities prepared for the Multisectoral Commission, which was charged with preparing the INDC, identified mitigation options in six sectors: energy, transport, industry, waste, agriculture and forestry. Implementation of these options would be expected to reduce annual emissions by a total of 87.26 MtCO₂eq by 2030. The proportions that would come from each sector are shown in Figure 3.

Figure 3. Emissions reductions by sector identified by Peru



Source: Ministry of Environment, Peru³¹

The same analysis identified 25 mitigation options for the energy sector. Collectively, these would reduce Peru’s annual emissions by 8.77 MtCO₂eq, which equates to 10.5% of total emissions reductions.³² Most of the energy sector options (see Table 2) are concerned with electricity generation and use. Many of the mitigation opportunities in the transport and industry sectors were also energy-related.

One reason for the energy sector’s forecasted continuing share of total emissions is the large proportion attributable to transport. In 2013, transportation accounted for 41.5% of Peru’s energy emissions, almost

Table 2. Emissions reduction options in the energy sector identified by Peru

Option	Emissions reduction (MtCO ₂ eq)
Integrated energy management system in industry and services	2.32
Combination of renewable energies	2.10
Improved cooking stoves	1.12
Reduction of losses in the national grid	0.89
Energy efficiency in brick-making (NAMA)	0.73
Co-generation in hospitals	0.71
Energy efficiency in new buildings (NAMA)	0.62
Co-generation in refineries	0.60
Reduced use of LT fuels in Iquitos	0.28
Replacement of street lighting	0.19
Optimisation of boilers (good practices)	0.19
Replacement of incandescent lights in housing	0.15
Energy efficiency labelling for equipment and domestic appliances	0.13
Replacement of fluorescent lights in housing	0.13
Replacement of old boilers	0.12
Replacement of old motors	0.10
Replacement of fluorescent lights in the commercial sector	0.08
Co-generation in industry	0.08
Electricity interconnection with Ecuador	0.06
Smart grids	0.06
Optimisation of motors (VSD technology)	0.05
Rural electrification with solar panels	0.05
Distributed generation with solar panels	0.04
Replacement of fluorescent street lighting	0.03
Solar water heaters for housing	0.03

Note: LT = low temperature; NAMA = Nationally Appropriate Mitigation Action; VSD = variable speed drive.

Source: Ministry of Environment of Peru (2015)³³

double the share of power generation.³⁴ For this reason, the Multisectoral Commission separated mitigation options for transport from other energy options.

Industry contributed 9.4% of Peru's total emissions in 2013.³⁵ Industrial emissions are of two kinds: those resulting from the transformation of materials in industrial processes, such as the production of minerals and metals and in the chemical industry; and those related to energy consumption by industry, including manufacturing, construction, agribusiness, mining and services. The eight mitigation options identified by the Multisectoral Commission for the industrial sector were almost all concerned with energy consumption in the cement and iron and steel industries.³⁶

The third-largest potential contribution to energy emissions reductions was identified as increased adoption of improved cooking stoves (Table 2), which would also help achieve SDG energy targets. The size of the emissions reduction contribution reflects the two thirds of the population who currently depend on traditional biomass as energy for cooking.³⁷ The options to increase distributed generation and rural electrification using solar panels would also extend access to electricity to the 25% of the

rural population who had no electricity supply in 2014. The government's energy plan for 2014-2025 anticipates universal access to electricity and 1.2 million households switching to liquefied petroleum gas (LPG) by 2025.³⁸

The mitigation options evaluated for the energy sector draw on existing national policies and plans. The National Energy Policy includes objectives to promote the development and use of clean energies and technologies, and to establish measures for the mitigation of energy-related emissions.³⁹ However, fossil fuels take a large share of Peru's overall energy mix, accounting for almost 80% of total primary energy supply and 48% of electricity generation in 2014.⁴⁰ The National Energy Plan (2014-2025) envisages a small reduction in the fossil fuel share of total primary energy supply, to 76% in 2025.⁴¹ The plan for the power sector is to achieve a 60% share for renewables by 2025, including a 5% share for 'new renewables' (i.e. solar, wind, biomass and geothermal).

Although Peru's NDC is aligned with its existing energy policies and plans, and an increase in renewable energy generation capacity is planned, further measures will be required to allow the country to make serious efforts to decarbonise its energy system.

Emissions pathway

Peru's business-as-usual emissions pathway would result in total annual emissions (including those from LULUCF) reaching 298.3 MtCO₂eq by 2030 (the NDC). This represents a 75% increase on the 2010 emissions level. Excluding LULUCF, emissions would increase by 79% to a total of 139.3 MtCO₂eq.

Although the energy sector is responsible for only 10% of total emissions, Peru's policies have a strong focus on reducing emissions from this sector. Under a legislative decree dating from 2008, the Ministry of Energy and Mines (MINEM) sets renewable energy targets for five-year periods, with priority given to the transmission of electricity generated from renewable sources.⁴² The Action Plan for 2010-2021 aims to scale up the share of renewable energy (including hydropower) in the total primary energy supply to 40%. This higher share of renewables in the energy mix would generate emissions savings of 7 MtCO₂eq by 2021.⁴³

Peru has two main energy sources for its electricity. In 2015, 49% of the country's electricity was generated by hydropower and 45% by gas-fired thermal power.⁴⁴ Peru currently has limited electricity from non-conventional renewables (i.e. solar, wind and geothermal). The security of supply from hydropower is at risk from the effects of climate change and, in the long term, electricity generation from gas may become incompatible with the Paris Agreement.

Peru's significant oil and gas reserves have created a dependence on gas for electricity. Although oil production is in decline, gas production is increasing,⁴⁵ with implications for the country's emissions trajectory. In emissions terms, growth in the production and consumption of natural gas is being offset by emissions reductions in the agriculture and forestry sectors.

