Initiative for Climate Action Transparency - ICAT

Sustainable development impacts assessment of Ghana's rooftop solar programme

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1. Introduction

Ghana has set a 10% maximum renewable energy target by 2030. The 2010 national energy policy outlines the renewable energy commitment for Ghana. To facilitate the achievement of the 10% goal, the 2011 renewable energy law, Act 832[1] was enacted to provide the legal and regulatory requirements for renewables. Act 832 broadly adopts economic and technical strategies to guide the development of the renewable market in the country. The fiscal incentives are the feed-in-tariff scheme and the renewable energy fund and all geared towards creating favourable investment or business environment for the private sector. Furthermore, the Act has also provided a strategy for renewable power transmission and distribution. Besides, the 2019 renewable energy master plan presents a new focus for scaling up renewable energy by providing finer details on the investment opportunities in the renewable energy market. The plan has further disaggregated the 10% renewable headline target into a broadly attainable megawatt medium-term goal of increasing the proportion of renewable energy[2] in the national energy generation mix from 42.5 MW in 2015 to 1,363.63 MW. In 2015, the Ministry of Energy also adopted the scaling up renewable energy penetration investment plan (SREP-IP) under the climate investment fund to help mobilise investments for renewable energy scale-up. Some of the significant achievements for scaling renewable energy include the following:

- Rolling out a net metering scheme for distributed renewable energy.
- Drafted for adoption a renewable energy purchase obligation guideline
- Implementing renewable energy licensing framework
- Conducted renewable energy resource mapping
- Installed 42.5MWp utility-scale PV systems in the Central and Upper East regions and generated 33 GWh of solar energy in 2018.

Given the already impressive efforts at creating a conducive policy and regulatory climate for renewables, attention is now on translating the commitments to megawatts on the ground. As a result, there have been several public and private sector renewable energy initiatives that seek to contribute to achieving government-set targets. It ranges from solution in mini-grids, lighting, productive use, utility-scale, distributed renewables, and home systems. That is why Ghana's nationally determined contributions (NDCs) aimed to scale up renewable penetration as one of the ways to reduce greenhouse emissions and at the same time help achieve sustainable development goals in the energy sector. Under the ICAT[3] project, Ghana focuses on renewable energy policy as a necessary part of climate mitigation action in the NDCs analysis.

However, it is essential to note that, investing in renewable energies, is not only about increasing access to clean and affordable energy, but has considerable socio-economic, climate and environmental benefits. These benefits of renewables are usually not adequately highlighted in policy decision-making. Typically, the benefits are either not addressed at all or do not receive ample attention in policy analysis. So the full benefits of renewable investments are not compelling enough to compete with traditional carbon-intensive energy sources. Evaluating the energy and greenhouse emission reduction potentials for renewable policies has relatively progressed due to the availability of methodologies and best practices. The WRI[4] and ICAT[5]

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[1] http://energycom.gov.gh/files/RENEWABLE%20ENERGY%20ACT%202011%20(ACT%20832).pdf

[2] "Japan to See Renewables Exceed Nuclear Power Generation in 2030." Jiji Press English News Service, JIJI Press America, Ltd., 6 Apr. 2015, p. n/a.

[3] Initiative for Climate Action Transparency

[4] https://wriorg.s3.amazonaws.com/s3fs-public/Policy_and_Action_Standard.pdf

policy assessment tools are widely applicable approaches for climate policies and measures. There is little work on the tools for the assessment of sustainable development benefit of mitigation actions in developing countries. Therefore in most of the NDC, generic references have been made to the potential sustainable development benefits of climate action without verifiable data to back it. Having recognised the gap, the ICAT sought to build on the groundbreaking works on the assessment of potential sustainable development of climate actions. ICAT effort culminated in the development of the methodology for sustainable development impacts of climate policies and measures[6]. In this work, Ghana has decided to focus on mitigation actions in the renewable energy space. Specifically, the exercise looks into assessing the sustainable development impacts of solar rooftop programme by complementing the analysis of the renewable energy and GHG emissions reduction potential of the programme.

