BMZ Federal Ministry
for Economic Cooperation
and Development

Future-Makers.
Building the future.
Let's join forces.

Assessing development impacts: lessons from a case study in Ghana

Published by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

In cooperation with ECN

Acknowledgement

This publication has been produced with the assistance of GIZ, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The authors would like to thank Donald Pols of the Energy research Centre of the Netherlands (ECN) and Daniel Blank of GIZ for their valuable insights and review.

Assessing development impacts: lessons from a case study in Ghana

Abbreviations and acronyms

ADB	Asian Development Bank
BMZ	*Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung*
BAU	Business as usual
CO_2	Carbon Dioxide
CDM	Clean Development Mechanism
CGE	Computable General Equilibrium
COP	Conference of the Parties
CEA	Cost Effectiveness Analysis
CBA	Cost-benefit Analysis
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit*
DIA	Development Impact Assessment
EISD	Energy Indicators for Sustainable Development
ECN	Energy Research Center Netherlands
EPA	Environmental Protection Agency
FIGI	Framework of Inclusive Growth Indicators
GCMC	Ghana Cylinder Manufacturing Company
GACC	Global Alliance for Clean Cookstoves
GHG	Greenhouse Gases
GDP	Gross domestic product
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
IAM	Integrated Assessment Model
IAEA	International Atomic Energy Agency
ICS	Improved cookstoves
ICT	Information and communication technology
IISD	International Institute for Sustainable Development
$ktCO_2$	Kilo-tons carbon dioxide
$kT\ CO_2/yr$	Kilo-tons carbon dioxide per year
KfW	*Kreditanstalt für Wiederaufbau*
KNUST	Kwame Nkrumah University of Science & Technology
KP	Kyoto Protocol
LPG	Liquefied Petroleum Gas
LEDS	Low Emission Development Strategies
LEDS GP	Low Emissions Development Strategies (LEDS) Global Partnership
MACCs	Marginal Abatement Cost Curves
MFPs	Multifunctional platform, a machine that produces mechanical and electrical energy to reduce time and physical labour for agro-processing activities in rural areas
MW	Megawatt
MWh	Megawatt hour
MOEP	Ministry of Energy and Petroleum
MEST	Ministry of Environment Science and Technology
MCA4climate	Multi-Critical Analysis for Climate Change
MSW	Municipal Solid Waste
NBP	National Biofuel Policy
NDPC	National Development Planning Commission of Ghana
NREL	National Renewable Energy Laboratory
NAMAs	Nationally Appropriate Mitigation Actions
NPV	Net Present Value
NGO	Non-Governmental Organisation
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PUE	Productive uses of energy
REDD+	Reducing Emissions from Deforestation and Degradation
SNEP	Strategic National Energy Policy
SD tool	Sustainable Development Tool
SE4ALL	Sustainable Energy for All, an initiative of the UN
TNA	Technology Needs Assessment
TB	Tuberculosis
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD/tCO_2	US dollar per CO_2

Contents

Summary

There is a growing need to understand the impacts of countries actions from both a development and mitigation perspective. Development activities are increasingly being judged against their compatibility with climate change. At the same time, the dialogue around climate change is being reframed to recognise the national priorities of developing countries to improve their economies, societies and environment. Although there is a relatively long history of assessing sustainable development impacts of low-carbon projects, e.g. in relation to the Clean Development Mechanism (CDM), there are few tools available to decision-makers at the national or sector level.

In recognition of this, a Development Impact Assessment (DIA) visual was developed by the U.S. National Renewable Energy Laboratory (NREL), the Energy research Centre of the Netherlands (ECN), the International Institute for Sustainable Development (IISD) and GIZ within the LEDS Global Partnership (LEDS GP). The DIA visual links an action's development impacts with its mitigation potential and cost in order to provide a more comprehensive basis for decision making and communication - as compared to mitigation analysis using marginal abatement cost curves (MACCs) alone. The output can be used within government or with development partners and other stakeholders to help demonstrate priorities, communicate impacts and compare different low-carbon actions. The process and results attempt to combine climate impacts – which are often relevant to an international audience of negotiators and donors – alongside development impacts – which are most relevant for domestic stakeholders (Figure 1).

● Highly positive ◓ Positive ▬ Neutral / Minor impact ◡ Negative ◓◡ Uncertain / policy specific	Climate			Economic				Social					Environmental impact
	Abatement potential (2020 ktCO$_2$)	Abatement cost (2020 USD/tCO$_2$)	Climate resilience	GDP / macroeconomic impact	Energy security	Rural economic impact / development	Household / consumer impact	Employment	Energy access	Health	Education	Gender	
Improved cookstoves Rural woodfuel use intensity reduced by 10 % through improved cookstoves	200	-2 to 0	●	◓	◓	◓	◓	◓	◓	●	●	●	●
LPG for cooking LPG access by 2020 is 50 % as opposed to projected 24.5 %	360	3 to 85	●	◓	●	◓	◓	◓	●	●	●	●	●
Productive uses of energy (PUE) Irrigation 14000ha with RE (pilot prog.) 2000 RE powered MFPs (pilot prog.)	20	n.a.*	◓	◓	▬	●	◓	▬	◓	●	◓	●	▬
Improved charcoal production Plantations and improved conversion technologies penetrate 10 % of supply	100	1.5 to 20	◓	▬	▬	◓	▬	◓	▬	◓	▬	▬	◓
Landfill gas generation Accra and Kumasi landfills developed by 2020; approx. 30 MW of generation	360	18	●	▬	▬	▬	▬	▬	▬	●	▬	▬	●
Biodiesel production Domestic requirement for 5 percent blend by 2020	295	66	◓◡	▬	▬	◓	◓	◓	▬	●	▬	◓	◓

Figure 1 Overview of the DIA visual tool showing options listed down the left hand side and impacts (both climate and development) across the top. The impact scale (top left) uses colour and shape coded markers.

This DIA visual was applied in Montenegro and Kenya; however, these examples did not directly involve national stakeholders in a 'live' assessment of impacts[1]. From the perspective of better understanding the DIA visual, there was therefore an interest in applying it in a stakeholder workshop environment. A case study in Ghana was used to apply the tool in a 'live' setting with stakeholder involvement.

Ghana has set ambitious targets to cover 10 % of its electricity supply with renewable energy by 2020 as well as achieving "availability of and universal access to energy services and for export". The Government of Ghana is currently developing concrete strategies and programmes in order to meet these targets. Part of this process has included engagement with the UN initiative Sustainable Energy for All (SE4ALL), which produced a Situational Analysis Report in May 2012 and a Country Action Plan in June 2012.

Based on these documents and discussions with stakeholders in Ghana, there was an opportunity to apply the DIA visual to improve the understanding of the potential, costs, development impacts and trade-offs of the priority options considered in the SE4ALL initiative, as well as other relevant technology options proposed by stakeholders. Following discussions with local stakeholders, the DIA visual was applied as a case study to six technology options in the Ghanaian energy sector.

1. **Improved cook stoves;** focussing on rural woodfuel use
2. **LPG for cooking;** focussing on replacing charcoal stoves
3. **Productive uses of energy (PUE);** for example, solar drying, wind pump irrigation, etc.
4. **Biodiesel;** for domestic use
5. **Landfill gas for electricity**
6. **Improved charcoal production;** the largest single primary energy use in Ghana.

In order to apply the DIA visual in Ghana, a four-step process was followed to, firstly, ensure alignment of the process with national needs and, secondly, to obtain stakeholder input during the preparatory activities and during the assessment of development impacts. These steps were:

1. **Engagement and scope;** initial engagement with stakeholders in order to introduce the DIA visual, and determine a relevant scope for the study
2. **Indicators;** discussion of an appropriate set of indicators with stakeholders and review of prior practices
3. **Impacts;** in a quantitative sense for mitigation impacts as well as collation of a more qualitative set of supporting information on development impacts
4. **Assessment;** test the DIA visual at a workshop with stakeholders. Both to complete the case study DIA visual and provide feedback on the use and relevance of the tool.

There were two striking aspects to the assessment results (Figure 1). First, that a diverse group of stakeholders reached consensus on a final DIA for a wide range of technology options. The DIA visual process encouraged a structured debate that allowed individual technology options and indicators to be considered on a case by case basis. Second, the final assessment broadly supported the prioritisation of actions that was observed in the SE4ALL Action Plan. The workshop and results showed that a more formal DIA could be used to complement government planning/policy processes and build consensus amongst stakeholders.

The process of applying the DIA visual in Ghana and in following the four steps above, revealed a number of valuable lessons on how to use the DIA visual and for applying DIA more broadly. They are grouped into four categories:

1 **Stakeholders**
Stakeholder diversity; there is immense value in having a diverse range of stakeholders, with experience across different relevant sectors and the full range of development indicators.
Common aims; it is important that the aims of

---

[1] See Cox et al. (2013) for a discussion of how stakeholder views were accounted for n these exercises.

the workshop and DIA visual are clearly explained to participants in advance.

Supporting information; it is important to provide supporting information, in this case through one-page factsheets that will allow everyone to have a common minimum level of understanding of the technology options.

Facilitation and format; in order to improve ownership of the process and results, a local partner facilitated the workshop. The use of smaller break-out groups encourages everyone to contribute to the discussions and allows a focus on a smaller sub-set of options without overwhelming people with the full matrix.

2. **Indicators**
   Prior knowledge; there was generally a strong awareness amongst stakeholders of the types of development impacts of low-carbon actions. However, it was often the case that participants had not considered these impacts in significant detail or in a structured way.

   Type and number of indicators; the indicators that are used need to be relevant to the target audience of the technology options. Equally, balancing pragmatism with detail was seen as important. Defining too many indicators makes the assessment difficult and lengthy, but crucially also make interpretation of the results difficult. Defining too few indicators bears the risk of overly simplifying development impacts or providing insufficient differentiation between options to be useful.

   Complex indicators; it was practically very difficult to assess aggregate indicators (such as GDP or climate resilience) which are effectively composites of (or at least influenced by) a number of other more specific indicators. It is therefore useful to quantify, disaggregate or, at least, note the limitations of complex indicators and inter-linkages.

3. **Assessing impacts**
   Context sensitivity; impacts are not only influenced by technologies or deployment scenarios, but also by form of implementation (i.e. policy). Any technology scenario being described should try to be as descriptive as possible about the approach to implementation. Similarly, impacts are often country or region specific. Taken together, these considerations mean that it is difficult to generalise about the development impacts of any one technology.

   Judging scale; it is difficult to account for scale when comparing impacts of different options. One option may have large impacts per unit effort or cost when compared to another, but the DIA visual is not normalised in this way. Hence a technology that is implemented at pilot scale may look less favourable when held up against a full scale implementation of a second technology, even though the former has higher benefits with respect to its scale. Increasing the level of quantitative assessment of development impacts may be one way to help overcome this challenge, but may not always be possible.

   Absolute or relative impacts; it is clear that mitigation potentials and abatement costs are calculated against a business as usual (BAU) or reference case. However, this use of a baseline technology as a reference is arguably less relevant when assessing development benefits, particularly in a workshop environment. Another solution to this challenge would be to include the BAU technology in the DIA visual as one of the options to be assessed. The broader message here is the need to be transparent about the impacts of replaced technology (i.e. recognise any trade-offs of pursuing low-carbon technologies).

4. **Relevance**
   Relevant scenarios; it is vital that relevant implementation scenarios are chosen, which are either grounded in current government ambitions or based on a realistic potential for implementation.

Recognition of limitations; it is important not to oversell the DIA visual and to make it clear that the visual is a discussion and communication tool; an aid to decision making rather than a mechanistic tool for prioritisation.
Expansion beyond impacts; it may be very valuable to complement the development indicators in the DIA visual with information on barriers. Without these barriers it was felt that there could be a tendency for the results of the visual to look overly positive. Closely linked to this is the need to consider measures of cost other than marginal abatement cost, such as total investment costs or public funding requirements, which are often more relevant to policymakers.

Outlook

Although this case study was focused on energy sector technology options, the DIA visual is equally applicable for other sectors. Moreover, the DIA visual is methodology-neutral in terms of how impacts are assessed. In this case study, a stakeholder workshop supported by neutral factsheets (with limited quantitative information) was used to make an assessment of impacts; however, one could also imagine certain indicators that lend themselves to a more quantitative assessment of impacts.

The DIA visual's primary selling points are its ability to facilitate discussion and communicate findings to aid in prioritisation. It can provide information on the initial assessment of development impacts and facilitate comparability of technology options within a sector in this regard. A DIA may also provide initial input to the design of monitoring and reporting systems for the implementation of technology options. Lastly, the DIA visual is not a mechanistic decision making tool, rather an aid to decision making. Clearly communicating the benefits of DIA processes, as well as their limitations, is a key factor in encouraging their adoption.

Woman transporting firewood on her head.
©GIZ/Ursula Meissner

1 Introduction

The historical institutional divide between development goals and tackling man-made climate change is disappearing. On the one hand, development activities are increasingly being judged against their compatibility with climate change and, on the other hand, the dialogue around climate change is being reframed to recognise the national priorities of developing countries to improve their economies, societies and environment. An example of this can be seen in the emerging UNFCCC concepts of Low Emission Development Strategies (LEDS) and Nationally Appropriate Mitigation Actions (NAMAs).

