THE GOVERNMENT OF THE DEMOCRATIC SOCIALIST
REPUBLIC OF SRI LANKA

FINAL

CARBON FOOTPRINT REDUCTION ROADMAP

MAY 2026

NATIONAL WATER SUPPLY AND DRAINAGE BOARD

SRI LANKA

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Technical Support:

ADB TA 10340-SRI: Strengthening Institutional Capacity for Sustainable Water Sector Development

ASIAN DEVELOPMENT BANK

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Democratic Socialist Republic of Sri Lanka

Carbon Footprint Reduction Roadmap: Draft

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ABBREVIATIONS

ADB	Asian Development Bank
BESS	Battery Energy Storage Systems
BOD	Biological Oxygen Demand
BTR1	first Biennial Transparency Report
BTR2	second Biennial Transparency Report
CCR	Climate Change Roadmap
CCRR	Climate Change Resilience Roadmap
CEB	Ceylon Electricity Board
CFRR	Carbon Footprint Reduction Roadmap
CH_4	Methane
CNZ2050	Carbon Net Zero 2050 Roadmap and Strategic Plan
CO_2	carbon dioxide
CPP	Climate Prosperity Plan
DEWATS	Decentralized Wastewater Treatment System
DMA	District Metered Area
FSTP	Fecal Sludge Treatment Plant
GCF	Green Climate Fund
gCO_2e	gram carbon dioxide equivalent
$GgCO_2e$	gigagram carbon dioxide equivalent (= 1000 tons carbon dioxide equivalent)
GHG	greenhouse gas
GWP	global warming potential
HFC	Hydrofluorocarbon
IFI	International Financial Institution
IKI	International Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
JICA	Japan International Cooperation Agency
LULUCF	land use, land use change and forestry
M&E	monitoring and evaluation
MCDA	Multi-Criteria Decision Analysis
MCF	Methane Correction Factor
MDB	Multilateral Development Bank
MHCWS	Ministry of Housing, Construction and Water Supply
MRV	measurement, reporting & verification, also monitoring, reporting & verification
N_2O	nitrous oxide
NAP	national adaptation plan
NC4	fourth national communication
NDC	nationally determined contribution
NDC3.0	third NDC
NRW	non-revenue water
NWSDB	National Water Supply and Drainage Board
PBL	policy-based loan
PPP	Public-Private Partnership
PV	Photovoltaic
tCH_4	tons of methane
tCO_2e	tons of carbon dioxide equivalent
tN_2O	tons of nitrous oxide
TNC	third national communication

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TROF	Trees outside forest
UNFCCC	United Nations Framework Convention on Climate Change
VFD	Variable Frequency Drive
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WWTP	Wastewater Treatment Plant

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I. INTRODUCTION

A. Background

1. The background to the roadmap is provided by the Asian Development Bank (ADB) policy-based loan (PBL) "*Water Supply and Sanitation Reform Program*" [1] to the water sector of Sri Lanka, of which the National Water Supply and Drainage Board (NWSDB) is a key part. The PBL covers two reform areas, one of which is '*Climate-resilient, safe, inclusive, and environmentally sustainable water supply systems management strengthened.*' This reform area covers among others the following policy action in subprogram 2:

- Policy Action 2.3 Building upon subprogram 1, NWSDB will: (…) (iii) approve a Carbon Footprint Reduction Roadmap to reduce greenhouse gas (GHG) emissions measured in kg of CO2e per cubic meter of water sold.

2. This report assists NWSDB in the achievement of the policy actions mentioned in Paragraph 1, covering the first part, the preparation of the CFRR.

B. Content of the report

3. The preparation of the CFRR requires first the setting of the stage: reviewing relevant greenhouse gas (GHG) mitigation policies of Sri Lanka, and revieing Sri Lanka's GHG inventory. Next, it involves a baseline assessment, involving the preparation of a GHG inventory for NWSDB. Then it involves the identification of mitigation options that provide reasonable returns on investment and target setting, based on the identified mitigation options. The results of consultations carried out in the context of the preparation of the CCR are used to validate the proposed mitigation options at least in terms of content. Finally, it is important to consider how the CFRR can be financed. For this, tools developed in drafting the guidance for applying to a climate fund are applied.

C. Set-up of the report

4. This report is set up as follows. Section II elaborates the methodologies proposed to be followed for the two parts of the assignment. Section **Error! Reference source not found.** presents the key climate change mitigation policies of the government of Sri Lanka. Section **Error! Reference source not found.** presents the GHG inventory and carbon footprint of NWSDB. Section **Error! Reference source not found.** discusses the carbon footprint reduction targets and the supporting mitigation actions. Section VI discusses the barriers, strategy, financing and next steps, and Section VII concludes.

