Initiative for Climate Action Transparency – ICAT

REVISION TO NDCS IN ENERGY INDUSTRY IN SRI LANKA:

ASSESSMENT OF MITIGATION IMPACTS AND SUSTAINABLE DEVELOPMENT IMPACTS

Initiative for Climate Action Transparency - ICAT –

REVISION TO NATIONALLY DETERMINED CONTRIBUTIONS IN ENERGY INDUSTRY IN SRI LANKA

DELIVERABLE 2: ASSESSMENT OF MITIGATION IMPACTS AND SUSTAINABLE DEVELOPMENT IMPACTS

ClimateSI, 2020

H.M. Buddika Hemashantha, W. Indike Dassanayake, D.M.Anuradha Lakmini Dissanayake, Himesh Hansamal, Chrishma Dharshani Perera

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Climate Smart Initiatives (Pvt) Ltd.,
Sri Lanka.

List of Acronyms

ADB	Asian Development Bank
BAU	Business As Usual
CAIT	Climate Analysis Indicators Tool
CCS	Climate Change Secretariat
CEB	Ceylon Electricity Board
CH_4	Methane
CIFF	Children´s Investment Fund Foundation
ClimateSI	Climate Smart Initiatives (Pvt) Ltd
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DSM	Demand Side Management
GACMO	The Greenhouse Gas Abatement Cost Model
Gg	Gigagram
GHG	Green House Gas
ICAT	Initiative for Climate Action Transparency
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
LTGEP	Long Term Generation Expansion Plan
LNG	Liquefied Natural Gas
LUCF	Land Use Change and Forestry
MAC	Marginal Abatement Cost
MEWR	Ministry of Environment Wildlife Resources
MMDE	Ministry of Mahaweli Development & Environment
MPE	Ministry of Power and Energy
MRV	Monitoring, Reporting & Verification
MW	Megawatt
N_2O	Nitrous Oxide
NDC	Nationally Determined Contributions
NMVOC	Non-methane volatile organic compounds
NO_x	Nitrogen Oxides
ODSM	Operation Demand Side Management
PJ	Petajoule
PUCSL	Public Utilities Commission of Sri Lanka
RE	Renewable Energy
SDG	Sustainable Development Goal
SLSEA	Sri Lanka Sustainable Energy Authority
SO_2	Sulfur Dioxide
UDP	UNEP DTU Partnership
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNOPS	United Nations Office for Project Services
WRI	World Resources Institute

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Executive Summary

Sri Lanka submitted its first set of Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2016. According to the list of NDCs, Sri Lanka intends to reduce 20% of its GHG emissions from the energy industry. This will be 4% unconditional and 16% conditional against BAU scenarios**.** Seven (7) main NDCs covering sustainable power generation, energy saving through demand side management activities and strengthening sustainable energy related policies were submitted to UNFCCC.

Existing NDCs including energy industry NDCs were developed based on a qualitative assessment without quantitatively assessing GreenHouse Gas (GHG) impacts and sustainable development impacts. This assessment aims to assess the GHG impacts and sustainable development impacts of the proposed new NDCs so that policy makers can take informed decisions while finalizing the energy industry NDCs.

First deliverable under this assignment, scoping study, produced a new list of 9 NDCs after evaluating the existing NDCs and additional NDCs against SMART (Specific, Measureable, Actionable, Relevant and Time-bound) criteria, which were agreed previousely with CCS of MEWR while revising transport sector NDCs. These NDCs covers wind, solar, large hydro, waste to energy, mini hydro, biomass, conversion of fuel based power plant to natural gas, energy efficiecny to reduce per capita electricity consumption and reducing the losses in electricity grid have lower priority.

This report assessed: a) the marginal abatement cost (MAC) and GHG impacts of the new list of 9 NDCs using GACMO model; and b) sustainable development impacts of the new list of 9 NDCs using ICAT SD methodology. Then, outcome of these two assessments were used to prioritize and revise the energy industry NDCs.