2. Assessment of sustainable development impacts Ghana's solar rooftop programme

2.1 Brief description of the programme

The government announced the solar rooftop programme in 2015[7]. The primary objective of the programme was to provide 200MW peak load relief on the national grid through solar PV technology in the medium term. As part of the initiative, the Energy Commission was tasked to facilitate the installation of 20,000 rooftop solar PV systems in residential facilities (homes) under a capital subsidy scheme in 2016. Under this initiative, qualified beneficiaries receive capital subsidy in two forms, as either, cash payment for solar panels composed of the solar PV system or the supply of actual solar panels after the beneficiary has purchased and installed the requisite Balance of System (BoS) components such as inverter, batteries and charge controllers. The maximum capacity of solar panels each beneficiary is entitled to be up to 500W. Several commercial banks have expressed interest in providing loan facilities to interested beneficiaries in respect of the procurement of BoS components for the solar PV systems of their choice.

2.2 Methodology for the sustainable development impacts assessment

The assessment of the sustainable development (SD) impacts for the Ghana solar rooftop programme followed the approaches described in the ICAT sustainable development methodology. The team conducted an ex-ante assessment for the rooftop programme. The methodology establishes the overall boundary influence of the solar programme and then identifies potential impact category according to the environment, social, economic pillars of SD. It further provides structured ways to determine the inclusion or otherwise of identified impact in the assessment boundary based on likelihood, magnitude, and direction of impacts[8]. Due to the limited time available for this assessment, the team relied on secondary data from multiple sources in the evaluation of each impact category. The causal chain approach was used to identify the specific potential of the solar rooftop programme. Generally, it depicts the causal relationships of impact as every stage of implementation of the programme. Figure 1 captures four broad impact categories. First, the impacts have been included in the assessment boundary and are likely to occur as a result of the implementation of the solar rooftop initiative. Some of the impacts related to climate change, jobs, capacity development, access to clean energy, incomes, and air quality. The second category of impacts is those that

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[5] https://climateactiontransparency.org/wp-content/uploads/2019/06/ICAT-Renewable-Energy-Methdology-June-2019.pdf

[6] https://climateactiontransparency.org/wp-content/uploads/2019/06/ICAT-Sustainable-Development-Methodology-June-2019.pdf

[7] energycommunity.org/default.asp?action=dologin

[8] Table 7.5 of the document titled; example of assessment the sustainable development impacts of a solar PV incentive policy shows similar results qualitative assessment of solar PV incentive policy.

have been excluded from the assessment due to lack of data, insignificant effects and not occurring. Category 3 includes the impacts that are significant but occurs outside Ghana's jurisdiction. The current assessment period cover 2016-2030 with 2016 as the base year the rooftop initiative commenced.