Ethiopia and Peru: Conclusions

Analysis of the NDCs of Ethiopia and Peru highlights the role that can be played by geography and natural resource endowments in determining a country's greenhouse gas emissions. Although both countries have considerable renewable energy resources, their mitigation commitments depend on actions in the agriculture and forestry sectors. In the case of Ethiopia, forestry emissions are associated with energy consumption. Ethiopia's electricity is, and will continue to be, generated almost entirely from renewable sources (hydropower), while Peru will increase the share of hydropower but will retain a substantial fossil fuel generation capacity. This is related to Peru's oil and gas reserves. Both countries will face a challenge in reducing energy emissions from transport.

A notable feature of the NDC processes in Ethiopia and Peru is that in both countries the policy framework for action on climate change was well established before the Paris Agreement. Peru's National Strategy on Climate Change dates from 2003 and was revised in 2009, while Ethiopia's green economy strategy was adopted in 2011. These strategies were reflected in a variety of policies, regulations and plans. Together with technical analysis of mitigation options, these informed their NDCs.

Towards more ambitious NDCs

This section reviews the NDCs of Bangladesh and Ghana. Both countries are forecasting significant increases in total energy emissions by 2030. Although their NDCs target reductions against the business-as-usual emissions trajectory, they plan to develop their energy sectors in ways that will quadruple their emissions. Both countries target reductions that are at the low end of the range of commitments made by all lower-middle-income countries. This section aims to understand why these two countries have not been more ambitious in their initial NDC commitments, and whether there is scope for greater ambition in their revised NDCs.

Bangladesh

The Bangladesh NDC was developed by the Ministry of Environment and Forests (MOEF). While the Ministry has supported the implementation of improved cooking technologies, responsibilities for energy planning are shared with the Ministry of Finance, the Ministry of Planning, and the Ministry of Power, Energy and Mineral Resources (MPEMR).⁴⁶

The NDC itself was “prepared through consultation and dialogue with the Government’s Advisory and Technical Committees, which include a range of stakeholders including line ministries, Planning Commission, technical departments, professionals, experts, and the private sector”.⁴⁷ It was not approved at inter-ministerial level, however.⁴⁸ Because the the Ministry is not directly responsible for NDC implementation in all sectors, inter-ministerial collaboration in preparing the NDC would have helped ensure cross-ministerial ownership of its targets and implementation, including in the energy sector.

The NDC is based on existing national energy and climate policy commitments. Implementation is to be carried forward under the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), and other policies and plans.⁴⁹ Its overarching objectives are to reduce emissions and guide adaptation to the impacts of climate change, while ensuring governance support for NDC implementation and attracting international backing for its objectives.⁵⁰

The greenhouse gas emissions reductions scenario included in the INDC encompasses only the power, transport and industry sectors.⁵¹ The business-as-usual scenario forecasts a 264% increase in greenhouse gas emissions between 2011 and 2030, from 64 MtCO₂eq in 2011 to 234 MtCO₂eq in 2030. The unconditional scenario projects a 5% (or 12 MtCO₂eq) reduction in annual emissions to 2030, and the conditional scenario predicts a 15% (or 36 MtCO₂eq) reduction in emissions to 2030 compared with business-as-usual.

Emissions reductions in other sectors, including LULUCF, were not included in the NDC targets because reliable estimates for these sectors were unavailable. In 2012, the agriculture sector was responsible for 39% of total emissions and LULUCF for a further 17%, while the energy sector represented 33%.⁵² Emissions reductions in these sectors are subject to international support.⁵³

The NDC indicates that the power sector is expected to reduce emissions by between 5% and 18% compared with business-as-usual, under unconditional and conditional scenarios respectively.⁵⁴ Under the business-as-usual scenario, power sector emissions are expected to increase more than four-fold from 21 MtCO₂eq to 91 MtCO₂eq between 2011 and 2030.⁵⁵

NDC unconditional energy mitigation actions are taken from the BCCSAP, and include improved energy efficiency in the production and consumption of energy, gas exploration and reservoir management, carbon-neutral development of coalmines and coal-fired power stations, and renewable energy development. Conditional energy mitigation actions listed in the NDC include 100% of new coal-based power plants to use super-critical technology by 2030, 400 MW of wind-generating capacity to be in place by 2030, and 1,000 MW of utility-scale solar power plant to be established, also by 2030.⁵⁶

The inclusion of coalmine development and coal power production seems at odds with the global objective of emissions reduction for climate change mitigation, as does the aim to increase gas

exploration. However, Bangladesh's strategy for the development of the energy sector remains focused largely on fossil fuel generation for the central grid, and reduces the potential role of mini-grid and off-grid clean energy technologies, particularly for increasing energy access.

The NDC presents existing programmes to provide access to off-grid solar electricity and improved cooking stoves as mitigation actions. By May 2017, 4.12 million solar home systems had been installed, serving about 10% of the population.⁵⁷ However, one third of the population still lacks access to electricity. The government aims to achieve universal access to electricity by 2021, principally through grid connections.

About 90% of Bangladesh's 160 million people rely on wood fuel, agricultural waste or dung for their cooking energy.⁵⁸ The NDC includes expanded access to clean, improved cooking stoves and LPG as potential additional mitigation actions.⁵⁹ This would reduce dependence on traditional cooking technologies to less than 30% of the population by 2030, thereby contributing to emissions reductions and human health (see Box 1).

Box 1. The health co-benefits of a low-emissions energy strategy in Bangladesh

The Government of Bangladesh aims to achieve health co-benefits from the introduction of a low-emissions energy strategy. A healthier population would reduce government health expenditure and increase the number of productive hours available to the population (e.g. for education and employment purposes). Modelling by the Low Emission Development Strategies Global Partnership⁶⁰ finds that the introduction of short-term clean energy options – switching from liquid fuels, such as diesel and kerosene, to liquefied natural gas (LNG) and to biomass co-firing in coal-fired power plants – could result in 5,000 cumulative avoided premature deaths by 2020. If long-term clean energy options (increasing electricity imports and introducing demand-side improvements) are introduced alongside the short-term options, this could increase to 27,000 avoided premature deaths by 2030. Additional benefits would be gained through avoided health problems, which would allow people to spend more time on productive activities, such as education and employment.