MAC and GHG impact assessment found that the proposed new NDCs can reduce the GHG emission in energy industry by 25% by 2030 compared to business as usual (BAU) emissions projected based on base year 2010 (GHG emissions under BAU and NDC scenarios are 33.5 million tCO_2e and 25.1 million tCO_2e respectively). Only one NDC has negative MAC while all other NDCs have positive MAC values (<68 US$/tCO2e), which indicates that Sri Lanka needs financial support to achieve some of its NDCs targets within the given period of time.

1 Introduction

1.1 Background

Sri Lanka submitted its first Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2016. According to the list of NDCs, Sri Lanka intends to reduce 20% of its GHG emissions against BAU scenarios from the energy sector, out of which 4% would be unconditional and 16% would be conditional.

Target period to reduce GHG emissions is 2020 – 2030 while BAU was developed based on the base year 2010. Energy industry NDCs consist of 7 main NDCs which directly or indirectly influence the reduction of GHG emissions.

The Parties to the Paris Agreement are required to communicate their nationally determined contributions every five years in accordance with decision 1/CP21 and Article 4.9 of the Paris Agreement. As such, Sri Lanka is also required to revise its NDCs including energy industry NDCs by 2020.

A scoping study was carried out to identify a set of new NDCs for the energy industry. This report will focus on assessing GHG impacts and sustainable development impacts for those identified NDCs.

Annex 1 provides the list of proposed new NDCs.

1.2 Overall objectives of the revision to energy industry NDCs

Main objective of the assignment is to review and update energy industry NDCs of Sri Lanka. It consists of two parts:

> Part 1: Scoping study: Preparation of a list of proposed NDCs based on the criteria agreed by the CCS of MEWR.
>
> Part 2: Mitigation and SD assessment: Application of the GACMO model to quantify the GHG effects of those NDCs as well as Marginal Abatement Cost (MAC) curves; and application of ICAT SD methodology to assess the Sustainable Development impacts of the identified NDCs, with the aim of finalizing the list of new NDCs.

1.3 Objective of mitigation and sustainable development assessment

This report on mitigation and sustainable development assessment, which is the second deliverable of the assignment on reviewing energy industry NDCs of Sri Lanka, will address the part 2 of overall objectives: Mitigation and SD assessment.

This mitigation and SD assessment, which is based on the proposed list of new NDCs under the scoping study, will apply:

a) The GACMO model to quantify the GHG effects of those NDCs as well as Marginal Abatement Cost (MAC) curves; and
b) ICAT SD methodology to assess the Sustainable Development impacts of the identified NDCs, with the aim of finalizing the list of new NDCs.

Based on this assessment, energy industry NDCs will be prioritized and finalized.

1.4 Structure of the mitigation assessment

This report consists three main chapters. First chapter provides an introduction to the overall project of reviewing the NDCs and briefly describes the outcome of deliverable one, the scoping study, which identified 9 main NDCs. Further, Chapter 1 provides the objective of the ICAT, project and the mitigation assessment report. Chapter two discusses the methodology followed to assess the mitigation actions in detailed under seven major steps:

1. Identification of policies and actions in the pipeline to achieve the proposed NDCs;
2. Selection of appropriate modelling tool to assess GHG impacts and MAC;
3. Selection of parameters;
4. Data validation;
5. Application of the GACMO tool;
6. Assess the GHG effects and MAC values;
7. Assess the SD impacts; and
8. Prioritize revised NDCs based on MAC, Mitigation potential and SD impacts.

Third chapter discusses the results of the assessment, which mainly consists of the prioritized NDCs based on results of GHG and SD assessments. It also explains uncertainties associated with the study. Barriers to the study are also discussed in this chapter and few recommendations are made to overcome these barriers in the future.

2 Methodology

2.1 Identify policies and actions in the pipeline to achieve the proposed NDCs

National Energy Policy and Strategies of Sri Lanka which was published in August 2019. National energy policy is founded on ten pillars, rooted in the broad areas impacting the society, economy and the environment, in an effort to counter balance the forces through enhanced equity, security and sustainability, respectively.