In this context there is a need to understand the impacts of countries' actions from both a development and mitigation perspective. To do this a Development Impact Assessment (DIA) visual was developed by the U.S. National Renewable Energy Laboratory (NREL), the Energy research Centre of the Netherlands (ECN), the International Institute for Sustainable Development (IISD) and GIZ within the LEDS Global Partnership[2] (Cowlin *et al.*, 2012). This DIA visual was applied in Montenegro and Kenya; however, these examples did not directly involve national stakeholders in a 'live' assessment of impacts[3]. The visual links the development impacts of an action with its mitigation potential and cost, in order to provide a more comprehensive basis for decision making and communication, as compared to mitigation analysis using marginal abatement cost curves (MACCs) alone. The output can be used within government or with development partners and other stakeholders to help demonstrate priorities, communicate impacts and compare different low-carbon actions. The process and results attempt to combine climate impacts – which are often relevant to an international audience of negotiators and donors – alongside development impacts – which are most relevant for domestic stakeholders.

In this study, the DIA visual was applied as a case study to six options in the Ghanaian energy sector. This report is one of two produced from that work. The first report focuses on the technical results of the case study, in terms of quantifying mitigation impacts and assessing development impacts (Cameron *et al.*, 2013). This second report discusses the broader lessons learnt from the case study.

This introductory chapter provides: some context on the Ghanaian energy sector; a short history and understanding of the DIA visual itself; and the aims of the initial project. Chapter 2 gives a sampling of the historical use of development impact assessments in decision making based on a number of examples. Chapter 3 describes the approach and results from the Ghana case study. Chapter 4 draws lessons from the process and findings with conclusions presented in Chapter 5.

1.1 Country context

Ghana has shown impressive economic development over the past decades to become a middle-income country and this growth is expected to continue, partly driven by the relatively recent discovery and ongoing extraction of offshore petroleum resources. This growth calls for a large expansion of electricity infrastructure, approximately doubling supply generation levels from 2010 until the end of the decade, while facing increasing pressure on natural resources from wood extraction and a rural population that often lacks access to modern energy services.

At the same time, Ghana has set ambitious targets to cover 10 % of its electricity supply with renewable energy by 2020 as well as achieving "availability of and universal access to energy services and for export". At the current moment the Government of Ghana is developing concrete strategies and programmes in order to meet these targets. Part of this process has included engagement with the UN initiative Sustainable Energy for All (SE4ALL), which produced a Situational Analysis Report in May 2012 and

---

[2] http://ledsgp.org

[3] See Cox *et al.* (2013) for a discussion of how stakeholder views were accounted for in these exercises.

a Country Action Plan in June 2012 that detailed three priority 'pillars': liquefied petroleum gas (LPG) for cooking, improved cook stoves and productive uses of energy; along with a number of other areas for action.

Based on these documents, and discussions with stakeholders and development partners in Ghana, there was an opportunity to improve the understanding of the potential, costs, development impacts and trade-offs of the options considered in the SE4ALL initiative, as well as other technology options that were relevant to Ghanaian stakeholders.

1.2 DIA visual

Choosing different options and priorities for inclusion in planning and strategy is not a new challenge for policymakers. Several tools have been used to help analyse and present development and climate impacts. Examples include cost-benefit analyses (CBA)[4], with a focus on quantifying various impacts in economic terms, and marginal abatement cost curves (MACCs), which consider the costs of achieving climate (specifically mitigation) impacts. While it is not the intention here to discuss the pros and cons of the variety of available tools, it should be noted that many of these tools are flexible in terms of their scope. An approach such as CBA may attempt to monetise certain social or environmental impacts, or may simply consider direct economic impacts only.

The analysis produced through these tools can provide valuable insights, but they tend to exclude certain types of benefits that are more difficult to include in the frame of their analytical approach (for example, climate impacts in CBA, or social impacts in a MACC). A simple way to communicate development benefits and facilitate decision-making around low carbon interventions is needed; i.e. combining both climate and development impacts.

To answer this need, the LEDS Global Partnership proposed a visual that included both the information found in MACCs and an assessment against different development indicators based on an impact scale (Figure 2; see Section 3.4 for the full visual). On this scale impacts are depicted as “highly positive”, “positive”, “neutral or minor impact”, “negative” or “uncertain/policy specific”.

---

[4] And their associated metrics of financial return such as net present value (NPV)

● Highly positive
◓ Positive
▬ Neutral / Minor impact
◡ Negative
⊖ Uncertain / policy specific

	Climate			Economic				Social					
	Abatement potential (2020 ktCO$_2$)	Abatement cost (2020 USD/tCO$_2$)	Climate resilience	GDP / macroeconomic impact	Energy security	Rural economic impact / development	Household / consumer impact	Employment	Energy access	Health	Education	Gender	Environmental impact
Improved cookstoves Rural woodfuel use intensity reduced by 10 % through improved cookstoves	200	-2 to 0	●	◓	◓	◓	◓	◓	◓	●	●	●	●
LPG for cooking LPG access by 2020 is 50 % as opposed to projected 24.5 %	360	3 to 85	●	◓	●	◓	◓	◓	●	●	●	●	●
Productive uses of energy (PUE) Irrigation 14000ha with RE (pilot prog.) 2000 RE powered MFPs (pilot prog.)	20	n.a.*	◓	◓	▬	●	◓	▬	◓	●	◓	●	▬
Improved charcoal production Plantations and improved conversion technologies penetrate 10 % of supply	100	1.5 to 20	◓	▬	▬	◓	▬	◓	▬	◓	▬	▬	◓
Landfill gas generation Accra and Kumasi landfills developed by 2020; approx. 30 MW of generation	360	18	●	▬	▬	▬	▬	▬	▬	●	▬	▬	●
Biodiesel production Domestic requirement for 5 percent blend by 2020	295	66	⊖	▬	▬	◓	◓	◓	▬	●	▬	◓	◓

Figure 2 Overview of the DIA visual tool showing different options listed down the left hand side and different impacts (both climate and development) across the top. The impact scale (top left) uses colour and shape coded markers.

There is no predefined guidance for how these impacts should be assessed. They can be assigned through quantitative (for example, a calculation of the number of jobs created) or qualitative (for example, based on expert judgment and supporting evidence) analyses depending on data availability and method preferred by stakeholders. In that sense, the complexity of the visual is flexible, yet it provides a simplified method to compare options using multiple criteria of most interest to stakeholders (Cox *et al.*, 2013).

The DIA visual, therefore, has a relatively open ended scope (in terms of what types of indicators or impacts are considered) and can be more or less rigorous, depending on how these impacts are estimated. Figure 3 tries to show different tools (that could be used for assessing climate or development impacts) on two spectrums of scope and complexity, simply to give a sense of where the DIA visual could be considered to 'fit' versus other tools. Nearly all of the tools in Figure 3 can be applied in different levels of detail; for example, accounting for more or fewer impacts, so this picture should be considered as an indicative conceptualisation only.

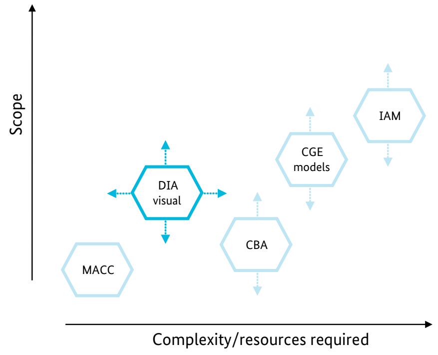


Figure 3 Conceptualisation of the relative complexity of different tools[5] versus their scope (in terms of considering impacts and interactions)

---

[5] where MACC = Marginal Abatement Cost Curves; CEA = Cost Effectiveness Analysis; CBA = Cost Benefit Analysis; CGE = Computable General Equilibrium; IAM = Integrated Assessment Model

The DIA visual has been previously applied in case studies in Montenegro and Kenya. In these two cases the assessment of impacts was predominantly carried out by international experts involved in those programmes of research. In Montenegro the DIA visual was completed by a team that used stakeholder responses to a prior technology needs assessment (TNA), but the results were not formally presented to stakeholders. In Kenya, the assessment was made by a team including some local experts, based on expert judgment and supporting evidence. The overall assessment of options was then validated at sector stakeholder workshops and through written responses.

This case study in Ghana is the first time that an assessment of development impacts has been done collaboratively within a group of country stakeholders. This involvement of decision-makers and stakeholders in the impact assessment process is important. It creates ownership and buy-in for the results; develops a stronger understanding of the various options being compared and raises awareness of aspects/impacts that might not have been known to all; and gives local insights into development impacts that may otherwise be overlooked.

1.3 Aim

Outputs

The aim of the work was to select a set of relevant and topical technology options in the Ghanaian energy sector and apply the DIA visual to these options in a collaborative stakeholder setting. From this a completed DIA visual was produced along with a background report describing the process and supporting information.

Outcomes

It is expected that the results can be used to support the decision making processes around increasing access to sustainable energy. Specifically, the tool is expected to support the

- Ministry of Energy, Ghanaian Energy Commission and National Development Planning Commission (NDPC) in gaining a deeper understanding of development impacts of different energy technologies, complementing a more traditional mitigation analysis that considers abatement potential and costs.
- alignment of Ghana's sustainable energy strategies and programmes (particularly the SE4ALL Action Plan) with the country's development goals and promote stronger linkages between development goals and climate mitigation ambition – and the potential for climate finance associated with this ambition.
- illustration of anticipated development impacts of planned activities.

The application and further development of the tool could also assist in the prioritisation and future development of Nationally Appropriate Mitigation Actions (NAMAs) or LEDS in Ghana, or be used by the Ministry of Environment in an ex-post manner to describe the mitigation impacts of existing development programmes and policies. The former possibility came up during discussions with development partners, while the latter was proposed by the Environmental Protection Agency (EPA) in relation to its role in preparing and submitting National Communications (and in the future, Bi-annual Update Reports).

2 Decision making and DIA

The assessment of development impacts can be used in various ways to influence government decision-making. LEDS are expected to result in GHG mitigation, as well as help to meet broader national development goals, such as poverty alleviation, economic growth and energy security. DIAs can help governments determine if low-carbon actions contribute to meeting these development goals, and can be helpful in monitoring sustainable development impacts by determining which areas need further elaboration and detailed indicators. Development impacts are typically assessed using the three pillars of sustainable development: economic, social and environmental impacts[6].

This section examines how sustainable development assessments have influenced government decision-making, looking at examples from the CDM and exploring early influences of development impact assessment on decisions in Kenya and Guyana.

2.1 Development Impacts in CDM

A variety of tools and approaches have been used to assess development impacts in CDM projects, helping host governments, developed country governments and private sector investors select CDM activities that bring positive sustainable development impacts. The voluntary CDM sustainable development tool (SD tool) was approved by the CDM Executive Board in November 2012 to assist project participants in describing the sustainable development co-benefits[7] of their CDM activities against established criteria. This tools aim to provide sound qualitative and quantitative criteria for describing sustainable development impacts, consistency across SD evaluations, and a means to report on aggregated performance of sustainable development co-benefits for various types of CDM activities in various host countries over time (UNFCCC, 2012a and 2012b). Other important tools in the CDM with staying power and broad reach include the Gold Standard and the Climate Community and Biodiversity Alliance for land-use projects.

Developing country decisions to pursue or approve CDM activities have been influenced by outcomes of sustainability assessments. For example, early in the development of CDM activities, Uruguay stressed the importance of sustainable development benefits as a criterion for approval of CDM activities, and developed and used the sustainability assessment tool, Multi-Attributive Assessment of CDM Projects, to facilitate a quantitative assessment of potential projects regarding their contribution to sustainable development (Heuberger *et al.*, 2007).

Several studies have attempted to determine if the CDM contributed to sustainable development, and what types of projects created the most benefits (see for example, Cosbey *et al.*, 2005; Olsen and Fenhann, 2008; Sun *et al.*, 2010; TERI, 2012). This body of work generally determined that the greatest level of co-benefits could be generated through renewable energy, energy efficiency, agriculture, and forestry activities if they account for sustainable development early in the design phase.

Three examples of how sustainable development assessments have impacted country decision are described below:

---

[6] The term "sustainable development" has existed for decades, yet no coherent set of quantified goals, targets and indicators exists to measure its progress (UNEP, 2012). Twenty-five years ago, the 1987 World Commission on Environment and Development proposed to develop new ways to assess this progress. This was echoed in subsequent international summits and agreements on sustainable development, including the first Rio Summit in 1992, the Johannesburg Plan of Implementation in 2002, the UN Commission on Sustainable Development, and the Millennium Development Goals. These efforts have influenced sustainable development assessments, including those taken under the Clean Development Mechanism (CDM) and early efforts to measure development impacts under LEDS and NAMAs.

[7] The language of 'co-benefits' is often seen in relation to CDM projects, where the primary measure of the efficacy of the mechanism, and projects under the mechanism, is GHG mitigation achieved. Sustainable development impacts are therefore described as 'co-benefits'. In this application of the DIA visual we are clear to use the language of impacts, recognising that certain actions could have negative consequences for certain groups or development aspects, as well as the fact that mitigation will often not be the main driver for action.