Emissions pathway

Management of policy regarding climate change and energy is currently disjointed across different government institutions in Bangladesh. This has resulted in an energy policy focused on the need for the country to reach high-income status. The central focus of energy policy is to increase energy production for industrial production and to expand access to electricity. There is some acknowledgement of the need to reduce emissions, including an objective to improve energy intensity (defined as energy consumption as a proportion of gross domestic product) by 20% between 2013 and 2030, and regulations to promote renewable energy technologies (such as the draft feed-in tariff mechanism and the Act establishing the Sustainable and Renewable Energy Development Authority). However, the overarching objectives of the national energy policies do not prioritise the development of clean energy.

As seen in Figures 4 and 5, the Bangladesh power sector is dominated by gas-fired generation, followed by oil and imported power.⁶¹ The NDC's targets to achieve 400 MW of wind-generating capacity and 1,000 MW of utility-scale solar power plants by 2030 are not yet found in national energy policy and plans. However, the investment plan for the Scaling Up Renewable Energy Programme (SREP), developed after the NDC, identifies 3,666 MW of renewable energy capacity that can be developed. This includes solar systems, wind power, biomass and biogas generation, as well as small hydropower and mini-grid systems.⁶² The SREP investment plan aims to introduce 3,100 MW of that capacity by 2021, more than twice the renewable energy installed capacity targeted in the NDC.

Figure 4. Total primary energy supply in Bangladesh (2000-2041)

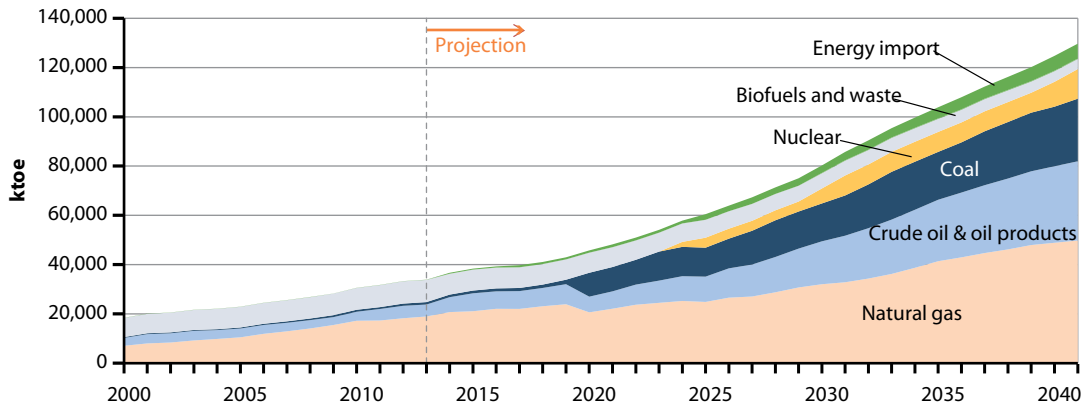
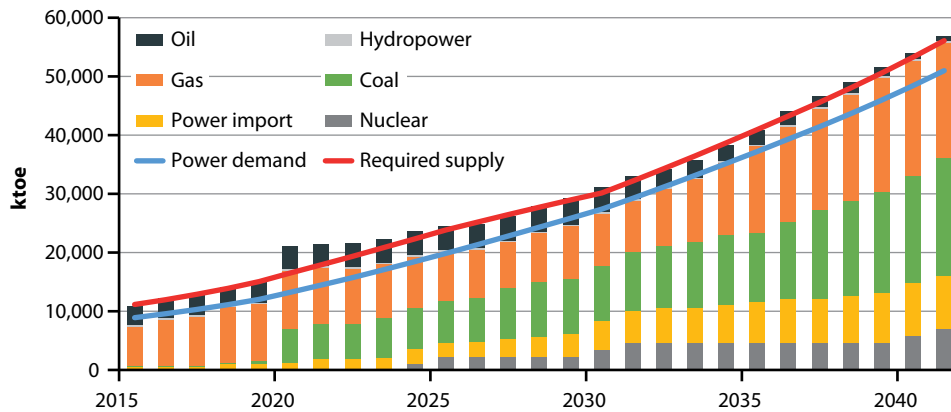


Figure 5. Trend in the energy mix in Bangladesh (2015-2041)



Note: trends in energy mix are based on a 'base case' scenario, with 35% coal and 35% gas contributions. Source: MPEMR (2016)⁶³

The recent Power System Master Plan (PSMP), developed by the Power Division of the Ministry of Power, Energy and Mineral Resources in 2016, envisages a power sector development trajectory based primarily on natural gas, coal and oil, with some contribution from other energy sources. Table 3 provides an overview of the contributions of different energy sources to installed capacity, currently and as planned for 2041. Although the PSMP was released after the NDC, it does not reflect the NDC's emissions and renewable energy targets. Instead, the PSMP envisions the development of infrastructure to enable an increase in gas and oil imports and expansion of domestic coal production to 2041, with a decline in domestic gas production.⁶⁴ As seen in Figure 5, this results in an (electricity) energy mix 'base case' scenario with increasing contributions from fossil fuels and hence rising emissions.

The result of the segregated climate and energy governance is that emissions reductions are given a low priority in Bangladesh's energy planning. The emissions trajectory is therefore likely to increase significantly over the next two decades.

Table 3. Vision 2041: Domestic production and imports of fossil fuels in Bangladesh, 2016 and 2041

	Units	Type	2016	2041
Coal	Million tonnes per year	Production	0.7	11
		Imports	0	60
Gas/LNG	Million standard cubic feet per day	Production	2,500	2,000
		Imports	0	4,000
Oil	Million tonnes per year	Imports	5	30
Biogas	Million standard cubic feet per day	Not stated*	4	62
Nuclear	MW	Not stated	0	7,200
Energy imports	MW	Imports	500	9,000
Renewable energy	–	Production	–	'Maximising renewable energy potential'

*From the SREP investment plan, this will include domestic development of biogas generation.