1. Assuring Energy Security
2. Providing Access to Energy Services
3. Providing Energy Services at the Optimum Cost to the National Economy
4. Improving Energy Efficiency and Conservation
5. Enhancing Self Reliance
6. Caring for the Environment
7. Enhancing the Share of Renewable Energy
8. Strengthening Good Governance in the Energy Sector
9. Securing Land for Future Energy Infrastructure
10. Providing Opportunities for Innovation and Entrepreneurship

As per the SLSEA Renewable Energy Development Plan Phase I, 2019-2025, SLSEA has developed Renewable Energy Resource Inventory and Resource Maps for the four major renewable energy resources - solar, wind, hydro and biomass, considering the seasonal variations and geographic segmentation. Therefore, these upcoming renewable energy capacities appearing in LTGEP 2020-2039 (Draft) were considered as NDCs.

To achieve the goals and the NDC targets, different policies and actions will be proposed. These actions and policies will be identified by conducting meetings with relevant stakeholders.

Proposed actions and policies which will contribute to achieve the proposed NDCs are listed in Table 1.

Table 1 Policies and actions related to the proposed NDCs

Source – LTGEP 2020-2037(draft) & SLSEA

No.	Revised NDCs list (Draft)	Proposed actions/policies
1	Establishment of wind power plants	Addition of Mannar Wind Park and other wind power plants as per the Base Case Plan of □LTGEP 2020-2039 [1]
2	Establishment of solar power plants	Addition of 900 MW solar power plants as per the Base Case Plan of LTGEP 2020 - 2039□ [1]
3	Establishment of biomass power plants	Addition of 55 MW biomass power plants as per the Base Case Plan of LTGEP 2020 - 2039□ [1]
4	Establishment of mini hydro power plants	Addition of 165 MW mini hydro power plants as per the Base Case Plan of LTGEP 2020 - 2039□ [1]
5	Conversion of fuel-powered plants to natural gas power plants	Addition of new LNG power plants and converting existing oil/coal based power plants into LNG as per the Base Case Plan of LTGEP 2020 - 2039□ [1]
6	Establishment of large hydropower stations	Addition of Broadlands HPP, Uma Oya HPP, Seethawaka HPP and Thalpitigala HPP [1]
7	Establishment of waste to energy power plants	Four Waste to energy projects (10 – 14 MW) Karadiyana, Karatota, Kelawarapitiya, Muthurajawela [2]
8	Reducing per capita electricity consumption compared to the 2010 base year through Demand Side Management (DSM) and Improving Energy Efficiency and Conservation	Demand Side Management activities conducted by "Presidential Task Force on Demand Side Management" 8.a) Efficient Lighting - Implementing design and technology features for the efficiency improvement in commercial sector lighting –Estimated Electricity Saving 549.1 GWh/year [3] 8.b) Efficient fans - Development of a standard (SLS1600:2011) for fan labelling – Estimated Electricity Saving 298.3 GWh/year [3] 8.c) Efficient motors - Motivate industries to replace existing inefficient motors with high efficient motors - Estimated Electricity Saving 248.2 GWh/year [3] 8.d) Efficient refrigerators - Provide 5 year Loan Scheme to households to replace inefficient refrigerators with efficient refrigerators - Estimated Electricity Saving 161 GWh/year [3] 8.e) Elimination of Incandescent lamps (Domestic) - Distribution of 10 million LED lamps among 3.9 million households ("Shakthi" LED Distribution Programme") - Estimated Electricity Saving 432 GWh/year [3]

No.	Revised NDCs list (Draft)	Proposed actions/policies
		8.f) Efficient chillers - Replace aging, inefficient chillers with modern efficient chillers in hotels, garment factories, hospitals and large-scale buildings - Estimated Electricity Saving 41 GWh/year [3] 8.g) Efficient air conditioning - Development of a standard for split type air conditioners labelling - Estimated Electricity Saving 125.4 GWh/year [3]
9	Reduction of technical and commercial losses of the electricity transmission and distribution system	Reduce the transmission and distribution loss from 13% (2010) [4] to 7.5 % (2030) [1]

2.2 Select appropriate modelling tool

2.2.1 Applicability of GACMO model for the proposed NDCs

Greenhouse gas Abatement Cost Model (GACMO) was used by default to quantify the marginal abatement costs (MAC) and the mitigation potential of each mitigation action identified under the prioritized NDCs/sub NDCs. Since GACMO model cannot be directly applied for the revised NDCs 8.b. the GACMO model was slightly modified to apply for NDC 8.b.