- Example 1: Actions by the government of China were influenced by initial studies of the sustainable development impacts of CDM projects. China decided to impose a tax on revenues from CDM projects, with proceeds going to a sustainable development fund. CDM activities considered to contribute less to sustainable development were taxed at a higher rate, with hydrofluorocarbon decomposition projects taxed at a rate of 65 per cent compared to 2 per cent for renewable energy projects (KPMG, 2009).
- Example 2: Early identification of CDM projects by Sweden included an assessment of sustainable development impacts (Arvidson, 2002), and the Swedish Energy Agency currently focuses investment on small and medium sized renewable energy or energy efficiency projects that make a strong contribution to sustainable development. An example is investment in a wind farm in Uruguay that reduced emissions, and provided electricity, generated jobs and increased local income in the rural southeast of the country (Swedish Energy Agency, 2012).
- Example 3: In 2013, Switzerland invested in a CDM cookstove project, paying above market prices for the credits, with the decision driven by a desire to invest in CDM activities that demonstrate real development benefits at the community level (Owino, 2013).

2.2 Considering Development Impacts in LEDS

Most LEDS state the importance of sustainable development in the identification of priority actions, yet few strategies have a robust assessment of development impacts to inform implementation decisions. Current impact assessment approaches used for LEDS and NAMAs are often based on “subjective scoring with little knowledge about the data informing it” (Olsen, 2012: 17). The strategies often make the assumption that low-carbon actions will always have helpful environmental, social or broader economic effects, or that sustainable development needs and priorities will be addressed through adaptation plans and actions. Two examples are set out below:

- Example 1: Brazil’s LEDS includes commitments to and stresses the importance of sustainable development (de Gouvello, 2010), but does not go beyond broad assumptions that low-carbon growth is good for economic development and will generate multiple benefits.
- Example 2: Ethiopia’s Green Economy Strategy identified priority actions using a screening process that included examining appropriate GHG abatement technology as well as potential contributions to and alignment with the Growth and Transformation Plan’s objectives. An OECD review cautions that GHG abatement in agriculture, livestock and forestry especially, but also in power and transport, will not always have positive development impacts. For example, proposals to reduce emissions in the livestock sector by shifting beef producers to poultry may result in GHG abatement, but they are extremely challenging and do not necessarily have positive sustainable development impacts. Such actions could cause considerable social upheaval and remove ecologically optimal use of rangelands (Bass *et al.*, 2013).

LEDS and DIA are relatively new ideas, yet lessons on how DIAs have influenced decision-making can be learnt from early actors. Guyana shows how assessments of the impacts of early LEDS actions have influenced government priorities moving forward. Kenya provides an example of a pilot application of the same DIA visual that was used in this case study in Ghana, and how it helped to inform decisions about early NAMA development.

Guyana

Guyana was an early mover, developing its first LEDS in 2009, which aimed to create a “low-deforestation, low-carbon, climate resilient economy” (Office of the President, 2009). Guyana’s 2013 updated LEDS provides evidence of emission reductions, economic growth and socio-economic development that was stimulated by actions identified in its original 2009 plan. The 2013 LEDS reviews economic and social development impacts enhanced by following a low-carbon development path; and the government points to clear signs that implementation of climate change programmes can improve the overall economy and support Amerindian peoples' development and land rights, while keeping emissions low. Successes include increased access to clean electricity, growth in low-carbon industries such as eco-tourism, doubled employment in the business process outsourcing sector, Amerindian communities having legal title to their land, and strengthened forestry laws (Office of the President, 2013).

This updated 2013 strategy built on four years of learning, including how implementation has impacted GHG emission trajectories and created development benefits. For examples, Amerindian and hinterland development will continue, building on successes in electrification and community development. The identification of four high-potential low-carbon sectors into which to attract investment was informed by successful growth and job creation from 2009 to 2012. The 2013-2015 programmes will build on this foundation to increase employment and economic value (Office of the President, 2013).

The learning was complemented by an emphasis on safeguards and standards in REDD+ activities, ensuring that payments and actions are not causing negative environmental or social impacts. Independent verification reports are concerned with REDD+ safeguards (Donovan *et al.*, 2012), but give some indication of how, in particular, social impacts can be assessed. The results of these verifications impacted Government of Norway decisions on release of funds; governance structures and stakeholder consultation processes; and decisions on REDD+ activities, including the decision to move to a national, as opposed to a programme, approach to REDD+.

Kenya

Kenya's low-carbon scenario assessment used a variation of the DIA visual. The purpose of the DIA visual is to assist policy makers and analysts in communicating the development impacts of LEDS options and in identifying a portfolio of actions that best meet both emissions reduction and development goals (Cox *et al.*, 2013). This approach was important for Kenya, whose National Climate Change Action Plan determines that a mitigation action is only considered a priority if it generates positive sustainable development impacts in line with the Government's long-term development blueprint, Kenya Vision 2030 and/or has climate resilience benefits (Government of Kenya, 2013: 26).

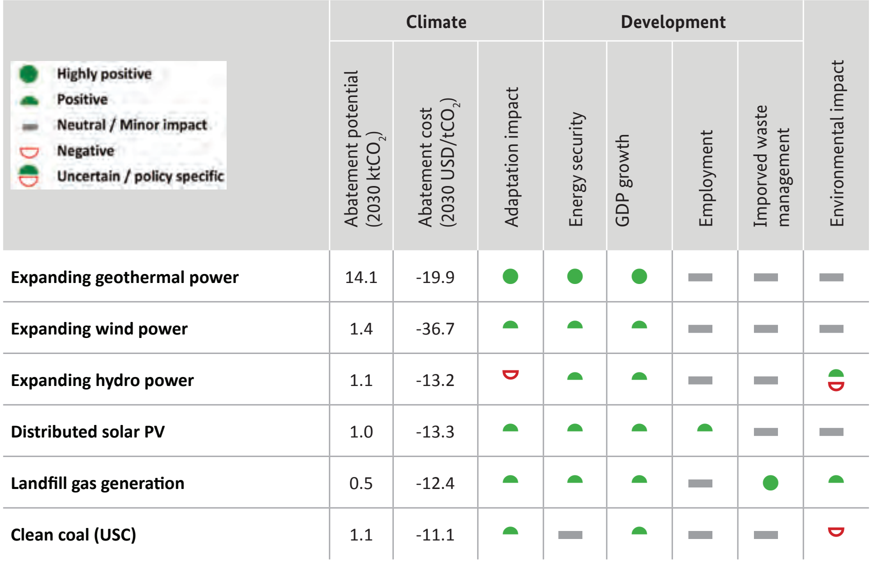
The low-carbon scenario assessment, which included the results of the DIA visual, directly influenced Kenya's decision to move forward on NAMA development in the geothermal sector[8]. Geothermal was identified as one of six priority low-carbon options because of substantial abatement potential and strong sustainable development benefits. Geothermal had the second largest mitigation potential of all low-carbon options in the assessment and contributed directly to the goals of Vision 2030, which states that "electricity is a prime mover of the modern sector of the economy", and aims to generate more energy at a lower cost and exploit geothermal power as a new source of energy (Government of Kenya, 2007:8).

Illustrated in Figure 4, the DIA concluded that geothermal electricity generation's contribution to energy security and GDP growth is highly positive. Improved electricity production helps to ensure a stable and secure supply of power, which is critical for economic growth and job creation. In addition, increased generation of renewable energy also has the benefit of improved energy security by reducing reliance on fossil fuel imports. Geothermal can have a minor impact on employment, identified mainly as temporary jobs during the construction stage, although the demand for full-time qualified personnel will increase as the sector grows. Potentially neg-

---

[8] This NAMA proposal is being developed under a partnership between the Government of Kenya and the Energy research Centre of the Netherlands, with support of GIZ through the Mitigation Momentum project (www.mitigationmomentum.org).

ative impacts are relocation of communities, and the influx of temporary workers that can strain social infrastructure in surrounding communities (IISD and ECN, 2012).



● Highly positive
◓ Positive
▬ Neutral / Minor impact
◡ Negative
⊖ Uncertain / policy specific

	Climate			Development				
	Abatement potential (2030 ktCO$_2$)	Abatement cost (2030 USD/tCO$_2$)	Adaptation impact	Energy security	GDP growth	Employment	Imporved waste management	Environmental impact
Expanding geothermal power	14.1	-19.9	●	●	●	▬	▬	▬
Expanding wind power	1.4	-36.7	◓	◓	◓	▬	▬	▬
Expanding hydro power	1.1	-13.2	◡	◓	◓	▬	▬	⊖
Distributed solar PV	1.0	-13.3	◓	◓	◓	◓	▬	▬
Landfill gas generation	0.5	-12.4	◓	◓	◓	▬	●	◓
Clean coal (USC)	1.1	-11.1	◓	▬	◓	▬	▬	◡

Figure 4 DIA visual showing low-carbon development options in the electricity generation sector in Kenya (Source: Cameron *et al.*, 2013)

2.3 DIA and Decision Making: Constraints and Recommendations

Low-carbon development strategies are relatively new, and efforts are underway to better account for and communicate sustainable development impacts within these documents. There are limited examples of how "formal" DIA processes impact government decisions, but important lessons are emerging from early work to assess development impacts in low-carbon plans:

- Various tools have provided helpful assessment of development impacts and have guided decision-making in regard to CDM, but these **tools are limited in application to LEDS** because they tend to assess impacts in one specific project. They do not allow for comparability across projects, across sectors or from an economy-wide perspective. As various methods and standards are used this results in fragmentation of measurement and monitoring results, which reduces the comparison of tangible development impacts across projects and sectors.
- As CDM impact assessments have determined, many important elements of sustainable development, such as technology transfer, employment generation and poverty alleviation, can be very **difficult to quantify** (Olsen, 2012). Development impacts assessment is often qualitative, and work needs to continue to identify quantitative (measurable) indicators.
- While countries attempt to strategically opt for actions that generate positive development impacts, there are **few examples of integrated sets of indicators that allow for analysis of the trade-offs and inter-linkages** across the economic, social and environmental pillars of sustainable development. It remains very difficult to compare development impacts across, for example, forestry and the transport sectors. The consideration of interactions across a portfolio of actions should be an important element of improved DIA that can inform decision-making about how trade-offs in the short term need to be managed and reconciled with anticipated long-term low-carbon benefits.

- To properly inform decision-making, DIA needs to **include information on winners and losers of low-carbon actions**. DIA often assumes that low-carbon actions will create development benefits or ignore negative impacts. The OECD notes that environmental solutions can turn out to be “poverty traps” rather than “routes out of poverty” (Bass *et al.*, 2013: 23). DIA should work to predict such outcomes of policy and investment shifts toward low-carbon options.

Continued work is needed to develop DIAs that contribute substantively to decision making. DIA, such as the LEDS GP visual used in the Kenya and Ghana case study, can provide a front-end overview of anticipated development impacts to aid decision-making, but moving forward on specific low-carbon initiatives may require more detailed sustainable development impact assessments, and development of meaningful indicators to measure progress and impacts.

Firewood-saving stoves
©GIZ/Dirk Ostermeier

3 Approach in Ghana

The goal of the case study in Ghana was to apply the DIA visual to a set of policy relevant technology options in the energy sector. This chapter outlines the methodology adopted and key outcomes in the process.

The overall approach following four main steps:

1. **Engagement and scope**; initial engagement with stakeholders in order to introduce the DIA visual, and determine a relevant scope for the study.
2. **Indicators**; discussion of an appropriate set of indicators with stakeholders and review of prior practices.
3. **Impacts**; in a quantitative sense for mitigation impacts as well as collation of a more qualitative set of supporting information on development impacts.
4. **Assessment;** test the DIA visual at a workshop with stakeholders. Both to complete the case study DIA visual and provide feedback on the use and relevance of the tool.

3.1 Engagement and scope

The case study started from what could be described as a 'blank slate'. There was no agreed scope, in terms of which energy sector options should be included in the analysis, nor an agreed set of indicators. Only the general idea that the study should focus on the priority options in the SE4ALL Action Plan along with other actions that were felt to be relevant to stakeholders.

The first action was to hold a series of meetings with a wide range of stakeholders across line ministries, relevant agencies, NGOs, development partners, the private sector and independent experts[9]. These meetings aimed to introduce the DIA visual, determine the detailed scope of the work (e.g. which options to include in the analysis) and define how the case study could best support the decision making processes in Ghana.

The starting point for option selection was a priority list of three actions – improved cookstoves, LPG for cooking and productive uses of energy (PUE) – in the SE4ALL Action Plan, along with another 6-8 options in the electricity sector listed in supporting documents. The meetings confirmed that the scope should include those three priority options, and that there was already a feed-in tariff (soon to be launched) to make larger scale renewable electricity options viable. Local stakeholders thus felt that renewable electricity options did not require examination in this case study due to their inclusion in the 2011 Renewable Energy Bill.