[1] ADB. 2024. Sri Lanka: Water Supply and Sanitation Reform Program. Project Number 56281-001.

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II. METHODOLOGY

5. In this section, the methodology for the CFRR[2] preparation is elaborated. The methodology followed seven steps, as illustrated in **Error! Reference source not found.**, with **stakeholder consultations** integrated throughout the seven steps. A few examples are included below to demonstrate the importance of stakeholder consultations not just as a single step, but throughout the process, followed by a discussion of the various steps in the methodology:

- Stakeholder consultation can ensure that data requests are reasonable and to the extent possible use established internal reporting channels inside NWSDB
- Stakeholder consultation can ensure that calculated carbon footprint is of maximum use. For example, would NWSDB prefer a single carbon footprint for the whole organization, or some disaggregation by department or regional centers?
- Potential mitigation options need to be discussed with stakeholder before being included into the strategy and roadmap, so that only mitigation options that have reasonable returns, that can be financed and are implementable are included in the roadmap.
- Consultations are necessary to ensure that the time planning for the implementation of the strategy (GHG mitigation options) is reasonable.

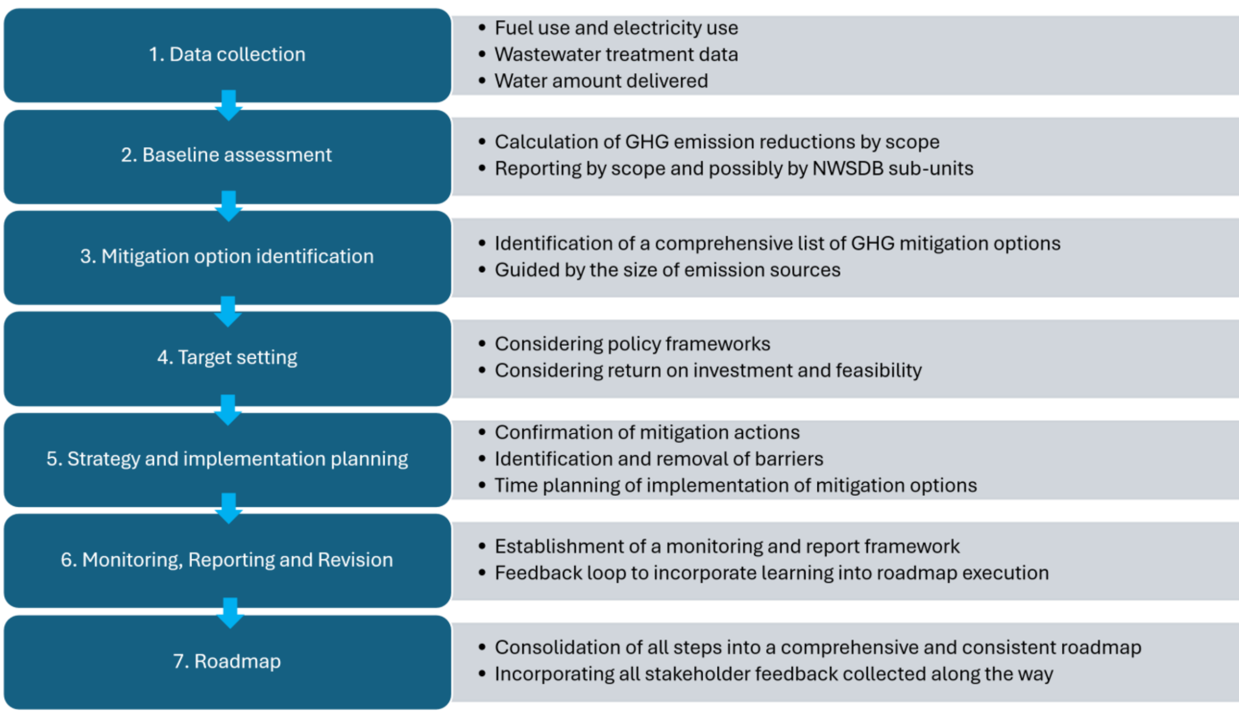

Figure 1. Carbon Footprint Reduction Roadmap, methodological approach

[2] Several carbon footprint methodologies exist, but results are typically quite similar independent of the choice of methodology. The methodology used in this assignment is a blend of the Greenhouse Gas Protocol Corporate Standard, suitable for companies and organizations. WRI and WBCSD. 2015. A Corporate Accounting and Reporting Standard: Revised Edition. The Greenhouse Gas Protocol, combined with use of the IPCC GHG Inventory Guidelines: IPCC. 2006. IPCC Guidelines for National Greenhouse Gas Inventories. Intergovernmental Panel on Climate Change.