Table 2 provides the applicability of the GACMO model to the identified mitigation actions/policies without any modifications to the tool.

Table 2 Feasibility of applying GACMO model for prioritized NDCs/sub NDCs

No.	Revised NDCs list (Draft)	Applicability of GACMO model	GACMO Technical area
1	Establishment of wind power plants	Yes	Wind turbines, on-shore
2	Establishment of solar power plants	Yes	Solar PVs, large grid & Solar home PVs

No.	Revised NDCs list (Draft)	Applicability of GACMO model	GACMO Technical area
3	Establishment of biomass power plants	Yes	Rice husk cogeneration plants & Biomass power from biomass residues
4	Establishment of mini hydro power plants	Yes	Mini hydro power connected to main grid
5	Conversion of fuel-powered plants to natural gas power plants	Yes	New natural gas power plant, Switch from fuel oil to natural gas in industry and Switch from coal to natural gas in industry
6	Establishment of large hydropower stations	Yes	Hydro power connected to main grid
7	Establishment of waste to energy power plants	Yes	Incineration plants
8	Reducing per capita electricity consumption compared to the 2010 base year through Demand Side Management (DSM) and Improving Energy Efficiency and Conservation		
	8.a) Efficient Lighting	Yes	Efficient office lighting with LEDs
	8.b) Efficient fans	No	N/A
	8.c) Efficient motors	Yes	Efficient electric motors
	8.d) Efficient refrigerators	Yes	Efficient refrigerators
	8.e) Elimination of Incandescent lamps (Domestic)	Yes	Efficient domestic lighting with LEDs
	8.f) Efficient chillers	Yes	Efficient Chiller > 300 TR
	8.g) Efficient air conditioning	Yes	Efficient residential air-conditioning
9	Reduction of technical and commercial losses of the electricity transmission and distribution system	Yes	Efficient electric grids

2.2.2 Explore the possibility of modifying the GACMO model

If the GACMO model cannot be applied directly to calculate the MAC and mitigation potential of selected actions, certain modifications will be carried out to the tool. This will only be carried out for the mitigation actions which can be included in the technical areas defined by GACMO model. These modifications to the mitigation actions will be described in Table 3.

Table 3 Modifications done for the GACMO model

NDC No	Default mitigation action of GACMO	Modified mitigation action	Applied modifications
8c	Efficient electric motors	Efficient electric fans	Fan is operating with a motor. Therefore, reduction option was changed as efficient fans and reference option was changed as inefficient fans.

2.3 Selection of the parameters

Baseline scenario

Previously 2010 has been considered as the base year for the NDCs. Business As Usual (BAU) Scenario also has been established considering the same year. As such, values of the parameters for baseline scenario were based on year 2010. However, latest available data were taken into account in the absence of the data for project implementing year. Annex 2 lists these activity data.

Project scenario

Period of achieving the revised NDC targets is the same as with the old NDCs (2020-2030). Values of the parameters for the year 2030 were forecasted based on historical data. When historical data are not available, latest available values were taken into account. Annex 2 lists these activity data.

Emission reductions

Emissions reductions in the year 2030 will be calculated using the following formula.