Source: MPEMR (2016)⁶⁵

An alternative vision for a low-emissions pathway

Bangladesh's emissions currently represent 0.35% of global emissions, although they are growing at a rate of 2% per year.⁶⁶ Although expanding energy capacity and access are important objectives, the potential contribution of renewable energy should be reviewed. Renewable energy presents an opportunity to provide lower-cost energy access compared with central grid expansion and large-scale fossil fuel developments, and will reach communities located in remote areas where the cost efficiency of extending the grid is low.

As Bangladesh aims to become a high-income country, energy provision per capita will need to increase to support rising productive activities. At the same time, the population is expected to grow to 200 million by 2050. The government will therefore need to accelerate energy provision in the coming years to meet current and future demand. The way in which the energy sector is developed to meet that demand will determine whether the country is locked into an emissions-intensive future.

The PSMP (2016) scenario analysis shows that decreasing the share of coal and increasing the share of gas would reduce future emissions. Significant emissions reductions of 234 MtCO₂eq (or 20% compared with business-as-usual) are possible by 2030 through a combination of switching liquid fuels (such as oil) to liquid natural gas, biomass co-firing in coal-fired power plants (up to 10%), electricity imports and demand-side improvements.⁶⁷

The cost of most renewable energy technologies is becoming competitive with fossil fuels.⁶⁸ In India, the cost of solar photovoltaic (PV) systems is now less than that of new and imported coal-fired power generation.⁶⁹ In Bangladesh itself, the levelised⁷⁰ costs of renewable energy technologies connected to the grid have been estimated to be as low as \$26 per kilowatt year for solar parks and \$130 for solar rooftops.⁷¹ The costs of off-grid technologies range from \$245 to \$456 per kilowatt year. Introducing the policy objective to increase renewable energy technologies would enable Bangladesh to achieve emissions reductions of greater than 20% by 2030.

When the cost of fossil fuel subsidies and negative externalities from burning fossil fuels are taken into account, the case for renewable energy technologies is strengthened. The development of renewable energy would also reduce Bangladesh's growing dependence on fossil fuel imports, which will increase sharply under the PSMP vision for 2041. The long-term target for 10 national LNG import facilities is likely to increase gas consumption and significantly increase wholesale electricity prices.⁷² Furthermore, the PSMP 2041 target of coal imports of 61 million tonnes per annum would cost the economy an estimated \$4.6 billion per year.⁷³

Beyond reducing the strain on the central grid and the relatively low levelised costs of renewable energies, off-grid technologies create opportunities for Bangladeshis who currently have no access to the central grid and who are unlikely to gain access in the near future due to the low financial viability of grid expansion in some regions.

The co-benefits of a low-carbon energy pathway

The development benefits of a low-carbon energy pathway include reduced health costs and increased employment opportunities; however, the NDC does not explore job creation aspects. Similarly, neither the national energy policies nor the 2016 PSMP explore the employment co-benefits of the renewable energy technology sector. However, the previous PSMP (2010) identified that up to 8,000 regular employees and 150,000 non-regular employees would be required for the development of the power sector in a scenario that is based largely on fossil fuels.

Some emerging evidence suggests that renewable energy technology value chains can provide more jobs on average than traditional power sector development. It is estimated that 129,000 jobs have been created in the renewable energy sector in Bangladesh, particularly in the off-grid solar PV sub-sector.⁷⁴ Based on a modelling exercise,⁷⁵ a further combination of actions (switching to LNG, biomass co-firing in coal-fired power plants, increasing electricity imports and demand side improvements) could create an estimated 110 million work hours by 2030. This is equivalent to 3,929 full-time jobs by 2030.⁷⁶

In addition, increasing the share of renewable energy technologies in the electricity mix to 10% would reduce (external) environmental costs by \$0.039 per kWh and increasing it to 20% would reduce the environmental costs by \$0.071 per kWh compared with the base case scenario.⁷⁷ Significant health benefits would also be gained when switching from traditional cooking and lighting to modern energy solutions.

Ghana

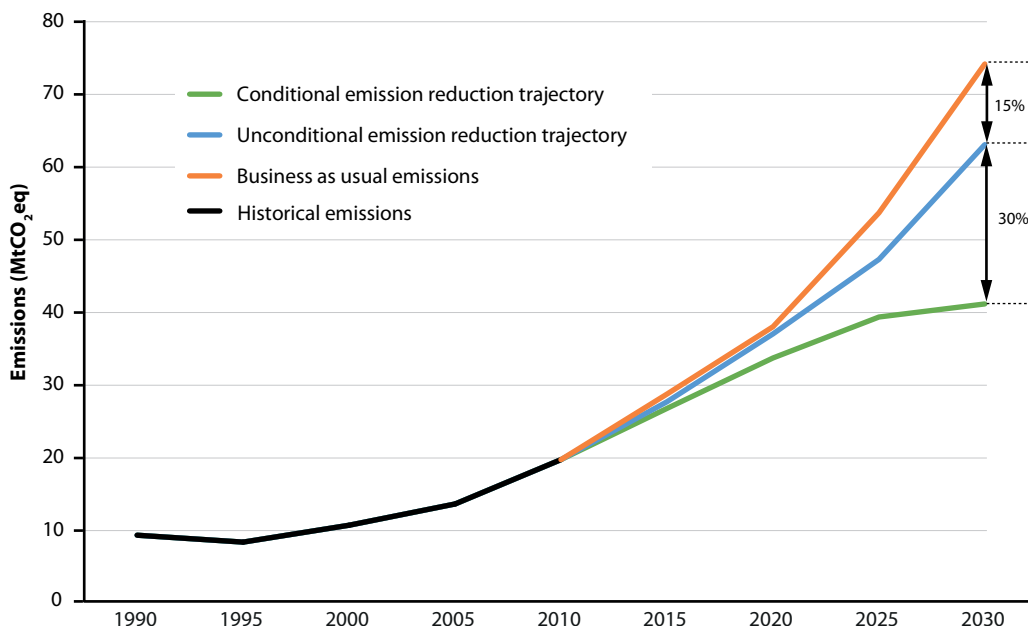
The development of Ghana's NDC was led by the Ministry of Environment, Science, Technology and Innovation (MESTI). The Ministry is not directly responsible for energy planning, although mitigation actions in the NDC are derived mainly from the energy sector. The energy sector falls under the remit of the Ministry of Energy, alongside the Ministry of Finance and the National Development Planning Commission, which have responsibilities for energy-related budgeting and broader development planning, respectively.