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6. It should be acknowledged that due to time constraints – preparation of the CCR, guidance on applying to any climate fund, and the CFRR all had to be completed inside a 4-month period – dedicated consultations were not possible. In part, the preparation relied on consultations that were conducted as part of the preparation of NWSDB's Climate Change Resilience Roadmap of 2024,[3] in part it also relied on consultations that were carried out with NWSDB staff in the context of the preparation of the CCR.

7. **Data collection** covered fuel use (Scope 1[4] emissions from fuel combustion), electricity use (Scope 2 emissions from partially fossil fuel based electricity generation), and wastewater treatment (Scope 1 emissions of methane (CH4) and nitrous oxide (N2O) during anaerobic process steps. These data were necessary for calculating a comprehensive picture of GHG emissions for NWSDB in terms of CO2 equivalent. A few points are worth noting:

- A data collection format was prepared, discussed with responsible NWSDB departments, distributed, and returned data were analyzed.
- Conversion of CH4 and N2O emissions required a choice of global warming potentials (GWPs). The latest GWPs published by IPCC[5] were used for this conversion from tons of CH4 and tons of N2O to tons of carbon dioxide equivalent (tCO2e): For CH4 (non-fossil origin), 27; for N2O, 273.

8. The **Baseline assessment** involved the calculation of GHG emissions from different sources and emission scopes. Standard calculation methods as incorporated in the GHG Protocol and IPCC guidelines have been used, with the following provisos:

- The assignment has produced an aggregate, NWSDB-wide carbon footprint. Disaggregation, if requested, can in principle be included as well.
- Latest IPCC defaults for fuel emission coefficients were used.
- For grid-supplied electric power, the harmonized IFI grid emission factors[6] were used.

9. The compilation of a comprehensive list of **mitigation options** available to NWSDB was an important precursor to the formulation of targets and strategy, because these need to include ideas about what mitigation options can be implemented.

[3] NWSDB. 2024. Climate Change Resilience Roadmap. February 2024.

[4] Scope 1 refers to emissions that are directly caused by the organization (here: NWSDB) and are hence under the direct control of the organization. Scope 2 emissions are caused outside of the organization but can to a significant extent be influenced by decisions of the organization. Scope 3 emissions are caused upstream (inputs bought) or downstream (emissions from outputs and waste delivered to third parties for further processing, cannot be easily influenced by the organization and are hence typically ignored in carbon footprint calculation. The approach taken followed this practice. In the case of NWSDB an additional argument for this choice is that Scope 3 emissions will likely be dominated by GHG emissions embedded in building materials such as concrete and steel, so that inclusion would lead to large year-to-year fluctuations that are not linked to business practices and mitigation efforts.

[5] Forster, P., T. Storelvmo, K. Armour, W. Collins, J.-L. Dufresne, D. Frame, D.J. Lunt, T. Mauritsen, M.D. Palmer, M. Watanabe, M. Wild, and H. Zhang, 2021: The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 923–1054, doi:10.1017/9781009157896.009. See Table 7.15.

[6] IFI TWG. 2022. Harmonized IFI Default Grid Factors 2021 v3.2. International Financial Institutions Technical Working Group on Greenhouse Gas Accounting (IFI TWG).

10. **Targets** 1) were in part derived from government guidance (see Section **Error! Reference source not found.**) but also 2) reflected the various options to reduce GHG emissions, the amount of emission reductions achievable through each option, the investments costs of each option, the net operational cost savings (or additional revenues) from the option, and the co-benefits from the implementation of the option, including environmental benefits and social benefits. The former defines what the government would like NWSDB to do, the latter what NWSDB can do without additional government support – the implementable mitigation options. Targets were based on the amount of GHG emission reductions that can be achieved through the portfolio of implementable mitigation options.

11. **Strategy** confirmed the mitigation options that will be pursued but goes beyond this by considering the obstacles and barriers towards their implementation, as well as the actions that can be taken to remove obstacles and barriers. One key obstacle is the need to finance the proposed investments. Different options to deal with financial constraints have been elaborated, including use of climate funds, sale of carbon credits, etc, noting however that the actual follow up on these options is outside of the scope of the current assignment.