Instead the meetings suggested three additional options – biodiesel, charcoal production and landfill gas – all of which were not currently well reflected in energy policy or development plans yet were felt to have a large potential in Ghana. These three options had the common characteristics that they were proposed by at least two different stakeholder groups and had a reasonable potential for implementation based on a quick scan of the sector.

The final list of six low-carbon options were all considered to have the potential to contribute significantly to development and/or mitigation in Ghana, but generally had not been included in mainstream development planning, hence they could profit from an analysis that stresses their development impacts. The final agreed list was:

1. **Improved cook stoves**
   With a focus on improved woodfuel stoves, as this is the dominant fuel source in rural areas where LPG is less likely to reach in the short term and where traditional cookstoves are dominant.
2. **LPG for cooking**
   Replacing charcoal as this is the most common fuel in urban areas where LPG distribution would be most effective in the short term
3. **Productive uses of energy (PUE)**
   For example solar drying, wind pump irrigation, etc.

---

[9] Including GIZ, Energy Commission, UNDP, Ministry of Energy, EPA, Forestry Commission, Ministry of Environment, Science and Technology, Clean Cookstove Alliance, Kimminic and John Young & Associates

4. **Biodiesel**
   Assumed to be for domestic use, taking care to differentiate between productive and non-productive crops; i.e. does the feedstock have an alternate market outside of biofuels?
5. **Landfill gas for electricity**
   Based on managed municipal solid waste landfills.
6. **Charcoal production**
   Focus is on production for domestic use, the largest single primary energy use in Ghana. Production for export is already regulated to require sustainable sources.

The agreed timeframe for the analysis was 2020, the target year for the SE4ALL Action Plan. Agreeing on a common timeframe for all options considered is important as it influences the level of ambition for any one of these six options.

3.2 Indicators

Key to the use of the DIA visual is an agreed set of indicators against which each option is eventually assessed. The visual itself does not propose any particular set of indicators and, although previous applications of the visual could offer some insights, it is necessary to choose indicators that are relevant for the country context and scope.

Two main sources were used to develop inputs for the final set of indicators, first, discussions with stakeholders, and second, a literature review of previous experiences with development indicators. A third step of review with stakeholders was undertaken using the draft list developed in steps 1 and 2.

Step 1: Stakeholders

Beyond suggestions for specific indicators, initial discussions noted two important points:

1. indicators need to be relevant to the target audience for each option; if some of the technology options are targeted at the rural population it will be important to have indicators that can reflect this.
2. indicators should not be overly disaggregated; it is important that impacts can be estimated and understood in a workshop environment, which requires relatively straightforward categorisation.

A number of specific indicators were proposed, including household income, gender, rural development and job creation. Different stakeholders had different priorities in this regard. The Clean Cookstove Alliance, for example, was particularly focused on the need to include gender aspects. That is a key concern and justification for the use of more efficient cooking technologies, as negative health impacts of traditional cooking methods, as well as time requirements for fuel collection, fall most heavily on women. It was also raised as a key aspect to consider from the development partner's perspective due to its importance in German development cooperation (for example: BMZ, 2012). A sub-set of the stakeholders was also identified that were interested to review and comment on a draft list of indicators.

Step 2: Literature review

The design and application of sustainable development indicators has a long history, in particular, linking back to the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. It was therefore felt to be useful to first look at these efforts before developing a draft list for the case study, while taking into account the views that stakeholders had expressed in an initial series of meetings.

The starting point for a non-comprehensive review was to examine a longer list of indicators that had been used by other organisations and programmes. The final list consisted of sustainable development indicators from:

- Government of Ghana planning documents; though no formally recognised set of government indicators could be ascertained (Kingsley Oppong *et al.*, 2010)
- initial DIA case studies in Montenegro and Kenya (Cox *et al.*, 2013)

- a recent draft CDM sustainable development tool (UNFCCC, 2012b)
- the MCA4Climate project; that attempts to apply aspects of multi-criteria decision making to the technology/policy prioritisation process (UNEP, 2011)
- the latest relevant report of the UN Commission on Sustainable Development, (UNCSD, 2007)
- the International Atomic Energy Agency (IAEA, 2005)
- the United Nations Economic Commission for Africa (UNECA, 2007)
- the Asian Development Bank (ADB, 2011)

These organisations each took different approaches to developing a set of indicators depending on the planned application. For example, the number of indicators ranged from 12 to 44 across those examined. Similarly, the approach to aggregation of indicators into categories, such as 'economic' or 'social' impacts, varied across sources. These differences demanded a pragmatic approach to selecting an initial set of indicators for the case study. Starting from those indicator sets that were more aggregated (i.e. fewer individual indicators) a short list was made. Then a quick scan of the longer lists was done, to check if all additional indicators were effectively covered in the short list.

Step 3: Review

This short list was then sent for review by six key stakeholders to confirm a set of indicators that were both relevant to the case study options and to Ghana development priorities (for example the medium term development plan) The six stakeholders for review were chosen to cover expertise across all six technologies in the case study. The final list of indicators after review is shown in table 1.

Table 1 **Adopted DIA visual case study indicators**

Category	Indicator
Climate	▸ Abatement potential (ktCO_2) ▸ Abatement cost (USD/tCO_2) ▸ Climate resilience
Economic	▸ GDP/macroeconomic impact ▸ Energy security ▸ Rural economic impact/development ▸ Household/consumer impact
Social	▸ Employment ▸ Energy access ▸ Health ▸ Education ▸ Gender
Environmental	▸ Aggregate (e.g. biodiversity, land, water etc)

3.3 Impacts

Once a set of indicators had been agreed it was possible to start on background work that examined the impacts of the six technology options. Two different approaches were used: First, a quantitative analysis of mitigation impacts (i.e. abatement potential and cost) based on 2020 scenarios for each option; and second, preparation of supporting, generally qualitative, information on the impacts of each technology option for all non-mitigation indicators.

Described in this report is a summary of the approach and results. More detail on the assumptions and development of the scenarios, both in terms of mitigation calculations and development impacts, can be found in the accompanying technical report (Cameron *et al.*, 2013).

3.3.1 Mitigation impacts

At the outset, it is also important to note that the SE4ALL Action Plan was not developed as a mitigation strategy, rather to provide development benefits. Its focus is predominantly on improving sustainable energy services, in line with the overall objectives of the SE4ALL initiative to i) increase access to energy, ii) improve energy efficiency and iii) increase the penetration of renewable energy. The mitigation calculations made for the options are, therefore, 'after the fact' and were not the primary objective in the design of Ghana's SE4ALL actions.

However, this links back to the value of the DIA visual, the ability to present both climate impacts alongside development impacts – which are most relevant for domestic stakeholders. In this case study, we start from options that have been proposed due to their potential to contribute positively to development, and then adding a mitigation perspective afterwards.

In order to estimate mitigation potentials and abatement costs, a baseline scenario and low-carbon scenario were developed for each technology option. From these the abatement potential in the year 2020 could be estimated. Marginal abatement costs were estimated from existing studies in similar contexts, or through calculation where estimates did not exist or were felt to be non-representative of the Ghana context.

Scenarios

Both baseline and low-carbon scenarios[10] were developed for each technology option. Baseline scenarios were developed based on existing government plans and policies. In general, the actions discussed in the SE4ALL Action Plan are yet to be included in government policy so these actions were therefore framed as the low-carbon scenario.

Similarly, in the event where an existing policy document was already found to be highly ambitious (compared to current or anticipated progress), the baseline scenario was taken as a simple extrapolation of current progress, and the low carbon scenario was based on the more ambitious policy document. An example of this was for biofuels. The current penetration of biodiesel into the domestic market is negligible, while a draft national Biofuels Policy that has been under development for a number of years calls for a significant compulsory blend in domestic diesel supplies by 2030. In this instance the implementation of the draft policy is assumed as the low-carbon scenario.

Table 2 Low-carbon scenarios and data sources for assumptions

#	Option	Low-carbon scenario 2020	Key inputs/sources
1	**Improved cookstoves**	Rural woodfuel use intensity reduced by 10 % through improved cookstoves	SE4ALL Action Plan Strategic National Energy Plan GACC Market Assessment Report
2	**LPG for cooking**	Access by 2020 50 % as opposed to projected 24.5 %	SE4ALL Action Plan National Energy Policy Energy Commission LPG policy brief
3	**Productive uses of energy (PUE)**	14,000 ha RE irrigation (pilot prog.) 2,000 RE MFPs (pilot prog.)	SE4ALL Action Plan
4	**Improved charcoal production**	Sustainable plantations and improved conversion technologies penetrate 10 % of charcoal supply (equivalent to 3-4 % of wood for charcoal is sustainable)	SE4ALL I&M Plan Energy for Poverty Reduction Action Plan National Woodfuel Policy (Draft) ECN estimate
5	**Landfill gas generation**	Accra and Kumasi sites developed by 2020; approx. 30 MW of generation	Sanitation Country Profile Kumasi Waste Manag. Dep. Report. ECN estimate
6	**Biodiesel production**	Domestic requirement for 5 % blend by 2020 (20 % by 2030)	National Biofuels Policy (draft)

Abatement potentials and costs

Abatement potentials were calculated between the baseline and the low-carbon scenarios using a standard approach of activity data and emissions factors. Where appropriate, emissions factors came from lo-

---

[10] Low carbon scenarios are used here to refer to the scenario that was presented to stakeholders in the workshop; i.e. the alternate scenario where the technology option is implemented.

cal studies or were calculated using relevant Ghanaian data. Otherwise nominal figures were used; for example, for a fuel switching between normal diesel and biodiesel.

There is expected to be only limited interaction between the various options due to the way in which the scenarios are framed. The most problematic, from a technical perspective, are the three options relating to cooking; LPG, improved cookstoves and charcoal production. For example, the way in which charcoal is produced will affect the overall emissions associated with a charcoal burning cookstove, and therefore the amount that is effectively offset by replacing the stove with LPG. However, the limited penetration of sustainably produced charcoal, and the focus of the two cookstove replacement options on different segments of the population, means that we assume that these small interactions can be safely excluded from this analysis.

Assumptions and data came from an initial list of sources that was compiled based on desktop research and previous engagement in Ghana. From this, a list of data gaps[11] was discussed with stakeholders in order to find additional sources of information or allow scenarios to be influenced by undocumented evidence.

3.3.2 Development impacts

In this case study the assessment of development impacts was undertaken by stakeholders in a workshop environment. However, for a number of reasons it was considered to be important to provide workshop participants with background information to guide these discussions. First, not all participants would be familiar with all technology options, particularly those that are in sectors where they have less experience. Second, even those experts who specialise in a particular technology might not have experience in the full range of impacts that a technology could have. For example, a good understanding of the domestic cookstove sector does not necessarily mean adequate experience in assessing the macroeconomic impacts of stove deployment. Third, an evidence base could help facilitate discussions in instances where participants disagreed about impacts.

To build up this evidence base, each of the technology options (listed in Section 3.1) was characterised for each of the indicators (listed in Table 1). Information was drawn from a wide range of sources, including studies that had already been considered development impacts in the Ghanaian or similar contexts, as well as anecdotal evidence from the previous bilateral stakeholder meetings.

This process gave long, referenced descriptions of each of the technology options by indicator focused on the Ghanaian context. As a final check of this background information a second series of meetings was held with experts. These were with local sector or technology experts and involved a trial, or mock, assessment of the DIA visual for those technologies where they had expertise. This allowed for final updates of the background study where details may have been missed in the desktop research or prior interviews, which had been less structured around a set of agreed indicators.

These long technology descriptions were too detailed to be useful in a workshop environment. Concise one-page factsheets (see Appendix A) were therefore created for each option, containing:

1. A short introduction to each technology and current status in Ghana
2. A description of the baseline and low-carbon scenarios
3. The mitigation potential and abatement cost results
4. Summaries of the background information for the other indicators

The factsheets aimed to present the available background evidence in a neutral way, providing information to guide discussion as necessary, but without determining the assessment results.

---

[11] mostly in regards to PUE potentials, characterisation of current cookstoves and charcoal production forecasts

3.4 Assessment of the DIA visual

The main objective of the case study was to apply the DIA visual with stakeholders in order to assess development impacts. Nineteen stakeholders from a wide variety of backgrounds and interests attended the workshop, allowing for representation of a range of views and perspectives. The focus was of course on the energy sector, but many of the options being discussed had implications for other sectors such as forestry or central ministries such as planning. The final list of attendant organisations can be found in Appendix C.

The workshop had introductory presentations on the following topics: the international context for looking at climate and development together; the SE4ALL Action Plan; the DIA visual and scenarios. Two discussions sessions were then held:

The first session was in smaller groups, with each group discussing two technology options. Each of these groups was provided with the one-page factsheets and asked to fill in the DIA visual for those two options, based on the rating scale. Following this each group reported back on their discussions and resulting assessment, including areas where there was disagreement, or where there was difficulty in assessing an indicator. In general the assessment process found a high level of agreement amongst participants. Only for some indicators or technology options was there less agreement, typically due to limitations of the DIA visual itself. These issues are discussed further in the following section of the report. It was also observed that the factsheets were well utilised and it was remarked by participants that they struck the right balance between provision of information and guidance.