Emission reductions = Emissions in BAU scenario – Emissions in Project scenario

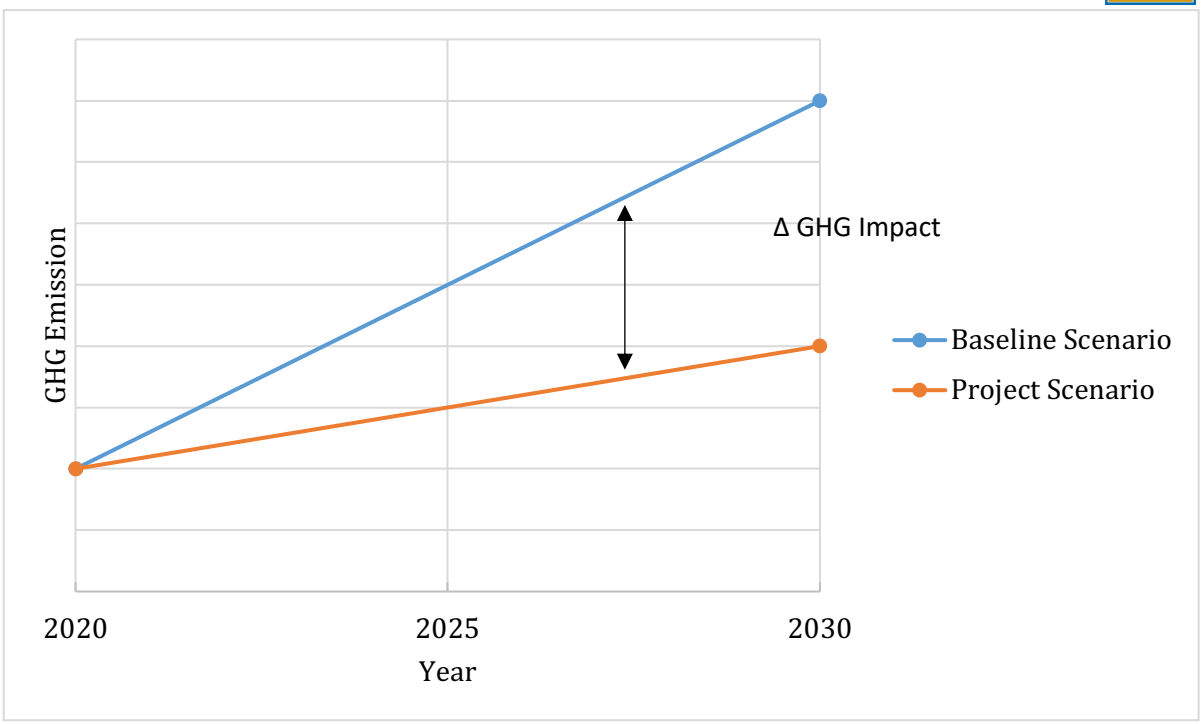

Figure 1 Calculating the mitigation potential

2.4 Data validation

All the data that will be used for the calculations will be validated during the stakeholder consultation process.

2.5 Applications of the GACMO model

2.5.1 Mitigation potential

Emission reductions were calculated using GACMO model. MAC values were calculated only for the NDCs which were analysed by the GACMO model. As per the calculations, highest emission reduction potential was possible from NDC 1 which is Establishment of large scale wind power plants followed by NDC 2 (Establishment of solar power plants) and NDC 9 (Reduce the T&D loss: Efficient Grid). Summary of the results is given in Table 4 below.

Table 4 Emission reduction potential and the MAC values of the proposed NDCs

No.	Revised NDCs list (Draft)	Emission reduction potential (tCO_2e/year)	MAC (US$/ tCO_2e)
1	Establishment of wind power plants	1,561,751	25.7
2	Establishment of solar power plants	1,247,150	52.2
3	Establishment of biomass power plants	237,017	35.6
4	Establishment of mini hydro power plants	541,134	10.9
5	Conversion of fuel-powered plants to natural gas power plants	539,727	21.5
6	Establishment of large hydropower stations	559,367	36.8
7	Establishment of waste to energy power plants	262,368	67.7
8	Reducing per capita electricity consumption compared to the 2010 base year through Demand Side Management (DSM) and Improving Energy Efficiency and Conservation		
	8.a) Efficient Lighting	553,080	-93
	8.b) Efficient fans	300,652	-55
	8.c) Efficient motors	243,730	-72
	8.d) Efficient refrigerators	540,250	-20
	8.e) Elimination of Incandescent lamps (Domestic)	538,127	-108
	8.f) Efficient chillers	87,794	-22
	8.g) Efficient air conditioning	125,779	-77
9	Reduction of technical and commercial losses of the electricity transmission and distribution system	1,152,864	50

2.5.2 Marginal Abatement Cost Curve (MAC)

MAC value indicates the cost of reducing GHG emissions and the potential emission savings of mitigation projects. As illustrated in Figure 2, lowest MAC value was recorded for the elimination of Incandescent lamps (Domestic) (-108 USD/tCO_2e). Second and third lowest values were recorded for NDC 8.a (-93 USD/tCO_2e) and for the NDC 8.g (-77 USD/tCO_2e).

Most economically viable mitigation action can be identified using the respective MAC values. Revised NDCs were also prioritized based on the calculated MAC values[1].