12. **Implementation planning** considered the timing of the implementation of the various mitigation options included in the strategy. This should consider the urgency of the implementation of the option for NWSDB as well as the availability of finance. Usually, this step requires significant consultations with stakeholders.

13. **Monitoring, reporting and revision** sets up the future procedures for monitoring implementation of the mitigation options and the resulting GHG emission reductions (data collection procedures, data processing and calculation, reporting according to a standardized reporting format). In the future, results will be reported to provide transparency to the government and possibly as a condition for climate finance and/or carbon finance. Moreover, the processes set out will allow learning that can be taken on board to modify implementation planning, emission reduction expectations, and formulation of additional preparatory actions to ensure the successful implementation of the mitigation options.

14. The compilation of the **Carbon Footprint Reduction Roadmap** requires the integration and consolidation of the preceding steps, including all the feedback obtained from NWSDB. A draft will be prepared that is then modified as needed based on the comments from NWSDB, and a final roadmap is issued.

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III. SRI LANKA'S MITIGATION POLICIES

15. The main Sri Lankan policy documents relevant for the assignment are the third NDC (NDC3.0)[7] covering 2026-2035, the National Adaptation Plan (NAP) 2016-2025 and 2026-2035, the Carbon Net Zero 2050 Roadmap and Strategic Plan (CNZ2050)[8] and the Climate Prosperity Plan (CPP)[9]. Of these documents, the NDC covers mitigation and adaptation in the medium-long term (up to 2035), the NAPs covers adaptation only, the CNZ2050 cover mitigation only during the period up 50 2050, whereas the CPP covers adaptation and mitigation during the period up to 2040.

16. In addition to these plans and policies, Sri Lanka has also produced reports to the UNFCCC. The most recent of these are the Third National Communication (TNC) to the UNFCCC and the first Biennial Transparency Report (BTR1)[10] to the UNFCCC. A Fourth National Communication (NC4) and second Biennial Transparency Report (BTR2) are being prepared, but no detailed information has been obtained at the time of preparation of this report. Below we provide information related to mitigation policies in Sri Lanka (relevant to both the Carbon Footprint Reduction Roadmap and the climate fund guidance), followed by information related to adaptation policies in Sri Lanka (relevant to the climate fund guidance only). In both cases, after providing a short general introduction, the discussion rapidly zooms in on the water supply & sanitation sector.

17. The TNC provides the breakdown of Sri Lankan annual greenhouse gas (GHG) emissions in 2010 presented in Table 1. Total GHG emissions excluding the land use, land use change and forestry (LULUCF) sector are 22.1 million tCO2e, total GHG emissions including LULUCF are 3.7 million tCO2e. Emissions are dominated by the energy sector, followed by the agricultural sector, while the LULUCF sector provides a net sink.

Table 1. Summary of GHG emissions and removals in 2010 in GgCO2e.

Sector	CO2 emissions	CO2 removals	CH4	N2O	HFCs	Total
Energy	12,810.00		950.46	393.70		14,154.16
IPPU	435.59				12.98	448.57
Agriculture	340.45		2,860.62	3,304.60		6,505.67
Waste	122.78		527.94	325.50		976.22
Total excl. LULUCF	***13,708.82***		***4,339.02***	***4,023.80***	***12.98***	***22,084.62***
LULUCF emissions	21,342.40		112.77	4.96		21,460.13
LULUCF removals		-39,826.30				-39,826.30
Net total	**35,051.22**	**-39.826.30**	**4,451.79**	**4,028.76**	**12.98**	**3,718.45**

CH4 = methane; CO2 = carbon dioxide; GgCO2e = gigagram of carbon dioxide equivalent (= 1000 tons of carbon dioxide equivalent); HFC = hydrofluorocarbon; IPPU = industrial processes and product use; LULUCF = land use, land use change and forestry; N2O = nitrous oxide.
Source: Ministry of Environment. 2022. Third National Communication of Climate Change in Sri Lanka. Submission to the UNFCCC Secretariat. Prepared by the Climate Change Secretariat, Ministry of Environment. p.21

[7] Government of Sri Lanka. 2025. Nationally Determined Contributions 3.0 (2026-2035). Government of Sri Lanka, 22 September 2025.
[8] Ministry of Environment. 2023. Carbon Net Zero 2050 Roadmap and Strategic Plan.
[9] Government of Sri Lanka. 2022. Climate Prosperity Plan: Preliminary Report.
[10] Ministry of Environment. 2024. First Biennial Transparency Report of Sri Lanka. Submission to the UNFCCC Secretariat.