In the second session the overall results for the six technology options were discussed side by side with the full group of stakeholders. Assessments that did not make intuitive sense or were felt to be inaccurate were questioned and debated, leading to some changes to the overall assessment matrix. However, in general the level of change was minor and both sides of an issue could be accommodated by clarifying the interpretation of a scenario.

It was notable that consensus could be reached, suggesting that the process had assisted in building a common understanding of the six technology options. Observation of the initially divergent positions of many of the participants in the first session suggests that the DIA visual process is highly likely to have contributed to building agreement. The final results are presented in Figure 5.

- ● **Highly positive**
- ◓ **Positive**
- ▬ **Neutral / Minor impact**
- ◡ **Negative**
- ◓◡ **Uncertain / policy specific**

			Climate	Economic				Social					
	Abatement potential (2020 ktCO$_2$)	Abatement cost (2020 USD/tCO$_2$)	Climate resilience	GDP / macroeconomic impact	Energy security	Rural economic impact / development	Household / consumer impact	Employment	Energy access	Health	Education	Gender	Environmental impact
Improved cookstoves Rural woodfuel use intensity reduced by 10 % through improved cookstoves	200	-2 to 0	●	◓	◓	◓	◓	◓	◓	●	●	●	●
LPG for cooking LPG access by 2020 is 50 % as opposed to projected 24.5 %	360	3 to 85	●	◓	●	◓	◓	◓	●	●	●	●	●
Productive uses of energy (PUE) Irrigation 14000ha with RE (pilot prog.) 2000 RE powered MFPs (pilot prog.)	20	n.a.*	◓	◓	▬	●	◓	▬	◓	●	◓	●	▬
Improved charcoal production Plantations and improved conversion technologies penetrate 10 % of supply	100	1.5 to 20	◓	▬	▬	◓	▬	◓	▬	◓	▬	▬	◓
Landfill gas generation Accra and Kumasi landfills developed by 2020; approx. 30 MW of generation	360	18	●	▬	▬	▬	▬	▬	▬	●	▬	▬	●
Biodiesel production Domestic requirement for 5 percent blend by 2020	295	66	◓◡	▬	▬	◓	◓	◓	▬	●	▬	◓	◓

Figure 5 Completed case study DIA visual resulting from the stakeholder workshop

The second session also included discussions on the DIA visual itself, guided by questions such as:

- How to best use a DIA visual and when;
- What is its potential application in Ghana? (e.g. National Communications, Biennial Update Reports, strategy documents, communication to development partners, NAMAs)
- Whether the DIA visual should list specific policies or broader technology scenarios;
- What level of quantitative background data is needed on development impacts;
- How to best deal with feasibility of options.

The results of these discussions are included in the following chapter that looks at lessons learnt.

Following the workshop a summary of the session, along with all presentations and factsheets, was distributed to participants. The technical report is the other main deliverable that will be distributed to stakeholders and Ghanaian policy makers.

4 Lessons learnt

The experience of assessing development impacts with a diverse group of stakeholders demonstrated several strengths of the DIA visual: its ability to stimulate discussion and improve the awareness amongst stakeholders during the assessment process; its ability to communicate qualitative information about development impacts; its flexibility in terms of scope and level of detail that can be tailored to a particular situation; and its potential to support decision making (Cox *et al.*, 2013).

At the same time the experiences provided important lessons around: the country and policy context sensitivity of development impacts; the challenges in accounting for the scale of actions; participatory stakeholder assessment processes; and the practical limitations of the DIA visual in the policy making process.

This chapter summarises the lessons learnt and observations resulting from the case study, grouped into four categories:

5. **Stakeholders;** relating to which stakeholders are included in the process, when this should be done and how they are communicated with
6. **Indicators;** the choice of indicators, their characterisation
7. **Assessing impacts;** in terms of the level of detail and quantification provided, as well as how to compare options
8. **Relevance;** how the DIA visual can be used within the policymaking process

4.1 Stakeholders

Stakeholder diversity

A sensitivity to stakeholder mix was recognised at the workshop, with the question being raised as to what would happen if the same exercise was undertaken by a different group of stakeholders? An example of this was observed in the case study results when the stakeholder assessment was compared to an initial assessment that had been conducted by ECN experts. The ECN results tended to be more conservative in terms of assigning benefits to options and more often gave an 'uncertain' rating for a certain field. As such, when applying the DIA visual, there is immense value in having a diverse range of stakeholders, with experience across different relevant sectors and the full range of development indicators.

For this case study a balanced view was sought by assembling a cross-cutting group of stakeholders that included, amongst others, experts in planning, health, forestry, private sector needs and gender issues, as well as NGOs and technical agencies. Even though the focus of the case study was on the energy sector, development impacts occur in all areas mentioned.

Common aims

It is important that the aims of the workshop and DIA visual are clearly explained in advance and that, in so far as is possible, individual stakeholders have been part of the process of developing a set of indicators and providing information on technology options. This makes it easier to have a discussion about impacts, rather than spending time on building awareness of the tool and agreeing on scope and indicators. This was achieved through prior bilateral meetings with the majority of workshop participants to explain the aims, confirm a set of indicators and collect information.

Supporting information

Most stakeholders will not be familiar with the full range of technology options or development indicators. Therefore, a first lesson is that it is important to provide supporting information, in this case through one-page factsheets that will allow everyone to have a minimum level of understanding of each relevant aspect.

Second, this process of providing supporting evidence requires a careful balance between a more neutral provision of information and overt guidance that could overly influence the assessment.

Facilitation and format

In order to improve ownership of the process and results we worked closely with a local partner from the EPA[12] who facilitated the workshop. This was valuable in demonstrating local buy-in to participants and open discussion, as well as contributing to building of local expertise in applying the DIA tool.

Similarly, the use of smaller break-out groups encouraged everyone to contribute to the discussions and allowed a focus on a smaller sub-set of options without overwhelming people with the full matrix. At the same time, the process of subsequently building consensus for the final matrix amongst the whole was important to allow participants to take observations or results from their break-out session and see how they compared to other groups' outcomes.

4.2 Indicators

Prior knowledge

In bilateral meetings, stakeholders generally show a strong awareness of different types of development impacts of low-carbon actions. However, they had often not considered these impacts in significant detail. This is the case, for example, when trying to consider if a certain option would have very large or more moderate impacts, or might objectively provide higher impacts than another. The structured assessment of impacts against a common rating scale (in this case: highly positive, positive, neutral etc) was therefore felt to be a valuable process as it forces stakeholders to think about each technology and indicator in turn. Also important was the provision of factsheets for participants in order to provide a common minimum level of understanding of all technologies and potential impacts.

Type and number of indicators

There are two key points here. First, the indicators that are used need to be relevant to the target audience of the technology options; i.e. the group that stand to be impacted by the option. For example, a programme to improve energy access in rural areas needs to capture benefits for rural communities in the final list of indicators used. Furthermore, there is a need to link the indicators used in the DIA visual to more precise, measureable aspects. Even if an indicator remains relatively general, it is useful to define the types of practical benefits that could be measured. This can help to give participants a clearer sense of what to consider when making assessments. Without this it can be difficult, for example, to define what improved 'health' or 'education' means.

Second, the idea of balancing pragmatism with detail was seen as important. Defining too many indicators makes the assessment difficult and lengthy, but crucially also makes interpretation of the results difficult. Defining too few indicators bears the risk of overly simplifying development impacts or providing insufficient differentiation between options to be useful.

In general, the use of a relatively limited set of indicators was felt to be appropriate However, stakeholders commented that for certain audiences, such as high level government officials who want brief and clear communications, a highly aggregated form of the DIA visual could be useful. Taking that to an extreme, the idea of a single overall aggregate indicator that is very easy for policymakers to interpret was proposed by participants. However, no conclusions on the practicality or operation of such an indicator were reached.

Complex indicators

The team noted that it was practically very difficult to assess aggregate indicators (such as GDP or climate resilience) which are effectively composites of (or at least influenced by) a number of other more specific indicators. However, there would be significant value in having a more holistic assessment of

---

[12] The EPA in Ghana has a broad mandate to co-manage, protect and enhance the country's environment, as well as seek common solutions to global environmental problems such as climate change. They play a key role in climate related planning activities in the country and in Ghana's National Communications and Inventory.

complex indicators, like GDP, that takes into account interactions and indirect effects. It is therefore useful to quantify, disaggregate or, at least, note the limitations of complex indicators and inter-linkages during an assessment.

4.3 Assessing impacts

Context sensitivity

The most critical observation from the workshop was that impacts are not only influenced by technologies or deployment scenarios, but also by form of implementation (i.e. policy). A good example is biofuels in Africa. When well regulated and inclusive of existing small landowners it can provide a number of benefits to rural populations, but, when left to market forces, benefits may only accrue to the project developers or even have negative impacts on aspects such as food security through competition for land. These issues caused a lot of debate amongst workshop participants, particularly with regards to the biodiesel option. The resulting consensus on biodiesel impacts came with the caveat that it relied on a socially-just form of implementation of the scenario. This also raised important questions about the way in which options are defined, should they be specific technologies, or instead specific policies or programmes? The calculation of MACCs is also linked to the approach to implementation, making firm estimates of abatement costs difficult in the absence of agreed policies.

In spite of this, it may often be appropriate to define the DIA visual in terms of technologies, as detailed policies may only be defined late in a political process. The DIA visual is most relevant early in a strategy or planning process, when decisions on priorities are being made. Another possibility may be to present the same technology more than once in the DIA visual with differing approaches to implementation. The key lesson is that any technology scenario should be as descriptive as possible about the approach to implementation[13].

Similarly, impacts are often country or region specific, depending on aspects such as: need for a certain service, what legacy technology is being replaced and performance of the proposed technology in that place. To try and account for this the background information on development impacts used studies that were focussed on Ghana or similar regional contexts.

The above considerations mean that it is difficult to generalise about the development impacts of any one technology.

Judging scale

The process of applying the DIA visual found that it is difficult to account for scale when comparing impacts of different options. One option may have large impacts per unit effort or cost when compared to another, but the DIA visual is not normalised in this way. Hence a technology that is implemented at pilot scale may look less favourable when held up against a full scale implementation of a second technology, even though the former has higher benefits with respect to its scale. If a scenario calls for only a limited implementation of a certain option, then this needs to be taken into account in the assessment. This is not always an intuitive process, particularly when the options being compared are substantially different. For example, comparing only options that provided large scale renewable electricity is less problematic, one can compare options based on capacity of installed MW, but comparing an option that improves the sustainability of charcoal production with the generation of electricity from waste is challenging, as there is no common measure of the scale of the option.

---

[13] This issue also directly affects marginal abatement cost calculations. Determining abatement costs from the perspective of government or firms/consumers (i.e. social or private) requires that policies and incentives are defined in advance, as these will influence relevant costs incurred by either party.

Increasing the level of quantitative assessment of development impacts may be one way to help overcome this challenge, but this may not always be possible due to limited data or indicators that are difficult to quantify.

Absolute or relative impacts

The baseline against which development impacts are assessed is an important nuance of the DIA visual. It is clear that mitigation potentials and abatement costs are calculated against a BAU or reference case. However, this use of a baseline technology as a reference is arguably less relevant when assessing development benefits, particularly in a workshop environment.

Consider an example of a renewable energy generation technology that creates a certain number of jobs per installed MW[14] and a BAU technology, that it replaces, that creates an equivalent number of jobs per MW. A relative approach to assessing development benefits would give the renewable technology a neutral rating, or zero impact, as no incremental jobs are created or lost. Whereas an absolute approach would give the renewable option a positive rating in recognition of its job creation potential. The former, relative approach is more conservative in assessing low-carbon technologies, always comparing them to a reference technology, but is arguably less effective as a communication tool for demonstrating development benefits and is much more difficult to reliably apply as a methodological approach in a live workshop.

Development benefits are already difficult to assess in an absolute sense, adding reference technologies to the picture complicates matters. The absolute approach tended to be naturally adopted by workshop participants and was more relevant to the way in which people thought about development impacts. If the goal of the exercise is to see which options contribute to sustainable development and one is most interested in relative impacts *between* options, then an absolute approach is probably the most practical and useful way of applying the DIA visual. Another solution to this challenge would be to include the BAU technology in the DIA visual as one of the options to be assessed. This would guarantee that impacts versus a reference technology are assessed. The broader message here is the need to be transparent about the impacts of replaced technology (i.e. recognise any trade-offs of pursuing low-carbon technologies).

4.4 Relevance

Relevant implementation scenarios

For the application of the DIA visual to provide value to the decision making process it is vital that relevant implementation scenarios[15] are chosen, which are either grounded in current government ambitions or based on a realistic potential for implementation. This allows the visual to be used for communication to policymakers with a minimum amount of interpretation of the results and also increases the buy-in of stakeholders to the assessment process.

Recognition of limitations

The exact purpose or added value of the DIA visual is not always apparent to stakeholders when the tool is first introduced. It was important not to oversell the DIA visual and to make it very clear that it is a discussion and communication tool; an aid to decision making rather than a formulaic tool for prioritisation. The DIA is a tool that is used at the planning and strategy stage, and can be used to provide guidance on areas requiring more detailed indicators at the implementation stage. Without this kind of description of the purpose of the visual, there was a tendency of some stakeholders to be cynical about its usefulness; however when clearly explained there

---

[14] Even the core unit of comparison can be ambiguous, should jobs be compared on a per MW or per MWh or per dollar of investment basis? This question has not been adequately resolved (Cameron and van der Zwaan, 2013).