Ghana's NDC was "prepared through a comprehensive and participatory process with high-level cabinet approval".⁷⁸ The process included inter-ministerial discussion of the document. This increases ownership of the NDC and its targets by different government ministries, including those involved in energy policy. However, the NDC was not adopted at the level of the head of state nor submitted for parliamentary approval, which suggests it could lack political support at the highest level.⁷⁹ The NDC notes that there is a need to enshrine its objectives in national legislation and that "these revisions are subject to approval by Ghana's Parliament".⁸⁰ The Low Carbon Development Strategy developed by the Ministry of Environment, Science, Technology and Innovation in 2016 incorporates NDC objectives into national policy.

Ghana's NDC is based on existing national documents submitted to the UNFCCC. These include the National Communications, Biennial Update Reports, Nationally Appropriate Mitigation Action (NAMA) and Technology Needs Assessments.⁸¹ It is also anchored in the anticipated national 40-year long-term development vision, the Ghana Shared Growth and Development Agenda, the National Climate Change Policy and the Low Carbon Development Strategy.⁸² The overarching objectives of these policies are to promote climate mitigation and adaptation efforts, as well as to attract investment in climate mitigation and adaptation to Ghana.

The NDC's emissions reductions scenarios for Ghana to 2030 project a reduction of 15% and 30% from business-as-usual (see Figure 6).⁸³ The business-as-usual scenario predicts an increase in emissions from 19.5 MtCO₂eq in 2010 to 74.0 MtCO₂eq in 2030.⁸⁴ This is equivalent to a 379% increase. Under the unconditional scenario, emissions reductions would be equivalent to 15% in 2030, compared with 45% under the conditional scenario.⁸⁵ Box 2 lists Ghana's emissions mitigation targets.

Figure 6. Ghana NDC emissions scenarios to 2030



Source: Government of the Republic of Ghana (2015)⁸⁶

Box 2: Energy emissions mitigation targets in Ghana’s NDC

Scale up renewable energy penetration by 10% by 2030:

- Increase small–medium hydro installed capacity up to 150–300 MW
- Attain utility-scale wind power capacity up to 50–150 MW
- Attain utility-scale solar electricity installed capacity up to 150–250 MW
- Establish 55 solar mini-grids with an average capacity of 100 kW
- Scale up the 200,000 solar home systems for lighting in urban and selected non-electrified rural households.

Promote clean rural household lighting:

- Increase solar lantern replacement in rural non-electrified households to 2 million.

Expand the adoption of market-based clean cooking solutions:

- Scale up adoption of liquid petroleum gas from 5.5% to 50% of peri-urban and rural households by 2030
- Scale up access and adoption with 2 million efficient cooking stoves in use by 2030.

Double energy efficiency improvement to 20% in power plants.

Scale up to achieve 120 million standard cubic feet natural gas for replacement of light crude oil for electricity generation in thermal plants.

Source: Government of the Republic of Ghana (2015)⁸⁷

Ghana’s NDC covers the energy, transport, industry, agriculture, forestry and other land-use and waste sectors, reflecting the country’s main sources of emissions.⁸⁸ In 2012, agriculture, forestry and other land-use were responsible for 45% of national emissions; energy (including transport) was responsible for 40%; and waste for 13.4%.⁸⁹ Industrial processes were responsible for only 1.5% of emissions in the same year.⁹⁰

The NDC’s mitigation actions in the energy sector aim to scale up renewable energy penetration by 10% by 2030, increase access to solar lighting and clean cooking technologies, and improve the energy efficiency of power plants. These targets are embedded in a variety of policy documents (e.g. the 2016

Low Carbon Development Strategy)⁹¹ and programme plans. These mitigation actions will contribute to Ghana's aim to achieve universal access to electricity by 2020, up from 78% of the population in 2014.⁹² Overall, decentralised renewable energy is expected to account for 30% of rural electrification by 2020.⁹³

The mitigation actions in the NDC and energy policies aim to reduce dependence on wood fuel and other biomass energy, which accounts for over one third of total primary energy supply. The main use of biomass energy is for cooking. Only 21% of Ghanaians had access to clean cooking technologies in 2014.⁹⁴ By 2020, the aim is for 30% of the population to be using LPG and 10% to be using improved cooking stoves.

Provisions for improving the efficiency of thermal power plants include increasing gas-fired power production at the expense of oil-fired generation.⁹⁵ This will be an important tactic to lower Ghana's domestic energy emissions, while extending the life of existing infrastructure assets. However, to ensure emissions reduction targets are achieved, Ghana also needs to ensure strong diversification of the energy sector into low-carbon technologies.

Emissions pathway

Ghana's NDC emissions reduction targets have yet to be enshrined in national energy policy. The National Energy Policy (2010) sets a goal "to ensure that energy is produced and utilised in an environmentally sound manner", and outlines how this is to be pursued, but does not set targets.⁹⁶ The Strategic Energy Plan (2006-2020) mentions the importance of emissions reductions in combating climate change, and includes plans to scale up renewable energy to 10% of total electricity generation capacity by 2020.⁹⁷ However, this goal is focused exclusively on grid solutions.⁹⁸ The NDC meanwhile envisions a 10% penetration of renewable energy technologies by 2030,⁹⁹ ten years later than the existing targets, demonstrating a disjointed approach to energy policy targets across ministries and/or policy documents.

The country's national energy policies frequently cite the need to improve institutional coordination and governance of energy. While the NDC does not specify which ministry is responsible for carrying forward the ambition to reduce the country's energy emissions, the Low Carbon Development Strategy (2016) developed by the Ministry of Environment, Science, Technology and Innovation enshrines the NDC mitigation action targets, and thus denotes the Ministry of Environment, Science, Technology and Innovation as the lead ministry responsible for carrying forward the NDC targets. Coordination with the ministries responsible for energy policy and planning will be important in this regard.