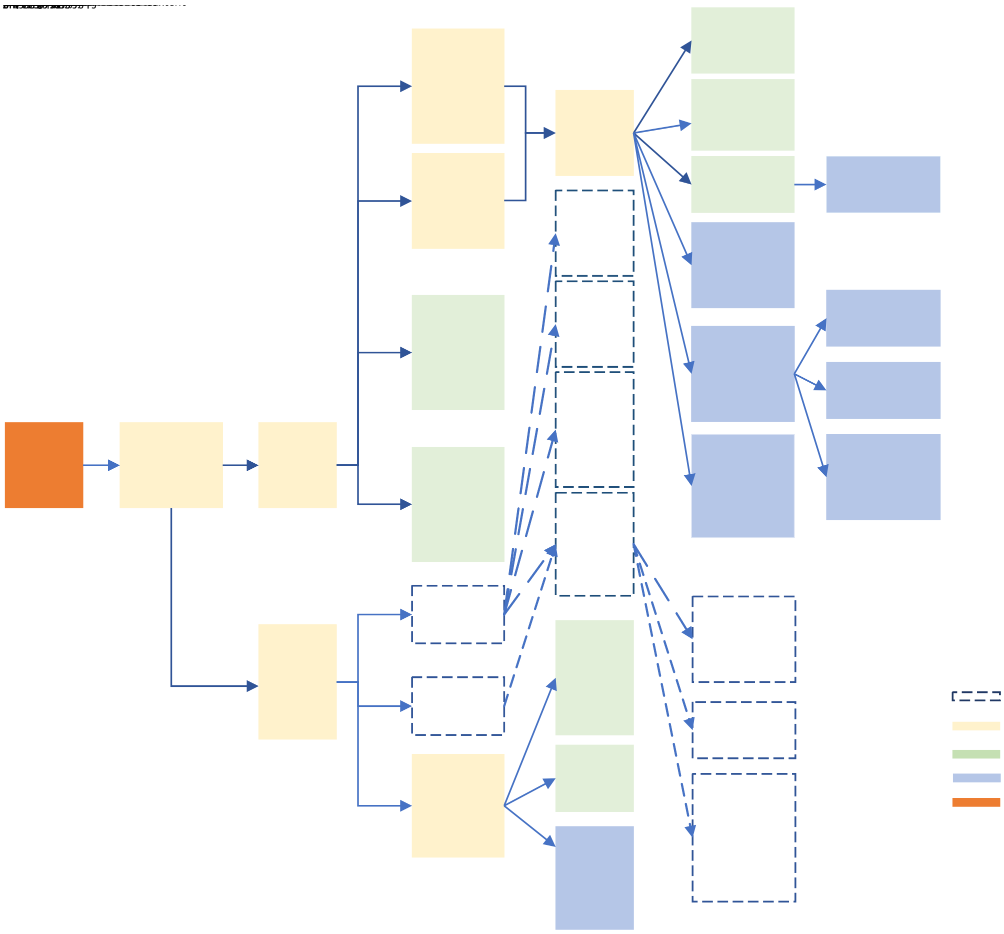

Figure 1: Causal chain of the solar rooftop programme

Under the climate mitigation impact category, the assessment has included GHG savings from avoided grid-electricity use and diesel generators. For grid electricity, emission reductions have been quantitatively estimated using the existing grid emission factor figure and the total amount of solar energy generated as well as the number of CFL bulbs replaced with LED bulbs in the GACMO model. Even though estimating emission savings from diesel generator use is included in the assessment boundary, it is challenging to get access to accurate data for the computation. However, a simplified approach has been used to compute emission reductions from generating a given amount of solar energy for the same quantity from diesel generators (Table 1). The underlying assumption of the GHG calculation is that the primary electricity source for the beneficiaries is fossil fuel-based grid electricity and diesel generators are back up. For air quality and health impacts, PM_s and NO_x were estimated using default emissions factors were obtained mainly EMEP/EEA or EMEP/ CORINAIR[9] air pollutant emission inventory guidebook. The data on the number of deaths due to air pollution was unavailable, so a qualitative approach was used to evaluate this specific impact category.

Table 1: Assessment boundary for the solar rooftop programme

Sustainable development pillars	**Impact categories included in**	**Specific impacts included in the quantitative/qualitative**	**Indicator(s) to quantify or evaluate**	**Feasible to quantify or evaluate**		**Included in the assessment boundary**
				Quantitativ	Qualitativ	

[9] https://www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook/emep

	the assessment	**assessment boundary**		e	e	
Environmental	Climate change mitigation	Reduced GHG emission from grid-connected fossil fuel-based power plants	GHG emissions (tCO_2e/year	Yes	No	Yes
		Reduced GHG emissions from diesel generators		No	No	No
	Air quality/health impacts of air pollution	Reduced air pollution from grid-connected fossil fuel-based power plants	Emission of $PM_{2.5}$, PM_{10}, SO_2 and NO_X (t/year), number of death due to air pollution	Yes	Yes	Limited data. The calculation based on proxies
		Reduced air pollution from diesel generators		Yes	No	Limited data. The calculation based on proxies
Social	Energy	Increased renewable energy generation from more solar generation	Solar installed capacity (MW), % solar of total installed capacity of renewable energy sources	Yes	No	Yes
	Access to clean, affordable, and reliable energy	Increased access to clean, affordable, and reliable electricity	Number of houses/building/facilities with access to clean energy resulting from the rooftop programme	Yes	No	Yes based on estimates and expert judgement
	Capacity development	Increase in training for skilled workers in solar relevant sectors	Many new skilled trainees and workers on the ground.	Yes	No	No
Economic	Jobs	Increased jobs in solar PV installation, operations, and maintenance	Number of new jobs resulting from the solar rooftop programme	Yes	No	Yes
	Income	Increases income for households, institutions and other organisation due to reduction in energy cost	Savings in an annual electric bill (USD/year)	Yes	No	Yes, based on estimates and expert judgement
	Energy security	Reduced dependence on imports of fossil fuels	Reduction in liquid fuel imports from the solar rooftop programme	No	Yes	Yes, but based on import cost of fossil fuel