[1] MAC values can only be calculated for the NDCs which were analyzed using the GACMO model

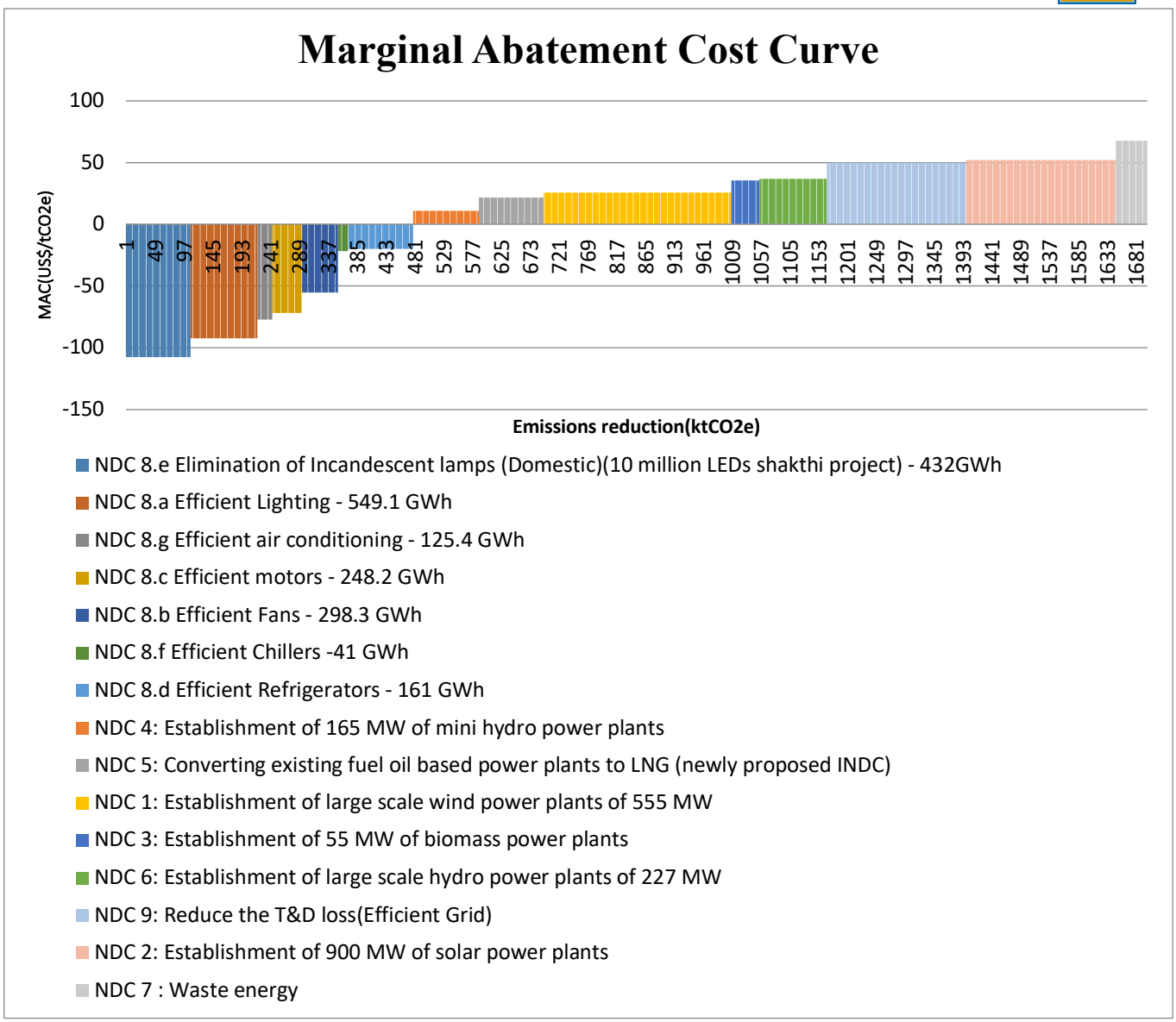

Figure 2 Marginal Abatement Cost Curve for the year 2030 Source – Own work

2.5.3 Summary of the assessment of sustainable development impacts

NDCs which came out as an outcome of the scoping assessment were considered for the Sustainable Development analyses. Thereby following NDCs were studied;

- Establishment of Large Scale Wind Power Plants
- Establishment of solar power plants
- Establishment of biomass power plants
- Establishment of mini hydro power plants
- Converting existing fuel oil based power plants to LNG (newly proposed INDC)

ICAT Sustainable Development Methodology was applied in the analyses.