The Renewable Energy Act (2011) sets out the legal framework for the feed-in tariff and obligations related to renewable energy technologies. The Low Carbon Development Strategy (2016) also provides a remit to "assess the current climate change mitigation policies/strategies and challenges", as well as to assess major emissions sources, develop long-term mitigation scenarios and develop the institutional framework needed to support implementation.¹⁰⁰

Despite these positive policy signs, around half of Ghana's total primary energy supply and electricity are provided by fossil fuels,¹⁰¹ and the country plans to continue its reliance on fossil fuels up to 2020. Under the National Energy Policy (2010), the country had aimed to become a major exporter of oil (and power) by 2012-2015, including through "sustainable exploration, development and production of the country's oil and gas endowment".¹⁰² The Strategic Energy Plan (2006-2020) echoes these commitments and sets a target for Ghana to become self-sufficient in petroleum products by 2020, as well as to accelerate the rate of hydrocarbon exploration and production, such as through competitive royalty rates of 1-4%.¹⁰³

Under the business-as-usual scenario, Ghana's emissions will almost quadruple, from 19.5 MtCO₂eq in 2010 to 74.0 MtCO₂eq in 2030.¹⁰⁴ The Strategic Energy Plan (2006-2020) meanwhile envisages that fossil fuels will continue to play an important role in the energy mix up to 2020. Table 4 shows the optimum energy and fuel mix of the Strategic Energy Plan (2006-2020). Figure 7 provides a visual demonstration that the energy mix is not expected to change substantially by 2020 (in proportional terms).

To align the NDC's climate mitigation ambitions with national energy policy, further cross-ministerial collaboration is required. The revisions of Ghana's NDC will provide an opportunity to increase ambition, engage with national energy policy planners and promote shared ownership.

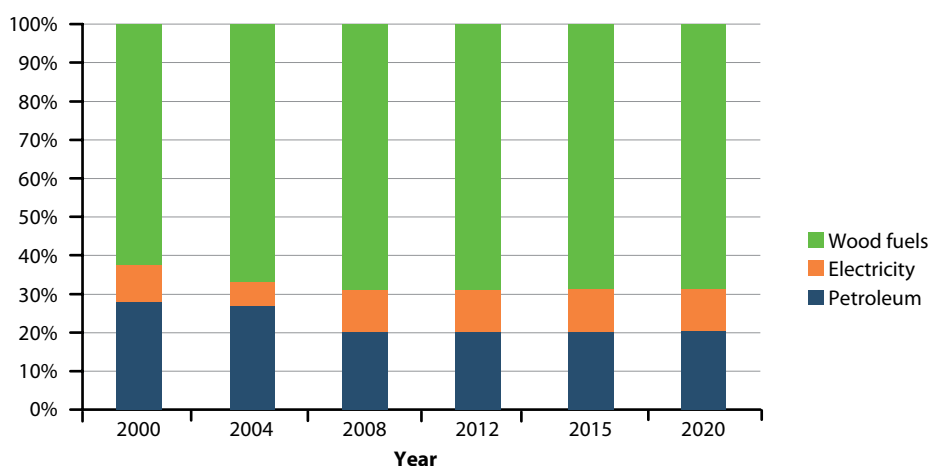
Table 4. Ghana’s energy and fuel mix, under the Strategic Energy Plan (2006-2020)

	Unit	2008 (short term)	2015 (medium term)	2020 (long term)
Wood fuels	tonnes	25–31 million	29–35 million	40–50 million
LPG	tonnes	131,800	160,600	295,000
Kerosene and jet kerosene	tonnes	218,000	241,600	336,300
Petroleum and premix petroleum ^a	tonnes	779,400	894,200	1.18 million
Diesel	tonnes	1 million	1.28–1.43 million	1.51–2 million
Residual fuel oil	tonnes	116,200–124,200	124,800–134,000	147,200–156,400
Electricity	GWh	11,300–13,500	13,800–16,300	20,100–22,300

Note: ^a Petroleum is referred to as ‘gasoline’ in the source document.

Source: Energy Commission (2006)¹⁰⁵

Figure 7. Energy shares for a high economic growth scenario under the Strategic Energy Plan (2006-2020)



Source: Energy Commission (2006)¹⁰⁶

An alternative vision for a low-emissions pathway

The scenarios explored by Ghana’s Energy Commission for the Strategic Energy Plan (2006-2020) included energy mixes in the power sector with 41–51% contributions from thermal, 39–49% from hydropower, 3–8% from nuclear and 5–10% from renewables.¹⁰⁷ The NDC retains a 10% renewable energy target by 2030.¹⁰⁸ The National Energy Policy (2010) notes that Ghana is well endowed with renewable energy resources and that these have the potential to ensure the country’s energy security. There is indeed scope for greater ambition to scale up the role of renewable energy in Ghana. For example, modelling suggests that a combination of carbon taxation, energy efficiency, and transmission and distribution investments could decrease emissions by up to 66% compared with a business-as-usual scenario by 2040.¹⁰⁹ Preparation of the Renewable Energy Master Plan, currently under development, suggests that much higher targets for installed renewable energy capacity would be possible.¹¹⁰ Additional policy measures that support the deployment of renewable energy projects more directly could help to reduce emissions even further.