Regarding the social impact of the solar rooftop initiative, the focus is on the improvement of access to clean and reliable energy and capacity development in solar technology. Total projected solar generation has been estimated based on the standard size of solar (installed capacity), annual capacity factor and efficiency factor per installation and summed together to cover the whole 200,000 targets. The GACMO model was used to calculate the potential solar energy generation. Having estimated the total expected solar energy generation, the team derived the share of installed capacity of the national total and the number of households/buildings with access to clean energy. Estimating the total number of people that are expected to receive training on solar can be challenging due to a lack of data. When it comes to the economic pillar, the assessment covered parameters such as jobs, incomes and import cost of liquid. For jobs figures, it is challenging to get data on direct solar jobs on installations, operations, maintenance, imports, consultants.

So, the estimate on jobs prospect associated with the rooftop initiative was from the total licensed solar companies in the country.

This data on licensed solar companies is not solely for those involved in the solar rooftop programme, and it also included private sector initiatives. Therefore, a fraction of total licensed solar companies was calculated to represent the job prospects associated with the solar rooftop initiative. In the assessment the team used benchmark maned-hours required for the installation of 200MW solar PV for the solar rooftop programme. Savings in an annual electric bill (USD/year) from the use of solar PV installation instead of grid power was estimated based on the average unit price of solar and grid electricity. The price difference multiplied by the total solar power generated gives saving to the households/buildings on the solar rooftop programme. Bank of Ghana and Ghana statistical service collect data on import cost of liquid fuels and natural gas. The annual variations in import value of liquid fuels are due to the combination of several factors. But these factors cannot be solely attributed to the combined effects of the use of solar energy generated from 200 MW in households/buildings involved in the solar rooftop programme. Even though the projected 200MW solar energy capacity can reduce grid electricity that may not necessarily lead to a reduction in import of liquid or gas fuel for electricity generation. That said, expert judgement was used to estimate the potential import variation due to kicking in of 200 MW solar PV capacity.

3. Matrix for sustainable development impact of solar rooftop programme

Table 2 presents the matrix for the solar rooftop programme followed the ICAT sustainable development methodology. It also captures the results of the assessment using the parameters included in the assessment, as shown in table 1. The social, economic, and environmental impacts of the solar rooftop programme show higher benefits to the country than usually reported with energy or climate change lens alone. In terms of the environmental impacts, the increasing levels of avoided GHG emissions and air pollutants are 16.7 kilotonnes, 27.7 kg of NO_x and 0.3 kg of $PM_{2.5}$. On the social impact side, an estimated that 40,000 households nation-wide are to get access to clean and affordable energy for implementing the solar rooftop programme. Majority of the households will use solar energy to complement the primary electricity use from the national grid. Furthermore, the job direct and indirect job prospect is a vital component of the initiative.

It is likely to generate around 280 installation and maintenance jobs in the implementation period. The assessment has not included jobs associated with imports, retail, operations, and consultancy services in the assessment due to the lack of reliable data. But it is important to stress the availability the jobs once the implementation of programme is underway. Another aspect of the social benefits of the programme related to the acquisition of new skills in solar technology. Although the team did not get data on number of beneficiaries of solar training especially for those involved in installation and maintenance of solar PVs, it is worthwhile to indicate that the Energy Commission, some tertiary institutions and international organisations organise regular training courses on solar for artisans in the country. The cumulative avoided annual electric bill for the 40,000 households over the 15 years comes up to US$ 400,000 at an average of $164, 000 per annum. In the same vein, the avoided cost associated with the import of natural gas to produce an equivalent of 32,850 GWh solar energy is the measure of the contribution of programme to energy security. The avoided import cost of natural gas is estimated at US$ 295,600 over the 15 years.