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18. BTR1 provides the breakdown of Sri Lankan annual GHG emissions in 2021 which provides the basis for the breakdown presented in Table 2, in which the data for comparison purposes are rearranged to match the 2010 format. Total GHG emissions excluding the LULUCF sector are 28.9 million tCO2e, total GHG emissions including LULUCF are 19.2 million tCO2e. Again, emissions are dominated by the energy sector, followed by the agricultural sector, while the LULUCF sector provides a net sink. Between 2010 and 2021, emissions increased, both including and excluding the LULUCF sector.

Table 2. Summary of GHG emissions and removals in 2021 in GgCO2e.

Sector	CO2 emissions	CO2 removals	CH4	N2O	HFCs	Total
Energy	20,684.02		788.18	224.69		21,696.90
IPPU	519.29				NA	519.29
Agriculture	161.88		4327.13	1581.09		6,070.11
Waste	76.20		359.84	221.86		657.90
Total excl. LULUCF	***21,441.39***		***5,475.15***	***2,027.64***		***28,944.20***
LULUCF emissions	420.66					
LULUCF removals		-10,149.20				
Net total	**21,862.05**	**-10,149.20**	**5,475.15**	**2,027.64**		**19,215.64**

CH4 = methane; CO2 = carbon dioxide; GgCO2e = gigagram of carbon dioxide equivalent (= 1000 tons of carbon dioxide equivalent); HFC = hydrofluorocarbon; IPPU = industrial processes and product use; LULUCF = land use, land use change and forestry; N2O = nitrous oxide.
Source: Author's calculations based on Ministry of Environment. 2024. First Biennial Transparency Report of Sri Lanka. Submission to the UNFCCC Secretariat. Prepared by the Climate Change Secretariat, Ministry of Environment.

19. NDC3.0 provides the mitigation agenda up to 2035 and includes commitments to limit cumulative emissions in the period 2026-2035 from a baseline of 557.8 million tCO2e (tons of carbon dioxide equivalent) cumulative emissions to 461.8 million tCO2e cumulative emissions, a reduction of 116.1 million tCO2e[11] or 20.1%. Of this, 8.1 percentage point is unconditional (not dependent on foreign funding) and 12 percentage point is conditional (dependent on foreign funding). The emission reduction target of NDC3.0 is significantly more ambitious than the emission reduction target in the updated NDC, which for the period 2021-2030 amount to 65.2 million tCO2e cumulative emission reductions or 14.9% vis-à-vis the baseline.

20. The updated NDC noted (and NDC3.0 makes a similar point) that Sri Lanka is a low carbon emitting country with per capita emissions of around 1.02 tCO2e per person, and its development pathway has remained low-carbon-intensive. A recent analysis of the interplay between per capita emissions and human development, picks out Sri Lanka as a rare example of a country that has achieved both high human development and managed to keep CO2 emissions well below the long-term average needed to contain global warming targets of the Paris Agreement.

21. NDC3.0 contains specific sectoral analysis and commitments for the electricity, transport, agriculture, waste, agriculture and forestry sectors, and hence does not directly cover the water supply sector. The waste sector includes wastewater treatment, which is relevant for NWSDB, while several of the other sectoral NDCs, in particular related to the energy sector

[11] Figures do not add up due to rounding.

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(electricity and transport) contain mitigation priorities that are relevant to NWSDB. Combining these, the following NDC measures from NDC3.0 are potentially relevant to NWSDB[12]:

- Electricity 1: Enhance renewable and clean energy contribution to the national electricity generation mix by increasing Solar PV, Wind, Hydro and Sustainable Biomass based electricity generation.
- Electricity 2: Introduction of grid-integrated energy storage systems, such as Pumped Storage and Battery Energy Storage Systems (BESS), to increase absorption of renewable energy and reduce thermal generation as a conditional measure.
- Electricity 3: Implement Demand Side Management measures by promoting energy-efficient equipment, technologies, and system improvements in a national Energy Efficiency Improvement and Conservation programme covering commercial, institutional, and residential sectors.
- Transport 4: Promote electric mobility.
- Waste 5: Implement and promote sustainable wastewater management systems in urban and rural areas.
- In addition to these, there are several NDC measures related to Nature-Based Solutions in the forestry sector that may have some relevance to NWSDB's mitigation efforts, such as Forestry 2, Expansion, restoration, and sustainable management of trees outside forest (TROF), Forestry 3, Promote catchment protection in major rivers through tree planting, and Forestry 4, Conservation and enhancement of blue carbon ecosystems, including mangroves, seagrass, and salt marshes.

Box 1. The goal and objective structure of the CPP

Goal 1: Unlock domestic energy abundance through renewables, modernization and sustainable transport.