The expansion of renewable energy technologies means that their costs are becoming increasingly competitive in Africa. New projects in West Africa are demonstrating some of the most competitive solar PV installation costs.¹¹¹ On-grid solar PV projects in 2014-2018 will cost from \$1.2 to \$2.9 per watt (compared with the global average for utility-scale projects of \$1.8 per watt in 2015), while off-grid stand-alone solar PV mini-grids or solar PV hybrid mini-grids (of over 200 kW) will cost \$1.9–5.9 per watt.¹¹²

Ghana has availability of renewable energy resources, in particular biomass, solar and wind, and to a lesser extent small-scale hydropower.¹¹³ With aggressive policy measures towards the deployment of renewable energy and increased energy efficiency, access to energy can be increased while, at the same

time, reducing the latent energy risk of a fossil-fuel-based energy trajectory.¹¹⁴ This, however, requires significant investment in the policy and political economy environment to protect renewable energy investors¹¹⁵ and the scaling up of public–private partnerships.¹¹⁶

The co-benefits of a low-carbon energy pathway

The employment opportunities associated with a low-carbon energy trajectory could be greater than those created under a traditional fossil-fuel-powered energy trajectory. According to Ghana’s Energy Commission, job creation gains to 2020 seem to be highest when the energy sector is most diversified (compared with other scenarios), with energy generated using natural gas, hydropower, nuclear fuels and renewable options.¹¹⁷ This scenario estimates job creation gains equivalent to 111 million construction work hours and 572 million operation and maintenance work hours by 2020, representing a total of 22,767 full-time jobs between 2006 and 2020.¹¹⁸

Ghana’s NDC estimates that job creation gains when following a low-carbon energy trajectory could be equivalent to 997.5 million job hours to 2030 or 266,000 full-time jobs during this period.¹¹⁹ This would primarily be in the renewable energy and forest sectors.¹²⁰ It is worth noting, however, that this level of job creation depends partly on the fulfilment of INDC conditional scenario actions.

A low-carbon energy trajectory could also reduce the cost of energy provision. This would have a positive impact on government expenditure for a given level of energy penetration in the population. The Government of Ghana could save significantly by diversifying its energy sector into renewables and by improving energy efficiency. Modelling indicates that under business-as-usual, the net present cost of Ghana’s energy system in 2040 would be \$15.5 billion.¹²¹ With investments in energy efficiency strategies in all sectors and the introduction of a carbon tax, this could be reduced to a net present cost of \$8.9 billion by 2040.¹²² Including strategies for the improvement of the transmission and distribution billing system and the reduction of non-technical losses would increase this slightly to a net present cost of \$9.1 billion.¹²³

Bangladesh and Ghana: Conclusions

The emissions reduction targets specified in the NDCs of Bangladesh and Ghana appear modest, even when compared with those of other countries at similar levels of development and per capita emissions. Bangladesh has an unconditional commitment of a 5% reduction on business-as-usual emissions by 2030, while Ghana has a 15% reduction. Both countries’ unconditional commitments are at the lower end of the range for all lower-middle-income countries (1–78% reductions on business-as-usual emissions). Bangladesh has a conditional commitment of a 10% reduction on business-as-usual emissions by 2030, which is one of the lowest specified by a lower-middle-income country. Ghana’s conditional commitment of a 30% reduction on business-as-usual emissions by 2030 is close to the middle of the range.

The NDCs of both Bangladesh and Ghana recognise the scope to submit more ambitious targets in revised NDCs. In its NDC, Bangladesh “reserves the right to revise its intended nationally determined contribution at any point of time” and considers its NDC to be a living document.¹²⁴ Ghana’s NDC mentions a possible review in 2025, the mid-point between 2020 and 2030. The cycle of NDC revisions set out in the Paris Agreement provides a schedule for both countries, beginning with the 2018 facilitative dialogue and an opportunity to submit a revised NDC by 2020. The analysis in this paper suggests that there is potential for both countries to submit more ambitious emissions reduction commitments in 2020 that would be consistent with their energy sector development goals.

The case for a more ambitious approach to developing low-carbon energy systems in Bangladesh and Ghana is reinforced by the development co-benefits that this could realise. Ghana’s own analysis (by its Energy Commission) suggests that a more diversified energy mix would create more jobs.¹²⁵ The NDC estimates that 266,000 jobs could be created by 2030 when following a low-carbon trajectory.¹²⁶ In Bangladesh, there are already more than 129,000 jobs in the (decentralised) renewable energy sector,¹²⁷ and around 4,000 additional jobs could be created in the power sector by switching fuels (oil to LNG), biomass co-firing in coal-fired power stations and improved demand-side efficiencies.¹²⁸

Although the NDCs of Bangladesh and Ghana take account of existing energy policies, their ministries of energy were not deeply involved in the formulation process. Structured inter-ministerial consultation was

not conducted during NDC preparation in Bangladesh. Although consultations with other ministries did take place in Ghana, the NDC did not receive approval at the level of the head of state or parliament. One consequence may be that NDC commitments are not yet fully reflected in national priorities and sectoral policies and strategies. In Ghana, the national Low Carbon Development Strategy, adopted in 2016, does reflect NDC commitments, but inconsistencies remain with the power sector master plan for 2016. In Bangladesh, the mitigation actions included in the NDC have yet to be included in the BCCSAP, which provides the basis for all national climate change policy and action. Further steps will be required in both countries to ensure the alignment of NDCs and national energy objectives.

Overall conclusions

NDCs vary considerably in their levels of ambition and in the details they provide about how commitments will be achieved. The depth of analysis underpinning the overall emissions reduction targets also varies between countries. Most NDCs refer to existing relevant national policies and strategies. However, national policies may be several years old and may not fully reflect the challenges of climate change. They may also be under revision. Where climate change is integral to national policies and development strategies (as in Ethiopia, for example), NDC commitments are more likely to be aligned with sectoral plans.

References to energy sector policies and plans in the NDCs are not always comprehensive, and commitments on energy emissions are not always aligned with energy plans. In some countries, the disjointed nature of energy sector policy and planning contributes to this inconsistency. Unsynchronised planning calendars and policy development processes for different elements of the national energy system, including the separation of renewable energy from conventional energy policy, results in diverse and sometimes inconsistent energy targets.

Many NDCs were prepared in 2015 over a short period of time, and the timing did not coincide with the cycle of national development or sectoral planning. It is almost inevitable, therefore, that NDC mitigation targets are not yet reflected in the national energy policies and plans of many countries. While alignment is beginning to take place in some countries (e.g. Ghana's Low Carbon Development Strategy), NDCs have been produced for an international audience and there may be political (or tactical) reasons to maintain differences between them and national planning objectives.