Table 2: Matrix of the general aspect of sustainable development impacts of solar rooftop programme in Ghana

Information	**Details**
Title of action	Ghana solar rooftop programme
Type of action	Financial incentive
Description of action	The programme provides a capital subsidy to cover the free supply of 50W solar panel. Homeowners pay for the rest of the system, including replacing all lights with LEDs, which is a requirement for the free supply of the 500W panel. It also s to provide 200MW peak load relief on the national grid through solar PV technology in the medium term. The capital subsidy to the beneficiaries comes in two forms, either as, cash payment for solar panels of the solar PV system; or the supply of actual solar panels after the beneficiary has purchased and installed the requisite Balance of System (BoS) components such as inverter, batteries, charge controllers. Each beneficiary under the programme is entitled to a maximum capacity of 500W solar panels. The applicant pays for the cost of any additional solar PV panels installed beyond mandatory 500 W. In phase 1, the programme is limited to residential facilities and must satisfy the following conditions before joining the initiative: • change all lamps in their homes to LED lamps, • be willing to purchase BoS components, • agree to install BoS before the supply/installation of the solar PV panels from the programme, • install only deep cycle batteries designed for solar PV systems, • ensure that BoS meet the minimum standards set by Ghana Standards Authority (GSA), • invoice Energy Commission with the cost of 500Wp solar panel supplied the beneficiary for reimbursement. Agree price is GHC3.8 per Watt, and • use only solar PV installers licensed by the Energy Commission for all the installation works. A prospective application can download from the website on Energy Commission[10] and the contact list of solar installation and maintenance licensed holders, as well as the link to the energy consumption of domestic electrical appliances, is published on the Energy Commission's website[11]. The Energy Commission has also put out the lists of LED dealer and manufacturers in Ghana[12] and local banks[13] that have expressed interest to participate in the programme to aid prospective beneficiaries to make informed choices. Summary of application processes is below: • pick an application form from the office of the Energy Commission or its website, fill and submit it,

[10] http://www.energycom.gov.gh/images/Application_Form__for_NATIONAL_Rooftop_Solar_Programme_-_RESIDENTIAL_APPLICANT-Final_new.pdf

[11] http://www.energycom.gov.gh/images/Energy_Savings_Chart.jpg

[12] http://www.energycom.gov.gh/images/List_of_LED_Lamp_Dealers_and_Manufacturers.pdf

[13] http://www.energycom.gov.gh/images/List_of_Banks_that_Expressed_Interest_to_Participate_in_the_Rooftop_Solar_Programme.pdf

	• receive approval of application from the Energy Commission, • obtain a list of accredited solar vendors to purchase BoS from the Energy Commission, • purchase the requisite BoS components (batteries, charge controllers, inverter, changeover switch and wires) from an accredited solar vendor of your choice, • Invite Energy Commission field officers to come and inspect the installation of the BoS, and • obtain from the Energy Commission solar panels to be coupled to the installed BoS or a cash refund for the cost of the solar panels already purchased and installed, if the criteria are met. The estimated cost rooftop solar programme is USD 52 million and can leverage additional private sector investment. Also, to enable the smooth implementation of the programme, the Commission organises regular training and capacity building of various stakeholders such as banks, installers and government agencies. The Commission also has a dedicated online portal for a prospective applicant to download the registration form and get access to the list of interested banks, LED dealers and licensed solar companies.
Status of action	The programme started in 2016, and currently, implementation is ongoing.
Date of implementation	January 2016
Date of complete	There is no formal completion date for the programme
Implementation entity or entities	Ministry of Energy oversees the programme implementation. Energy Commission is the technical implementation entity. The Commission sees to the direct operationalisation of the programme. It has appointed a national programme director who is responsible for the day-to-day operations. The Commission has permitted private companies to supply and install the solar PVs. The supplier then sends an invoice to the Commission for payment at an agreed price. The Commission also undertakes pre-inspection of the BOS before the supply of the solar PV.
Objectives and intended impacts or benefits of the action	The objective of the action is to increase the penetration of solar energy, increase access to clean energy, increase energy sufficiency, create green jobs and reduce greenhouse gas with emphasis on households.
Level of the action	National focusing electrified households
Geographic coverage	Ghana
Sector targeted	Energy supply – home solar PV system
Related actions	Ghana targets to achieve 10% renewables in the national energy mix by 2030. Of the 10%, installations of 741.3 MW is expected to be solar power, of which, 200MW is to come from distributed solar PV. The solar rooftop programme aims to achieve 20MW of the distributed solar PV target.
Relevant SDGs	The action can contribute to directly to SDG 13 (climate action), SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth), SDG 12 (responsible consumption and production).
Support legislation	National renewable energy act (Act 832, 2011)
Monitoring, reporting and verification plan	At the household level, the licensed solar installation companies are responsible for monitoring and reporting parameter like the number of installations and beneficiaries, location, invoices on distributed solar PV to households. The quantity of solar electricity generated can be available at the user level. For all the