[15] i.e. what level of deployment is considered at a given point in time in the future for that particular technology option, what future situation is being assessed for impacts?

was general agreement on its potential value when applied early in the decision or strategy process.

Expansion beyond impacts

A key message to come from the case study exercise was the importance of complementing the development impacts in the DIA visual with information on barriers. For example, a certain technology option could have outstanding benefits, but still have major barriers to implementation that are not able to be captured in the set of indicators. Aspects such as social acceptance of a technology, supply chain constraints and capital investment barriers – to name just a few – are unlikely to be seen in an application of the DIA visual that focuses on development impacts. Without these barriers it was felt that there could be a tendency for the results of the visual to look overly positive. The prior case study in Montenegro attempted to include a barrier assessment in the DIA visual (Cox *et al.*, 2013) and, although this added to its visual complexity, the Ghana case study suggests that this may be a useful addition.

Closely linked to this is the need to consider measures of cost other than marginal abatement cost, such as total investment costs or public funding requirements, which are often more relevant to policymakers. Marginal abatement costs are most useful as a measure of mitigation action cost effectiveness and can provide some indication of comparability across options, but are often a poor indicator of which options a government should pursue from an overall economic viewpoint. Their relevance is dependent on the perspective chosen in their calculation (i.e. social or private abatement costs), the assumptions made and the form of implementation policy assumed. This suggests that an extension of abatement cost data with estimates of total capital requirements and public versus private splits could be a useful way to improve the tool. This may not always be possible, for example in the instance where policy choices and approach to implementation are not known, but assumptions based on best- or likely-practice could be used. A similar approach was adopted in the presentation of the Kenya Climate Change Action Plan priority actions, where abatement costs were supplemented with investment estimates (IISD and ECN, 2012).

Solar panels

©GIZ/Sumi Teufel

5 Conclusions

The case study demonstrated a successful application of the DIA visual in a workshop environment and provided a number of important lessons on the use of the DIA visual and DIA more broadly.

There were two striking aspects to the assessment results. First, that a diverse group of stakeholders reached consensus on a final DIA for a wide range of technology options. The DIA visual process encouraged a structured debate that allowed individual technology options and indicators to be considered on a case by case basis. This, along with the provision of neutral factsheets, is seen as a large factor in the ability of participants to agree on a final assessment. Second, the final assessment broadly supported the prioritisation of actions that was observed in the SE4ALL Action Plan, with LPG, improved cookstoves and PUE showing strong development benefits. This result adds weight to the SE4ALL Action Plan's conclusions and shows how a more formal DIA can be used to complement government planning/policy processes and build consensus amongst stakeholders.

Regarding other potential applications:

1. In the case of Ghana, the government could demonstrate the sustainable development benefits of its goal to cover 10 per cent of its electricity supply with renewable energy by 2020, aiding in budget allocation decisions or planning discussions with international donors.
2. The DIA assessment can also provide guidance on moving forward with a specific GHG mitigation option and developing LEDS/NAMA concepts and proposals. The DIA findings can provide preliminary information on the areas where detailed indicators are needed, which can inform the development of systems for monitoring and reporting on the sustainable development impacts of mitigation actions.

In order to assess whether the results of this DIA visual case study are utilised by Ghanaian policymakers, or whether the tool itself is adopted in another context, a number of approaches are proposed[16]:

- Follow-up interviews with Government of Ghana stakeholders who participated in the DIA workshop.
- Appearance of the DIA technology options or reference to the DIA visual results in Government of Ghana planning documents.
- Inclusion of the DIA visual results in the Ministry of Environment Science and Technology's green economy strategy.
- Use of the DIA visual approach in National Communications and Bi-Annual Update Reports to communicate the climate impacts of existing or planned policies and programmes[17].

Although this case study was focused on energy sector technology options, the DIA visual is equally applicable to other sectors[18] where a number of technology or policy options present themselves. As mentioned in the introduction to this report, the DIA visual is methodology neutral in terms of how impacts are assessed. In this case study, a stakeholder workshop supported by factsheets (with limited quantitative information) was used to make an assessment of impacts; however, one could also imagine certain indicators that lend themselves to a more quantitative assessment of impacts. For example most economic indicators, job impacts and health impacts such as air quality (particularly for the transport sector where air pollution is a key driver for intervention).

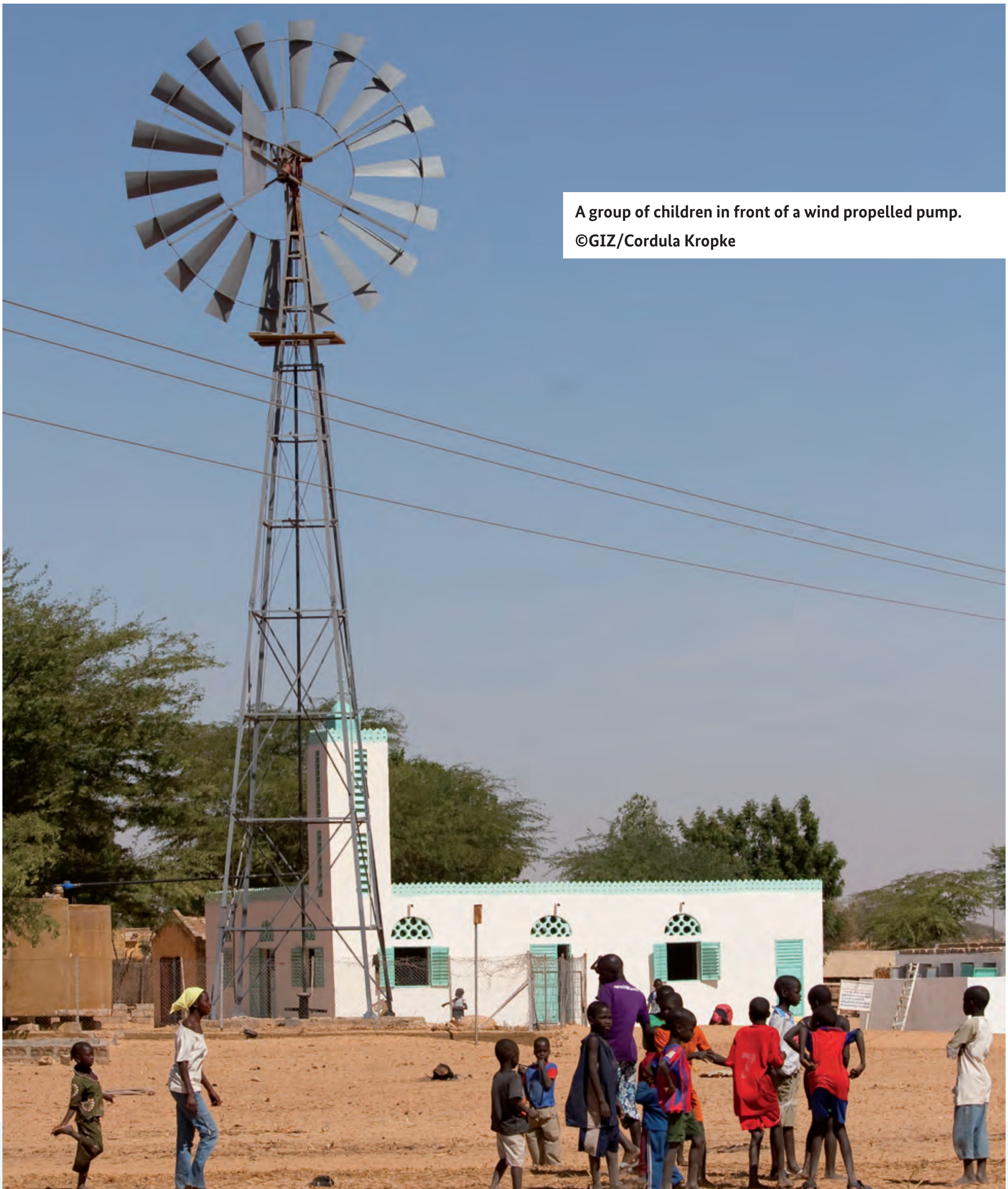
---

[16] The relatively limited nature of the case study and ongoing support for the DIA visual should be recognised in assessing the above measures. Furthermore, these potential impacts are not likely to be visible in the relatively short time-frame of this project, but should be assessed in 3 bis 6 months.

[17] Based on discussions with the EPA, the DIA visual may be adopted on the basis that it provides an effective communication tool at the nexus of development and climate. Its use in official Government of Ghana documents would, in turn, increase familiarity with the approach and increase the likelihood that it is used in planning in the future.

[18] See IISD and ECN (2013) for an application of the DIA visual to non-energy sectors in Kenya. Die Quelle IISD and ECN 2013 befindet sich nicht in den References. Vielleicht ist IISD and ECN 2012 gemeint?

The DIA visual's primary selling points are its ability to facilitate discussion and communicate findings to aid in prioritisation. The DIA visual can provide information on the initial assessment of development impacts, and facilitate comparability of technology options within a sector in this regard. As noted above, a DIA may also provide initial input to the design of monitoring and reporting systems for the implementation of technology options. The DIA visual is not a mechanistic decision making tool, rather an aid to decision making. Clearly communicating the benefits of DIA processes, as well as their limitations, is a key factor in encouraging their adoption.



A group of children in front of a wind propelled pump. ©GIZ/Cordula Kropke

6 References

ADB (2011) Framework of Inclusive Growth Indicators: Key Indicators for Asia and the Pacific 2011 Special Supplement, Asian Development Bank

Arvidson, A. (2002) CDM Project in Africa. Tiempo 44/45. Retrieved from: http://www.tiempocyberclimate.org/portal/archive/issue4445/t4445a3.htm

Bass, S., Wang, S., Ferede T. and Fikreyesus D. (2013). Making Growth Green and Inclusive: The Case of Ethiopia. OECD Green Growth Papers 2013-17. Paris: OECD Publishing.

BMZ; Federal Ministry for Economic Cooperation and Development (2012), Strategies 185, Development Policy Action Plan on Gender 2009 – 2012, Retrieved from BMZ website. See http://www.bmz.de/en/what_we_do/issues/HumanRights/frauenrechte/deutsche_politik.

Cameron, L., Würtenberger, L. and Stiebert, S. (2012). National Climate Change Action Plan: Mitigation Chapter 5: Electricity Generation, National Climate Change Action Plan. Retrieved from: http://www.kccap.info/index.php?option=com_phocadownload&view=category&id=36&Itemid=41.

Cameron, L. and van der Zwaan, B.C.C. (2013) Employment in renewables: a literature. Review, mimeo.

Cameron, L., Falzon, J. and Hekkenberg, M. (2013) Assessing development impacts: results for 6 energy technologies in Ghana, Energy research Centre of the Netherlands (ECN).

Cosbey, A., Parry, J., Browne, J., Yuvaraj Dinesh Bab Preety Bhandari, Drexhage, J., and Murphy, D. (2005). Realizing the Development Dividend: Making the CDM Work for Developing Countries. Winnipeg: International Institute for Sustainable Development.

Cowlin, S., Cochran, J., Cox, S., Wuertenberger, L., Lacy, S. and Hove, H. (2012). Presenting Development Benefits of Low Emission Development Options, LEDS-GP Webinar, September 2012. Retrieved from: http://en.openei.org/w/index.php?title=File%3ADIA_Visual_Development.pdf&%20page=1

Cox, S., Katz. J. and Wuertenberger, L. (2013) Assessing Development Impacts Associated with Low Emission Development Strategies: Lessons Learned from Pilot Efforts in Kenya and Montenegro, forthcoming.

de Gouvello, C. (2010). Brazil Low-carbon Country Case Study. Washington, D.C.: World Bank.

Donovan, R.Z., Moore, K. and Stern, K. (2012). Verification of Progress Related to Indicator for the Guyana-Norway REDD+ Agreement. Richmond: Rainforest Alliance.

Government of Kenya (2007). Kenya Vision 2030: The Popular Version. Nairobi: Government of Kenya.

Government of Kenya (2013). National Climate Change Action Plan 2013-2017. Nairobi: Ministry of Environment and Mineral Resources.

Heuberger, R., Brent, A., Santos, L., Sutter, C. & Imboden, D. (2007). CDM Projects under the Kyoto Protocol: a Methodology for Sustainability Assessment – Experiences from South Africa and Uruguay, Environment, Development and Sustainability, 9 (1): 33-48.

IAEA (2005) Energy Indicators for Sustainable Development: Guidelines and Methodologies, International Atomic Energy Agency.

IISD and ECN (2012). Mitigation. Background paper for the: Government of Kenya , National Climate Change Action Plan. International Institute for Sustainable Development and the Energy research Centre of the Netherlands Retrieved from: http://www.kccap.info/index.php?option=com_phocadownload&view=category&id=36&Itemid=41.