All of the NDC s had shown a common impact on two particular SDGs, Energy (SDG 7) and Climate Action (SDG 13). Some NDCs has shown its impacts on other SDGs along with the common SDGs as mentioned above.

Establishment of large scale wind power plants had an impact on the SDG 15 by the impact on migratory birds and also impacting over soil fauna upon the establishment of the wind power plants. Establishment of biomass power plants also had an impact over SDG 15 by reducing the forest cover.

Newest NDC "Converting existing fuel oil based power plants to LNG" had shown a vast range of SD impacts as shown in the table 4.

Table 4 SD Impacts

NDC	Impacts on SDG s					
	SDG 7	SDG 8	SDG 9	SDG13	SDG 15	SDG 17
Establishment of Large Scale Wind Power Plants	✓			✓	✓	
Establishment of solar power plants	✓			✓		
Establishment of biomass power plants	✓			✓	✓	
Establishment of mini hydro power plants	✓			✓		
Converting existing fuel oil based power plants to LNG (newly proposed INDC)	✓	✓	✓	✓		✓

2.5.4 Prioritization of NDCs

Most economically viable mitigation actions can be identified using the respective MAC values and GHG effects while most environmentally effective NDC can be found using SD assessment. Then, proposed new NDCs will be prioritized based on the calculated MAC values, Emission reduction and SD impacts. These NDCs and their respective MAC, GHG effects and SD impacts are shown in Table 5.

Table 5 Prioritized NDCs -based on the calculated MAC values

No	NDC	MAC (US$/ tCO_2e)	Emission Reduction (tCO_2e)	SD impacts	Prioritization (Rank)
1	Establishment of wind power plants	25.7	1,561,751	High	1
2	Establishment of solar power plants	52.2	1,247,150	Moderate	3
3	Establishment of biomass power plants	35.6	237,017	High	7
4	Establishment of mini hydro power plants	10.9	541,134	Moderate	4
5	Conversion of fuel-powered plants to natural gas power plants	21.5	539,727	Very High	2
6	Establishment of large hydropower stations	36.8	559,367	-	8
7	Establishment of waste to energy power plants	67.7	262,368	-	9
8	Reducing per capita electricity consumption compared to the 2010 base year through Demand Side Management (DSM) and Improving Energy Efficiency and Conservation			-	6
	8.a) Efficient Lighting	-93	553,080	-	
	8.b) Efficient fans	-55	300,652	-	
	8.c) Efficient motors	-72	243,730	-	
	8.d) Efficient refrigerators	-20	540,250	-	
	8.e) Elimination of Incandescent lamps (Domestic)	-108	538,127	-	
	8.f) Efficient chillers	-22	87,794	-	
	8.g) Efficient air conditioning	-77	125,779	-	
9	Reduction of technical and commercial losses of the electricity transmission and distribution system	50	1,152,864	-	5

3 Discussion

According to the Third National Communication, GHG emissions of the energy industry of Sri Lanka in the year 2010 is around 7.3 $MtCO_2e$. It is expected to be around 21 MtCO2 in 2020 and 33.5 MtCO2 by 2030 (extrapolated based on the historical GDP values and forecasted GDP values). GHG emissions in energy industry can be limited to 25.1 $MtCO_2e$ by 2030 if all proposed NDCs are implemented (Figure 3).