- Objective 1: Financing maximized renewable energy and grid modernization potential and connectivity.
- Objective 2: Sustainable transportation.
- Objective 3: Accelerated Transition and Modernization Through Re-skilling and Training

Goal 2: Financially engineer a climate secure transformation

- Objective 4: Shifting sustainable debt through conversion and attrition of capital to climate projects.
- Objective 5: Carbon Financing Hub to value blue carbon, soil carbon, forest carbon, etc.
- Objective 6: Financially protect the economy and livelihoods

Goal 3: Galvanize climate protection against key risks

- Objective 7: Climate-Smart Agriculture.
- Objective 8: Strengthening fisheries value chains to safeguard food security and nutrition.
- Objective 9: Building resilience to heat and climate-sensitive diseases.

Source: Government of Sri Lanka. 2022. Climate Prosperity Plan: Preliminary Report, p. 17, 21-22, 25-26.

22. The CPP provides a framework for climate action up to 2040, focusing both on adaptation and on mitigation, although the emphasis is on adaptation. The CPP has three overriding goals, each with three objectives, summarized in Box 1. Only some of the objectives relate to mitigation and are relevant to the water sector. Below we have highlighted the proposed mitigation actions that could potentially be relevant to NWSDB.

[12] NDC measures are numbered by subsector. In the following enumeration, we first give the subsector covered, followed by the number within the subsector of the potentially relevant measure.

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- *Objective 1: Financing maximized renewable energy and grid modernization potential and connectivity*. Sustainably exploit the full potential of national renewable energy resources, optimizing energy efficiency, as well as increase grid connectivity by upgrading the grid and connecting Sri Lanka to neighboring countries.
- *Objective 2: Sustainable transportation*. Support the transition towards a RE-based, resilient mobility network, promoting sustainable lifestyles and sustainable mobility.
- *Objective 5: Carbon Financing Hub to value blue carbon, soil carbon, forest carbon, etc.* Maximize access to carbon financing to support investment efforts while supporting conservation & ecosystem services for multi-industries (agriculture, industry, tourism etc.).

23. CNZ2050 provides a framework for mitigation actions that will bring Sri Lanka towards carbon neutrality and net carbon removal by 2050. CNZ2050 is built on a baseline projection by 2050 and an alternative deep mitigation scenario, both with a sectoral breakdown. Sectors considered are energy (not including emissions from fuel used in transport and industry), transport, industry, waste, agriculture and forestry, and there does not include water as a sector. However, the sectoral roadmaps and strategies contain actions relevant to NWSDB. Table 3 provides a comprehensive overview of the proposed mitigation scenario, changing from net emissions of 23.62 million tCO2e in 2050 to net removals (negative emission) of 7.72 million tCO2e in 2050. The following of the proposed actions could potentially be relevant to NWSDB:

- Renewable energy such as biomass, wind and solar to be added throughout the planning time window.
- Improving energy efficiency and conversion.
- Dedicated energy plantations for biomass and counter balancing plantations in existing hydropower catchments and land earmarked for future energy infrastructure.
- E-mobility: electrification of railway, buses, and private vehicle fleet.
- Constructed wetland for wastewater treatment and reuse of treated wastewater for greening.
- Community level biogas production from fecal material at the community level. Overall, biogas production from fecal material at the community level has the potential to significantly reduce greenhouse gas emissions while promoting sustainable development.

Table 3. Sectoral emissions in 2050, baseline and carbon net zero scenario.

Sector	**Baseline emissions in 2050 (Million tCO2e/year)**	**Carbon Net Zero scenario emissions (Million tCO2e/year)**
Energy (excl fuel use in transport and industry)	13.25	0.00
Transport	19.01	9.58
Industry	2.58	0.012
Waste	2.33	0.00172
Agriculture	6.32	2.48
Forestry – emissions	2.54	2.15
Total emissions	***46.03***	***14.25***
Forestry – removals	-22.41	-21.97
Net emissions	**43.62**	**-7.72**

Source: Ministry of Environment. 2023. Carbon Net Zero 2050 Roadmap and Strategic Plan, p. 3-4.

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IV. NWSDB'S GHG INVENTORY AND CARBON FOOTPRINT

24. NWSDB's GHG inventory and calculation of the carbon footprint measured in gCO2e per m3 water consumed is included in Table 4. Details of the calculations are provided in Paragraph 28 after a discussion of the main results. The total GHG emissions of NWSDB in 2025 were 211,693 tCO2e, and the carbon footprint was 334 gCO2e/m3 water consumed.