Kingsley Oppong, S., Acheampong, E., Opuni-Frimpong, E. and Kwasi Adu , J. (2010) National GHG Mitigation Assessment for the Forestry and Agriculture Sectors of Ghana - Final Report, Environmental Protection Agency, Ghana.

KPMG (2009). Corporate Income Tax incentives for Clean Development Mechanism projects. China Alert: Tax and regulatory developments. Issue 34, April.

Office of the President, Republic of Guyana (2009). Low Carbon Development Strategy: Transforming Guyana's Economy while Combating Climate Change. Georgetown: Office of the President.

Office of the President, Republic of Guyana (2013). Low Carbon Development Strategy Update: Transforming Guyana's Economy while Combating Climate Change. Georgetown: Office of the President.

Olsen, K.H. and Fenhann, J. (2008). Sustainable development benefits of clean development mechanism projects: a new methodology for sustainability assessment based on text analysis of the project design documents submitted for validation, Energy Policy, 36 (8): 2773-2784.

Olsen, K.H. (2012). CDM sustainable development co-benefit indicators. Measuring the Future We Want. International Conference on Indicators for Inclusive Green Economy/Green Growth Policies, UNEP. Geneva, 4-6 December.

Owino, T. (2013). Personal interview, 15th July.

Sun, Q., Xu, B., Wennersten, R. and Brandt, N. (2010) Co-Benefits of CDM projects and policy implications. Environmental Economics 1 (2): 78-88.

Swedish Energy Agency (2012). The Swedish CDM and JI Programme: Contributing to global climate change. Eskilstuna: Swedish Energy Agency.

TERI (2012). Assessing the Impact of the Clean Development Mechanism on Sustainable Development and Technology Transfer. Delhi: The Energy and Resources Institute.

UNCSD (2007) Indicators of Sustainable Development: Guidelines and Methodologies Third Edition, United Nations Commission on Sustainable Development.

UNECA (2007) Sustainable Development Report on Africa: Managing Land-Based Resources for Sustainable Development, United Nations Economic Commission for Africa.

UNEP (2011) MCA4climate: A practical framework for planning pro-development climate policies, United National Environment Programme.

UNEP (2012). The need for numbers - goals, targets and indicators for the environment. Global Environmental Alert Programme Accessed at: http://www.unep.org/pdf/GEAS_Mar2012_Indicator.pdf.

UNFCCC (2012) Sustainable development co-benefits description for CDM project activities and programmes of activities - Draft tool Version 03.0, Clean Development Mechanism CDM-EB70-AA-A20.

UNFCCC (2012a). Annex 21: Draft Tool for Highlighting Sustainable Development Co-Benefits of CDM Project Activities and Programmes of Activities. CDM Executive Board 69, Proposed agenda – Annotations, Annex 21, Page 3.

UNFCCC (2012b). CDM Sustainable Development Tool (version 0.7). Accessed at: https://www.research.net/s.aspx?sm=WRFn5uJpH%2f5R1kKi72z%2fSDV9SDy1WMmYlPT5HNkW614%3d.

Appendix A

Technology factsheets

Landfill Gas Power

The municipal solid waste (MSW) created by a population is a significant management problem for any country. From a GHG perspective, methane is produced as the organic content in MSW degrades anaerobically (that is, without exposure to oxygen). However waste and methane are also potential sources of energy. Operations in many countries capture and use methane from MSW to generate electricity (or flare it if the goal is methane destruction), but it would be new technology for Ghana.

Landfill gas collection and power generation is estimated to be most economical form of electricity generation from MSW in Ghana. Promising sites include the engineered landfill in operation in Kumasi (Dompoase), landfill in operation in Accra (Sarbah) and the new landfill in Tema (Kpone).

Total MSW generated in Ghana in 2010 was 4.5 million tonnes, with urban population growth at 3.4 %/yr. At present, approx. 90 % of MSW is not well-managed.

Baseline/BAU Scenario 2020

Both current growth patterns in MSW and current trends in waste management practices continue. Only a 1 MW landfill gas generation facility is implemented at Oti.

LOW-CARBON SCENARIO 2020

Current MSW creation/collection rates, could fuel more than 60 MW of capacity if all was feasible.

However, new landfills take years to produce and only 2 engineered landfills exist. Assume that a new engineered landfill is made avail. for Accra and Kumasi landfill is tapped for gas.

Abatement potential

360 kT CO_2/yr in 2020

Abatement cost

18 USD/tCO_2

Climate resilience

Considered to have a minimal impact on climate resilience, except indirectly through aspects such as improved health.

GDP / Macroeconomic impact

Not competitive with current generation costs (except in examples of fuel shortages). Would required a feed-in-tariff to be competitive.

Energy Security

Improves energy security versus imported oil or gas (that currently is used to provide the balance of generation).

Rural development / economic impact

Appropriate landfills and collection are associated with urban areas, so likely minimal rural impact.

Household / consumer impact

Dependent on associated implementation strategies. If rates of waste collection are increased (with associated charges for a larger share of the population), then this could be a cost to households.

May marginally increase electricity prices.

Employment

Expected to create a modest number of permanent jobs per MW of installed capacity in relation to maintenance etc.

Would remove a significant number of informal jobs as scavengers, a potential barrier to implementation.

Energy access

Small impact due to a relatively small increase in generation capacity. Improves availability of electricity and reduces shortages.

Health

Significant health benefits relating to odour, hygiene, spread of disease, toxin leaching.

Education

Expected to have a minimal interaction with education.

Gender

May not have a specific gender impact.

Environmental impact

The engineered landfills associated with landfill gas can significantly reduce soil and water pollution.

Biodiesel production

Biodiesel is a liquid substitute for petroleum-based diesel fuel made from vegetable oil derived from a wide variety of oil-bearing plants such as castor, coconut, croton, jatropha, rapeseed (canola) and sunflower. Nearly all diesel-powered equipment can use blends of up to 20 percent biodiesel, and many engines can use higher-level blends or even pure biodiesel with little or no modification.

The Strategic National Energy Policy (SNEP), based on recommendations made by the Biofuels Committee set up in 2005, called for ambitious targets of 20 % use of biodiesel by 2020. Since then A National Biofuel Policy (NBP) has been formulated that moves this 20 % target to 2030. The NBP is currently undergoing strategic review.

A study of 17 commercial biofuel developers in Ghana in 2010 found that: the vast majority focus on Jatropha, are foreign owned, use business models requiring large-scale plantations and had minimal involvement of local smallholders at that time.

Baseline/BAU Scenario 2020

No biodiesel is introduced to Ghana's domestic supply.

Low-carbon scenario 2020

Considering the most updated fuel consumption projections and draft NBP, which aims to have biodiesel substitute traditional diesel by 20 percent by 2030. We assume a conservative target of 5 % by 2020.

Approx. 100,000 tonnes biodiesel in 2020.

Abatement potential
295 kT CO_2/yr in 2020

Abatement cost
66 USD/tCO_2 (study from Kenya)

Climate resilience
Pumped irrigation may provide a safeguard for food security.

Improved rural economic activity and income is, in itself, an improvement in resilience.

GDP / Macroeconomic impact
Blends of biodiesel are more expensive than traditional diesel in Ghana. Tax reductions to make it competitive would reduce tax income.

Export potential currently seems marginal to poor.

Energy Security
Regulated biodiesel blends would reduce oil imports for transport diesel by a similar amount.

Rural development / economic impact
Industrial-scale biofuel production often does not benefit the rural poor, unless well implemented.

Requires appropriate business models, regulatory oversight and land agreements.

Household / consumer impact
Possibly negative (due to higher cost) without a tax subsidy.

Employment
Wide range of employment impacts possible. Depends on business model.

Anecdotal evidence suggests commercial farms have relatively few permanent employees.

Can offer many temporary jobs during harvesting.

Energy access
No significant effect for this scenario of displacing traditional diesel.

Health
A legitimate concern about food scarcity if land is converted to non-edible crops.

Education
Could improve rural livelihoods and education opportunities, but highly dependent on the business model adopted by large growers.

Gender
Risk for women, to be negatively impacted due to loss of access to income from agricultural resources such as yam, locust bean and shea nuts.

Environmental impact
Require large tracts of land so has the risk of significant deforestation if not well regulated.

Productive Uses of Energy (PUE)

Productive uses of energy (PUE) involve the utilization of energy for activities that enhance income and welfare.

PUE can target a wide variety of productive uses, which can have a wide variety of development impacts.

The prioritized solutions for PUE in SE4ALL are:

- Irrigation: electric, wind pumps and mini hydro dams
- Agro-processing: crop-dryers, palm oil production and multifunctional platforms
- Fisheries: landing sites and coldstores and aquaculture

Other: Salt production and biogas use in schools and hospitals.

Baseline/BAU Scenario 2020

The mitigation impacts of PUE priorities are assessed compared to alternative irrigation/production by diesel-pump/diesel engine. For traditional drying etc the BAU is obvious

Low-carbon scenario 2020

14,000 ha irrigation by electric pumps, Poldaw windmills, and small hydro dams.

2000 MFPs for grinding and milling.

(noting that these are effectively pilot projects in the SE4ALL and not maximum potentials.

Abatement potential
20 kT CO_2/yr in 2020 (pilot programmes only)

Abatement cost
Costs for different PUE options vary highly and were not analysed in detail.

Climate resilience
Pumped irrigation can provide a safeguard for food security.

Improved rural economic activity and income is, in itself, an improvement in resilience.

GDP / Macroeconomic impact
Agriculture growth (and therefore irrigation) is a vital part of Ghana's economy.

PUE enables a wide variety of productive activities that offer added value on top of basic production.

Energy Security
Minimal impact on energy security. Most PUE provide services where there were none.

Rural development / economic impact
PUE increases the added value and production efficiency for rural populations.

Household / consumer impact
PUE can produce significant increases in income; e.g. for crop drying or water pumping.

MFPs allow increased efficiency for agricultural processing and to produce higher value products.

Employment
Opportunities in employment related to agriculture and food processing as well as installation and maintenance of PUE equipment.

Energy access
The main purpose of pursuing PUE is increasing energy access. Each technology thus has a strong direct impact on targeted stakeholders.

Health
Could provide food through increased harvests or reduced spoiling of food through drying.

Education
Could increase access to education by freeing up time and improving rural livelihoods/incomes.

Gender
Access to MFP frees up time and energy, reducing daily time spent on chores by 2 to 6 hours.

SE4ALL proposes specific training for women related to PUE technologies.

Environmental impact
Will reduce the amount of wood required and therefore pressure on forests.

Charcoal production

In Ghana up to 69 % of all urban households utilise charcoal for cooking purposes. Constituting a key pillar of the domestic energy supply, a national policy priority is to 'Sustain the supply and efficient use of woodfuels while ensuring that their exploitation does not lead to deforestation'.

Charcoal production using traditional kilns has a very low efficiency, with simple earth-mound kilns having a carbonisation efficiency below 20 %.

Moreover, the majority of charcoal is not produced from sustainable sources (i.e. not grown as a dedicated source of charcoal).

Baseline/BAU Scenario 2020

In the baseline scenario, it is assumed that production activities continue unabated in the current form. The annual growth in the demand is estimated at 3 % per annum.

Low-carbon scenario 2020

Assumes that short-crop energy rotation woodlots provide 10 % of final charcoal supply in 2020.

This production is matched to improved kilns which means that total sustainable wood supply is actually 3 to 4 % of all wood used for charcoal.

Abatement potential
100 kT CO_2/yr in 2020

Abatement cost
1.5 to 20 USD/tCO_2

Climate resilience
It increases climate resilience through reduced resource degradation.

But difficult to estimate to what extent this really improves climate resilience.

GDP / Macroeconomic impact
Woodfuel contributes 1.8 % of total annual GDP.

Improving the efficiency of this sector is complemented by reduced forest degradation costs.

Energy Security
Minor. Improves the efficiency and sustainability of existing domestic energy resources

Rural development/economic impact
Trade creates significant cash flow to rural areas.

Community woodlots and improved production techniques can increase proportion of the value captured by rural areas.

Household/consumer impact
Impact on prices unclear for urban users. Unlikely to reduce the costs of charcoal.

Employment
An important source of employment in rural areas.

Increased yield and specialisation may reduce net employment, however maintenance of woodlots may create new employment.

Energy access
This option is unlikely to reduce the costs of charcoal so impacts on energy access will be small.

Health
The use of cleaner technologies could greatly reduce air pollution impacts.

Education
Improved livelihoods for some producers could increase access to education for those groups.

Gender
Role of women in charcoal chain needs to be determined.

May have a positive impact on conditions of women if value captured by producers is increased.

Environmental impact
Will reduce the amount of wood required and therefore pressure on forests.

Improved cookstoves

Due to low affordability and accessibility to cleaner fuels, the traditional open fire, mud stove or coal pot cooking methods remain extremely popular within Ghana, especially in rural areas.

Current costs and transport complications, despite the government's LPG subsidy, keep LPG out of reach of most households. As most ICS are small, portable, charcoal stoves (catering to the popular peri-urban/urban preferred fuel in the South), the 80 % of the rural population using wood fuel have very limited ICS options.

There is a significant opportunity to improve the efficiency and health impacts of the cooking habits of this segment of the population of Ghana.