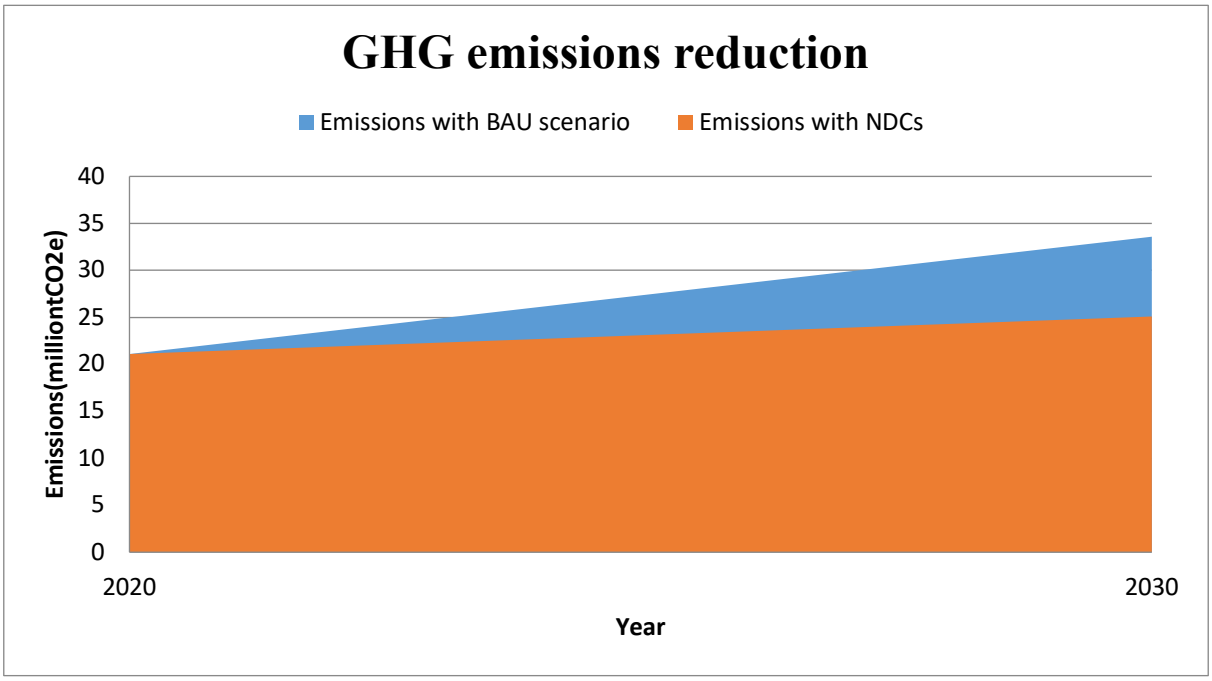

Figure 3 Variations of the GHG emissions within 2020 -2030 period

Source – Own work

Existing NDC targets for the energy sector is 20%. Out of this 4% is unconditional and 16% is conditional. Therefore, if proposed mitigation actions and policies are implemented as intended, Sri Lanka will be able to meet its NDCs targets within the targeted period.

Uncertainties

Even though data were validated by the respective entities, predicted data (for the year 2030) and data extracted from different sources in the absence of country specific, project specific data might cause some uncertainties to the results.

Barriers

Major barriers of reviewing the NDCs were, unavailability of the data sources used for formulating INDCs of Sri Lanka, lack of awareness of respective entities on ongoing project/policy activities, lack of communication among the respective entities, not having a common registry for the proposed projects, not having a proper reporting mechanism in place, lack of data, delay of the data communication due to manual process, etc.

Recommendations

To improve the mechanism, It is proposed to maintain a separate NDC unit in the energy sector which will maintain the documents related to the NDCs. Updating a project registry which includes the projects that will contribute to the GHG emission reductions on a common platform will improve the awareness among the relevant stakeholders and also will improve the process of NDC revision. Digitizing the data collection and reporting mechanism by connecting all the stakeholders and the NDC unit of the energy sector will improve the quality and efficiency of the upcoming NDC revision process.

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Annex 1: Proposed new NDCs for energy industry based on the

NDC No.	Revised NDCs list (Draft)
1	Establishment of wind power plants
2	Establishment of solar power plants
3	Establishment of biomass power plants
4	Establishment of mini hydro power plants
5	Conversion of fuel-powered plants to natural gas power plants
6	Establishment of large hydropower stations
7	Establishment of waste to energy power plants
8	Reducing per capita electricity consumption compared to the 2010 base year through Demand Side Management (DSM) and Improving Energy Efficiency and Conservation
9	Reduction of technical and commercial losses of the electricity transmission and distribution system