Table 4. GHG inventory and carbon footprint of NWSDB, 2025.

Source of GHG emissions	Key input value	Unit	Estimated GHG emissions (tCO2e/yr)
Diesel for vehicles	3,613,448	liters/year	9,639
Diesel for generators	70,560	kW	6,396
CH4 emissions from wastewater treatment	140.90	tCH4/year	3,804
N2O emissions from wastewater treatment	3.81	tN2O/year	1,039
Total wastewater treatment			*4,844*
CH4 emissions from septage treatment	83.02	tCH4/year	2,242
N2O emissions from Septage treatment	1.17	tN2O/year	321
Total septage treatment			2,562
Total scope 1 emissions			***23,441***
Grid power consumed	372,146,694	MWh/year	188,252
Of which offices	*7,513,387*	*MWh/year*	*3,801*
Of which pumps	*364,634,747*	*MWh/year*	*184,452*
Total scope 2 emissions			***188,252***
Total emissions			**211,693**
Total water produced	851,481,716	m3/year	
Total water consumed	632,998,762	m3/year	
GHG emissions m3 water consumed	**gCO2e/m3 per year**		**334**

25. GHG emissions are dominated by scope 2 emissions for power purchased, accounting for 89% of the total emissions, while Scope 1 emissions only account for 11%. Within scope 2, pumps account for the majority of the emissions (98% of scope 2 emissions, 87% overall), while offices account for only 2% of scope 2 emissions and 1.8% overall.

26. Scope 1 emissions are mainly from diesel consumption in vehicles and generators, accounting in total for 7.6% of total emissions and 68.4% of scope 1 emissions. Emissions of CH4 and N2O from wastewater treatment and septage treatment are minor, 3.5% of total emissions and 31.6% of scope 1 emissions. The latter reflect the relatively low penetration of offsite wastewater treatment as well as the shared responsibilities of different players in providing wastewater treatment services. A corollary of this is that the onsite emissions in the sanitation sector e.g. from latrine pits are high, but these are not part of NWSDB GHG inventory and carbon footprint.[13]

27. Compared to the GHG inventory included in the 2024 NWSDB CCRR, the results are slightly lower. This, however, is an artifact, as vehicle emissions appear to have been

[13] Calculations showed that onsite sanitation sector emissions are approximately 4 million tCO2e per year, and that annual emission reductions of 2 to 2.5 million tCO2e could be achieved. However, no financially compelling case could be developed for NWSDB to get involved in these emissions, which they do not "own".

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overestimated at the time. The GHG inventory included in this report is more comprehensive and accurate than the earlier GHG inventory.

28. The calculation methods used in compiling the GHG inventory and carbon footprint are summarized in the following points, explaining item by item the method and sources. The overall structure is in line with the GHG Protocol, while individual calculations are in accordance with the 2006 IPCC guidelines and IFI guidance.

- For diesel use in vehicles, the amount of fuel consumed (expressed in liters per year) was estimated by NWSDB based on number of vehicles, assumed mileage, and fuel economy. The estimate was converted to the amount of primary energy supplied through multiplication by the net calorific value (NCV), 36.0 MJ/l for diesel.[14] Primary energy inputs were converted to CO2 emissions (expressed in tCO2 per year) through multiplication by the emission coefficient (74.1 tCO2/TJ)[15] and division by 1 million to convert from MJ to TJ.
- Diesel use in generators was estimated based on the installed capacity of generators reported in the 2024 NWSDB CCRR. From total annual diesel consumption and total generation capacity in the sample for which data were available for the preparation of the 2024 CCRR, average diesel consumption per MW could be calculated (33.98 liter per kW). This number can be applied to the total generator capacity and combined with the NCV and CO2 coefficient as mentioned above to calculate CO2 emissions. This approach leads to estimate of 6,396 tCO2/year.
- CH4 and N2O emissions from wastewater treatment plants were calculated according to the procedures described in the IPCC 2006 guidelines, which was applied to each wastewater plant owned and/or operated by NWSDB. CH4 emissions were calculated by multiplying wastewater flow (in m3/day) by BOD (in mg/l = g/m3), by the CH4 potential (0.6 kgCH4 per kg BOD), by the Methane Correction Factor (MCF, value varying between 0 and 1 depending on the treatment technology) and dividing by million to convert from gram to ton. N2O emissions were calculated by multiplying wastewater flow (in m3/day) by the assumed total N load (45 mg N/l = 45g N/m3), by the N2O emission factor (0.005), by 44/28 to convert from N to N2O and dividing by million to convert from gram to ton.[16]
- CH4 and N2O emissions from septage treatment plants were calculated according to the procedures described in the IPCC 2006 guidelines, which was applied to each septage plant owned and/or operated by NWSDB only design treatment flows were provided. CH4 emissions were calculated by multiplying septage flow (in m3/day) by assumed BOD (6480 mg/l = 6480 g/m3), by the CH4 potential (0.6 kgCH4 per kg BOD), by the Methane Correction Factor (MCF, a value of 0.1 was assumed) and dividing by million to convert from gram to ton. N2O emissions were calculated by multiplying septage flow (in m3/day) by the assumed total N load (700 mg N/l = 700g N/m3), by the N2O emission factor (0.005), by 44/28 to convert from N to N2O and dividing by million to convert from gram to ton. (footnote 16)
- Emissions of CH4 and N2O were converted through multiplication by the latest IPCC GWPs, 27 for non-fossil methane and 273 for N2O (footnote 5).