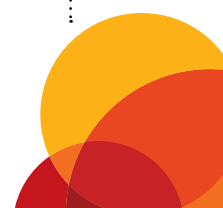
In many countries, the environment ministry is responsible for preparation and oversight of the NDC, but implementation will require action by several line ministries. The extent of inter-sectoral consultation in the preparation of NDCs varies between countries. The cross-government approaches taken by Ethiopia and Peru have helped ensure collaboration among ministries and may contribute to further cooperation during implementation. Opportunities to identify synergies and the development co-benefits of mitigation actions (e.g. for poverty reduction, job creation and health) could be missed due to the continued separation of NDC planning from national development policy.

The main priority of the energy sector in many countries is to expand the supply to meet rapidly growing and unmet demand. Generally, emissions reduction is a low priority for the energy sector, which is unreceptive to a narrative that presents development as a co-benefit of mitigation (rather than the other way around). However, the mitigation potential of access to modern energy services is recognised in the NDCs reviewed here, particularly with respect to energy for cooking. Sadly, progress on universal access to clean cooking technologies lags well behind access to electricity. Where emissions reductions from cooking energy are significant for NDC objectives (e.g. in Ethiopia), substantial change will be required from business-as-usual. Many countries are not on track to achieve the SDG target, including Bangladesh, Ethiopia and Ghana.

Commitments to energy sector emissions reduction, relative to a business-as-usual trajectory, are clearly determined in part by a country's energy resource endowment and opportunities for energy emissions reductions that do not compromise the expansion of affordable energy supply. Nevertheless, some countries could be more ambitious in their energy emissions reduction targets and still meet their energy development objectives. The revision of NDCs, beginning with the facilitative dialogue in 2018, provides an opportunity for these countries to realign their NDCs and energy plans.

Acronyms and abbreviations

BCCSAP	Bangladesh Climate Change Strategy and Action Plan
CDKN	Climate and Development Knowledge Network
CRGE	Climate Resilient Green Economy (Ethiopia)
GTP	Growth and Transformation Plan (Ethiopia)
GW	gigawatt
INDC	Intended Nationally Determined Contributions
ktoe	thousand tonnes of oil equivalent energy
LCDS	Low Carbon Development Strategy (Ghana)
LNG	liquefied natural gas
LPG	liquid petroleum gas
LT	low temperature
LULUCF	land use, land-use change and forestry emissions
MESTI	Ministry of Environment, Science, Technology and Innovation (Ghana)
MINEM	Ministry of Energy and Mines (Peru)
MOEF	Ministry of Environment and Forests (Bangladesh)
MPEMR	Ministry of Power, Energy and Mineral Resources (Bangladesh)
MtCO ₂ eq	megatonnes carbon dioxide equivalent
MWh	megawatt hours
NAMA	Nationally Appropriate Mitigation Actions
NDC	Nationally Determined Contributions
PSMP	Power System Master Plan (Bangladesh)
PV	photovoltaic
SDG	Sustainable Development Goal
VSD	variable speed drive
SREP	Scaling Up Renewable Energy Programme (Bangladesh)
toe	tonnes of oil equivalent energy
TPES	total primary energy supply
UNFCCC	United Nations Framework Convention on Climate Change



Endnotes

1. This paper uses NDC throughout to refer to the INDCs that have now become NDCs. INDC is used only where the reference is to the pre-ratification stage.
2. van Tilburg, X., Lütkehermöller, K., Rawlins, J., Roeser, F. and Luitjen, J. (2017) *NDC update report: We have lift off ...* Energy Centre of the Netherlands and New Climate Institute.
3. UNEP's 2016 Emissions Gap Report estimates that with full implementation of the NDCs, the average global temperature will rise by 3.2°C. UNEP (2016) *The emissions gap report 2016*. Nairobi: United Nations Environment Programme.
4. Scott, A., Van der Berg, L. and Patel, S. (2016) *Aligning objectives: International climate commitments and national energy strategies*. London: Overseas Development Institute.
5. Nordic Council of Ministers (2017) *Mitigation & adaptation synergies in the NDCs*. Nordic Council of Ministers.
6. Cabré, M. and Sokona, M.Y. (2016) 'Renewable energy investment in Africa and Nationally Determined Contributions (NDCs)'. GEGI Working Paper 11/2016. Boston: Global Economic Governance Initiative, Boston University.
7. Australian German Climate & Energy College (2016) *NDC Factsheet: Bangladesh* (http://climatecollege.unimelb.edu.au/files/site1/factsheets/Bangladesh_INDCFactsheet_UoM-PRIMAP_GWPAR4.pdf); Australian German Climate & Energy College (2017) *NDC Factsheet: Ethiopia* (http://climatecollege.unimelb.edu.au/files/site1/factsheets/Ethiopia_INDCFactsheet_UoM-PRIMAP_GWPAR4.pdf); Australian German Climate & Energy College (2016) *NDC Factsheet: Ghana* (http://climatecollege.unimelb.edu.au/files/site1/factsheets/Ghana_INDCFactsheet_UoM-PRIMAP_GWPAR4.pdf); Australian German Climate & Energy College (2016) *NDC Factsheet: Peru* (http://climatecollege.unimelb.edu.au/files/site1/factsheets/Peru_INDCFactsheet_UoM-PRIMAP_GWPAR4.pdf).
8. World Bank (2017) World Bank Country and Lending Groups (<https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>).
9. International Energy Agency statistics (www.iea.org/statistics/).
10. IEA and World Bank (2017) *Global Tracking Framework 2017*. Washington, DC: World Bank.
11. Republic of Ethiopia (2015) *Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia*. Addis Ababa: Federal Democratic Republic of Ethiopia.
12. The focus of this paper is on mitigation commitments, but it can be noted that Ethiopia's NDC also includes 17 adaptation objectives.
13. Republic of Ethiopia (2015) Op. cit.
14. This does not include the estimated reduction of 19 MtCO₂eq in neighbouring countries due to the export of electric power to them from Ethiopia.
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