	500Wp and above the field survey will be done by the Energy Commission to evaluate the impacts.														
Checks and balances	If the applicant and installer present false information to the Energy Commission, the capital subsidy will be held back until the correction is made in the submission.														
Specific impact category	Assessment of Reduced GHG emissions from grid-connected fossil fuel-based power plants														
Parameters	Installed capacity (MW), grid emission factor (tC/MWh), Solar electricity generated (GWh)														
Assumptions	In the baseline scenario, plans to add natural gas-based power equivalent to the 200MW solar rooftop capacity addition due to the solar rooftop programme. Also, the current electricity mix will not substantially change over the assessment period. Each household is entitled 500W of solar PV therefore the 20MW for the whole programme will cover 40,000 households nationwide. Cost of grid electricity is an average of the residential tariff based on PURC approved July 2019 tariff. Tariff assumed to hover 12 cent/kWh over the assessment period. Calculated total solar energy generation using the efficiency factor of 0.9 and annual capacity factor of 1825 hours in a year based on 5 hours daily insolation.														
Years	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline scenario															
Baseline capacity (MW)[14]	13.3	26.7	40.0	53.3	66.7	80.0	93.3	106.6	120.0	133.3	146.6	160.0	173.3	186.6	200.0
Thermal electricity (MWh)[15]	229.9	558.5	903.4	1149.8	4024.1	6898.5	9772.9	12647.3	15521.6	18396	21270.4	24144.7	27019.1	29893.5	32850
Natural consumption (Mscf)	2.33	5.7	9.2	11.7	40.79	69.9	99.07	128.2	157.4	186.5	215.6	244.8	273.9	303	333
GEF[16] (tC/MWh)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
CO_2 emissions (ktCO_2)	0.1	0.3	0.5	0.6	2	3.5	4.9	6.32	7.8	9.2	10.6	12.1	13.5	14.9	16.4
NO_x (EF[17]) (kg NOx/TJ)	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
NO_x emissions (kg)	0.2	0.5	0.8	1.0	3.4	5.8	8.2	10.7	13.1	15.5	17.9	20.4	22.8	25.2	27.7
$PM_{2.5}$ (EF) (kg $PM_{2.5}$/TJ)	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
$PM_{2.5}$ emissions (kg)	0.002	0.005	0.008	0.010	0.034	0.058	0.082	0.107	0.131	0.155	0.179	0.204	0.228	0.252	0.277
Unit cost of electricity (US cent/kWh)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Total electricity cost ($), thousand	28	67	108	138	483	8,28	1,173	1,518	1,863	2,208	2,552	2,897	3,242	3,587	3,942
Rooftop solar PV programme scenario															
No. of households	280	680	1100	1400	4900	8400	11900	15400	18900	22400	25900	29400	32900	36400	40000

[14] installed capacity of natural gas- based power plant
[15] Natural gas-based generated power (MWh)
[16] Grid emission factor
[17] Emission factor