Baseline/BAU Scenario 2020

Due to costs, large segments of the population will continue to use biomass in the foreseeable future. In northern Ghana and rural areas, basic wood stoves continue to be prevalent.

Low-carbon scenario 2020

Adopts the Energy Strategy Goal to reduce the average woodfuel energy intensity per rural household by 10 % by 2020.

Abatement potential
200 kT CO_2/yr in 2020

Abatement cost
-2 to 0 USD/tCO_2

Climate resilience
It increases climate resilience through reduced resource degradation.

But difficult to estimate to what extent this really improves climate resilience.

GDP / Macroeconomic impact
Draft Woodfuels Policy indicates that woodfuel contributes 1.8 % of total annual GDP.

Improving the efficiency of this sector is complemented by reduced forest degradation costs.

Energy Security
Minor. Improves the efficiency and sustainability of existing domestic energy resources.

Rural development / economic impact
Time spent on foraging wood impedes investments in education and livelihood-enhancing activities.

ICS construction and supply offers rural industry opportunities.

Household / consumer impact
Main cost is time, not wood cost.

Employment
The woodfuel business is a major source of employment for rural communities.

ICS will also potentially provide many jobs for rural craftspeople and women who act as salespeople.

Energy access
Traditional cookstoves to improved ones represents a basic improvement in energy access.

Health
Can reduce exposure to indoor air pollution which is likely cause of significant health issues in Ghana.

Education
Significant time savings for wood foraging that could be used for educational activities.

Gender
Group most affected by indoor air pollution.

More opportunities to sell ICS.

Major time savings for other tasks.

Environmental impact
Will reduce the amount of wood required and therefore pressure on forests.

LPG for cooking

Since 1989, government programmes, such as the establishment of the LPG Fund and Ghana Cylinder Manufacturing Company (GCMC) have contributed to growth in LPG consumption from 5,000 tonnes per year in 1990, to over 200,000 tonnes in 2009.

In 2006, an estimated 9.5 % of Ghanaian households used LPG as the main source of fuel for cooking (2010 data is due to be released soon). Household access to LPG is significantly higher than this, as many households have LPG cooking equipment but still choose to use charcoal as their dominant fuel source. Supply challenges and competition for LPG from the transport sector have at times proved a bottleneck for more wide-spread adoption.

The production rate at the Tema refinery is roughly a quarter of what is required and storage there, for imports, struggles to meet demand.

Baseline/BAU Scenario 2020

More realistic target of 18 % access in 2015 based on Energy Commission calculations; access of households to LPG in 2020 would be about 24 %.

Low-carbon scenario 2020

This option involves bridging the gap between the 50 % policy goal and projected 24.5 % BAU. This does not mean full substitution of charcoal – fuel stacking will mean that often the fuel switch is not complete.

Abatement potential
360 kT CO_2/yr in 2020

Abatement cost
3 to 85 USD/tCO_2

Climate resilience
This option mainly impact urban populations less at risk from climate change.

However, it increases climate resilience through reduced resource degradation.

GDP / Macroeconomic impact
Land degradation from various economic activities is estimate to impact about 2 % of GDP. Charcoal contribution is significant.

Challenging to determine net GDP impacts due to new domestic LPG resources becoming available and the use of government subsidies.

Energy Security
Difficult to determine. Closely linked to successful development of sufficient domestic LPG resources. Without this, could lead to increased LPG imports.

Rural development/economic impact
Urban focused option, negatively impacts rural charcoal production and associated livelihoods.

Household/consumer impact
Minimal for the households that would use this option (i.e. urban switch from charcoal).

Employment
Scale-up of LPG (replacing charcoal) would result in some rural jobs being lost (more than a LPG supply chain would create).

Energy access
Moving from charcoal with traditional/improved/advanced cookstoves to LPG represents a significant improvement in energy access.

Health
Switching to LPG, which is a cleaner burning fuel, will reduce exposure to indoor air pollution which is likely cause of significant disease in Ghana.

Education
Fuel swap (i.e. purchase alternate fuel) with minimal impact on education.

Gender
Group most affected by indoor air pollution.

Need to include in the supply chain if possible.

No major time savings (as replaces bought charcoal).

Environmental impact
The use of LPG is likely to reduce pressure on forests due to displacement of charcoal.

Appendix B

Review of development indicators

Author	**Kingsley Oppong et al. (2010)**	
Description	Described as “Ghana’s Sustainable Development Criteria and Indicators”, but further searches do not support this. Referencing suggests a possible basis in CDM.	
Title	National GHG Mitigation Assessment for the Forestry and Agriculture Sectors of Ghana – Final Report	
Criteria and Indicators	Social	Poverty reduction; development
		Employment creation
		Creation of economic opportunities
		Skills and expertise development
		Equitable access and utilization of resources
	Economic	Foreign exchange generation
		Promotion of macroeconomic benefits
		Investment opportunities
	Environmental	Environmental health issues
		Reduction in Greenhouse gases
		Improvement in local environment
		Improvement in biodiversity conservation
		Transfer of environmentally friendly technology

Author	**UNFCCC (2012)**	
Description	The COP, under the KP, requested the Executive Board of the CDM to “continue its work and develop appropriate voluntary measures to highlight the co-benefits brought about by CDM project activities and programmes of activities. This resulted in a voluntary tool agreed at the 70th meeting of the board.	
Title	Sustainable development co-benefits description for CDM project activities and programmes of activities – Draft tool	
Criteria and Indicators	Social	Jobs
		Health and Safety
		Education
		Welfare (includes poverty alleviation, rural development, gender and others)
	Economic	Growth
		Energy
		Technology
		Balance of payments
	Environmental	Air
		Land
		Water
		Natural resources

Author	**UNEP (2011)**	
Description	Develops a hierarchical criteria tree containing a set of generic criteria, against which climate-policy planners can evaluate proposed climate-policy actions and their potential contribution to a broad range of climate, environmental and socio-economic development objectives	
Title	MCA4climate: A practical framework for planning pro-development climate policies	
Criteria and Indicators	Climate related	Reduce GHG and black carbon
		Enhance resilience
	Economic	Trigger private investment
		Improve economic performance
		Generate employment
		Contribute to fiscal stability
	Environmental	Protect environmental resources
		Protect biodiversity
		Support ecosystem services
	Social	Reduce poverty incidence
		Reduce inequity
		Improve health
		Preserve cultural heritage
	Political and institutional	Contribute to political stability
		Improve governance

Author	**Cox *et al.* (2013)**	
Description	Based on sample visualisation provided. For this sample indicators were selected based on common development goals targeted by non-climate programs (such as Millennium Development Goals targets)	
Title	Assessing Development Impacts Associated with Low Emission Development Strategies: Lessons Learned from Pilot Efforts in Kenya and Montenegro	
Criteria and Indicators	Social	Health
		Education
		Gender
		Rural Development
		Energy Access
	Economic	GDP
		Employment
		Local industry
		Trade
	Environmental	Water
		Biodiversity

Author	**UN (2007)**	
Description	Third revision of sustainability indicators that were initially developed by the United Nations Commission on Sustainable Development based on Agenda 21 of the 1992 action plan in Rio de Janeiro.	
Title	Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition	
Criteria and Indicators	Poverty	Income poverty
		Income inequality
		Sanitation
		Drinking water
		Living conditions
		Access to energy
	Governance	Corruption
		Crime
	Health	Mortality
		Health care delivery
		Nutritional status
		Health status and risks
	Education	Education level
		Literacy
	Demographics	Population
		Tourism
		Vulnerability to natural hazards
		Disaster preparedness and response
	Atmosphere	Climate change
		Ozone layer depletion
		Air quality
	Land	Land use and status
		Desertification
		Agriculture
		Forests
	Oceans, eas and coasts	Coastal zone
		Fisheries
		Marine environment
	Freshwater	Water quantity
		Water quality
	Biodiversity	Ecosystem
		Species
	Economic development	Macroeconomic performance
		Sustainable public finance
		Employment
		Information and communication technologies
		Research and development
		Tourism
	Global economic partnership	Trade
		External financing
	Consumption and production patterns	Material consumption
		Energy use
		Waste generation and management
		Transportation

Author	**IAEA (2005)**	
Description	The product of an international initiative to define a set of Energy Indicators for Sustainable Development (EISD). The purpose of this publication is to present one set of EISD for consideration and use and to serve as a starting point in the development of a more comprehensive and universally accepted set of energy indicators.	
Title	Energy Indicators for Sustainable Development: Guidelines and Methodologies	
Criteria and Indicators	Equity	▸ Accessibility
		▸ Affordability
		▸ Disparities
	Health	▸ Safety
	Use and Production Patterns	▸ Overall Use
		▸ Overall Productivity
		▸ Supply Efficiency
		▸ Production
		▸ End Use
		▸ Diversification (Fuel Mix)
		▸ Prices
	Security	▸ Imports
		▸ Strategic Fuel Stocks
	Atmosphere	▸ Climate change
		▸ Air Quality
	Water	▸ Water Quality
	Land	▸ Soil Quality
		▸ Forest
		▸ Solid Waste Generation and Management

Author	**ADB (2011)**	
Description	Presents a framework of inclusive growth indicators (FIGI) and proposes a set of 35 indicators of inclusive growth. The FIGI was conceptualized with the three policy pillars and good governance and institutions as the guiding framework.	
Title	Framework of Inclusive Growth Indicators Key Indicators for Asia and the Pacific 2011 Special Supplement	
Criteria and Indicators	Poverty and Inequality	▸ Income
		▸ Non-income (includes schooling and child mortality)
	Growth and Expansion of Economic Opportunity	▸ Economic Growth and Employment
		▸ Key Infrastructure Endowments
	Social Inclusion to Ensure Equal Access to Economic Opportunity	▸ Access and Inputs to Education and Health
		▸ Access to Basic Infrastructure Utilities and Services (includes electricity cooking fuel)
		▸ Gender Equality and Opportunity
	Social Safety Nets	▸ Includes social security, public health expenditure and labour rating

Author	**UNECA; United Nations Economic Commission for Africa (2007)**	
Description	Indicators selected to measure the status of sustainable development in Africa. The criteria used to select the indicators include ease of measurement, availability, usefulness, sensitivity, user-friendliness, reliability, validity, policy relevance and cost effectiveness.	
Title	Sustainable Development Report on Africa Managing Land-Based Resources for Sustainable Development	
Criteria and Indicators	Economic	GDP Composition and growth GDP per Capita Agricultural Production Exports Savings and Investment Foreign Direct Investment ODA External Debt Balance of Payments Terms of Trade Education expenditures Health Expenditures Roads ICT Unemployment Inflation Rate
	Social	Poverty Level Income Distribution Access to Sanitation Access to Water Population Growth Fertility Child Mortality Maternal Mortality HIV/AIDS Malaria and TB Education Illiteracy
	Environment	Land Energy Water CO_2 Emissions Deforestation Soil Degradation

Appendix C

List of organisations

List of attending organisations at the final DIA visual assessment workshop. In total 19 attendees representing 17 organisations.

Name	Type
Kimminic	Private sector (biofuels)
Forestry Commission	Government
Environmental Protection Agency (EPA)	Government
Energy Commission	Government
Kwame Nkrumah University of Science and Technology (KNUST)	Research institute/university
John Young and Assoc.	Independent expert
Clean Cookstove Alliance	NGO
GIZ	Development partner
Ministry of Environment, Science and Technology (MEST)	Government
KfW	Development partner
UNDP	Development partner
Climate Action Network (CAN) Ghana	NGO
National Development Planning Commission (NDPC)	Government
HATOF Foundation	NGO
Anomenia Ventures	Independent expert
Ghana Health Service	Government
Ministry of Energy and Petroleum (MOEP)	Government

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn,
Germany

Sector Project Climate Protection Programme for Developing Countries
Friedrich-Ebert-Allee 40
53113 Bonn
Germany
Tel. +49 (0)228 4460-0
Fax + 49 (0)228 4460-1766

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
Germany
Tel. +49 (0) 6196 79-0
Fax +49 (0) 6196 79-1115

climate@giz.de
www.giz.de/climate

Authors
Lachlan Cameron (Energy research Centre of the Netherlands, ECN)
Deborah Murphy (International Institute for Sustainable Development, IISD)
James Falzon (ECN)
Michiel Hekkenberg (ECN)

Design and layout
Ira Olaleye, Eschborn, Germany

Printed by
TopKopie, Frankfurt/Main, Germany
Printed on FSC-certified paper

Photo credits
Cover: ©GIZ/Dirk Ostermeier; others: see photo

As at
October 2013

GIZ is responsible for the content of this publication.

On behalf of
Federal Ministry for Economic Cooperation and Development (BMZ)
Climate Policy and Climate Financing Division

Addresses of the BMZ offices

BMZ Bonn
Dahlmannstraße 4
53113 Bonn
Germany
Tel. +49 (0) 228 99 535-0
Fax +49 (0) 228 99 535-3500

BMZ Berlin
Stresemannstraße 94
10963 Berlin
Germany
Tel. +49 (0) 30 18 535-0
Fax +49 (0) 30 18 535-2501

poststelle@bmz.bund.de
www.bmz.de