Installed solar capacity (MW)	0.1	0.3	0.6	0.7	2.5	4.2	6.0	7.7	9.5	11.2	13.0	14.7	16.5	18.2	20.0
Solar energy (MWh)	229.9	558.5	903.4	1149.8	4024.1	6898.5	9772.9	12647.3	15521.6	18396	21270.4	24144.7	27019.1	29893.5	32850
Unit cost of solar energy (US cent/kWh)[18]	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8`
Total electricity cost ($), thousand	25	60	98	124	435	745	1,055	1,366	1,676	1,987	2,297	2,608	2,918	3,228	3,548
Job prospects[19]	19	38	57	76	95	114	133	152	171	190	209	228	247	266	285
Specific impact category	Sustainable development impact of solar rooftop programme														
Avoided GHG emissions (tCO_2/year)	0.1	0.3	0.5	0.6	2	3.5	4.9	6.32	7.8	9.2	10.6	12.1	13.5	14.9	16.4
Avoided NOx emissions (kg)	0.2	0.5	0.8	1.0	3.4	5.8	8.2	10.7	13.1	15.5	17.9	20.4	22.8	25.2	27.7
Avoided $PM_{2.5}$ emissions (kg)	0.002	0.005	0.008	0.010	0.034	0.058	0.082	0.107	0.131	0.155	0.179	0.204	0.228	0.252	0.277
Solar installed capacity (MW), % solar of total installed capacity of renewable energy sources	100%	100%	100%	100%	100%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Number of houses with access to clean energy resulting from the rooftop programme	280	680	1,100	1,400	4,900	8,400	11,900	15,400	18,900	22,400	25,900	29,400	32,900	36,400	40,000
Increased jobs in solar PV installation, and maintenance	19	38	57	76	95	114	133	152	171	190	209	228	247	266	285
Savings in an annual household electric bill (US$/year), thousand	2.76	6.70	10.84	13.80	48.29	82.78	117.27	151.77	186.26	220.75	255.24	289.74	324.23	358.72	394.20
Avoided import cost of natural gas (US$/year), hundred	20.7	50.3	81.3	103.5	362.2	620.9	8,79.6	1,138.3	1,397	1,655.7	1,914.4	2,173.2	2,431.9	2,690.6	2,956.7

[18] Cost of solar is based on 2016 approved FIT tariff by Ghana’s Public Utility Regulatory Commission

[19] Figures are based on proportional number of job prospect in the renewable energy master plan. It includes permanent and temporary jobs in solar installation and maintenance.

4. Conclusions

On the whole, the approach for the SD assessment insightful and had helped to contribute to improving the analytical rigour behind the NDCs and strengthen capacity and awareness. It has been a useful learning curve has offered us a viable alternative to evaluate the full effects NDC actions which hitherto focussed more on projecting the emission reduction benefits. The SD assessment did not only make it possible to assess the socio-economic benefits of climate actions beyond emission reductions but also brought the financial benefit of the action. It is an innovative way to visualise the multiple impacts of climate action in single dashboard to help improve communication and appreciate the full benefits of the action. This approach has also highlighted the additional benefit cross-sectoral benefits of climate action over the implementation period. This new way of evaluating the effect of climate actions would inform the Ghana team when it starts to revise the current NDCs next year. It would help to enhance the analytical rigour of the data undermining the revised NDCs.

In another important lesson from this exercise is about the need to beef up communication aspects. Most times, communicating climate action impacts skew towards energy and mitigation benefits without highlighting the additional social and economic aspects. It is a critical gap that must be addressed head-on. At least the results from the sustainable development show far more additional benefits of the solar rooftop programme are that usually not highlighted to policy-makers when making decisions. At least the assessment study has demonstrated that the real socio-economics of the solar rooftop programme that the general can relate to more than the unattractive energy and emission-led communication. The approach is crucial when it comes to making compelling case to decision-makers in the finance and planning ministries for more allocation of financial resources to support the NDCs. The general public relates better to the socio-economic benefits of climate measure than the global perspective. Once the general public starts to support the NDCs it enhances the chance to get them implemented. With the sustainable development results, it is possible to articulate the emission reduction potential and the socio-economic benefits (investment savings, job prospects, access to clean energy), for specific NDC interventions.