[14] https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html.

[15] IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy. Chapter 3. Mobile Combustion, Table 3.2.1., as amended from time to time. The calculation method is from the same source.

[16] The calculation method, the CH4 potential and the N2O emission factor are all from IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste. Chapter 6. Wastewater Treatment and Discharge, as amended from time to time. Other assumptions are expert judgments in line with the methodology.

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- For electrical power, emissions were calculated by multiplying the amount of grid-supplied power consumed (expressed in kWh per year) by 505.9 gCO2/kWh, the grid emission factor for firm energy and dividing by million to convert from gCO2 to tCO2.[17]
- To calculate GHG emission reductions from proposed investments in the following sections, reductions in grid-supplied power consumed (expressed in kWh per year), multiplied by 505.9 gCO2/kWh, the grid emission factor for firm energy, in the case of energy efficiency and water loss reduction projects, and multiplied by 646.4 gCO2/kWh, the grid emission factor for intermittent energy, in the case of solar PV projects and in both cases dividing by million to convert from gCO2 to tCO2.[18]

[17] This is a standard approach and in line with the IFI approach. The grid emission factor used is from IFI TWG. 2022. Harmonized IFI Default Grid Factors 2021 v3.2. International Financial Institutions Technical Working Group on Greenhouse Gas Accounting (IFI TWG).

[18] These are standard approaches and in line with the IFI approaches. The grid emission factors used are from IFI TWG. 2022. Harmonized IFI Default Grid Factors 2021 v3.2. International Financial Institutions Technical Working Group on Greenhouse Gas Accounting (IFI TWG).

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V. TARGETS AND CONFIRMATION OF MITIGATION ACTIONS

A. Targets

29. The first point to start for determining targets is mitigation options that have been identified and that likely can be implemented. The 2024 NWSDB CCRR contained three such mitigation actions – increased pumping efficiency, solar PV installation, and reduction of technical water losses. Together these reduce GHG emissions by 81,174 tCO2/year, or 38% of the 2025 GHG emissions of NWSDB.

30. Of course, this does not mean that the carbon footprint would decrease by 38% if the proposed measures were implemented. After all, it takes time to implement the measures, and while implementation is going on, the amount of water consumed increases each year. Therefore, some projections of the time required to implement the measures are needed, as well as projections how GHG emissions will evolve in the baseline are needed. NDC 3.0 has a planning period till 2035 (2026-2035), so it is logical to assume that the identified measures will be implemented between 2026 and 2035. The amount of water consumed annually grows by about 4.5% per year, so the amount of water consumed in 2035 is approximately 55% higher than in 2025. That also means that the impact on the carbon footprint is reduced. This means that the carbon footprint (a GHG intensity) would drop by 25% relative to 2035.

31. Because mitigation measures have been identified and previously accepted leading to a drop of the carbon footprint by 25% in 2035 compared to 2025, this could be a reasonable target. However, it is also necessary to consider the commitments of Sri Lanka under NDC 3.0. NDC 3.0 has as (rounded) overall target a reduction of 2026-2035 emissions by 20% compared to the baseline. As is done for all NDCs of developing countries, this is divided into a part that is conditional on foreign assistance (finance) and a part that is not conditional on foreign assistance. This reflects that in the UNFCCC process, developed countries have repeatedly promised financial support, but not always (fully) delivered. In the case of Sri Lanka, a reduction by 8% is unconditional (not dependent on foreign assistance) and a reduction by 12% is conditional (dependent on foreign assistance). How do plausible NWSDB carbon footprint reduction targets shape up against these NDC targets?

32. To analyze, it is necessary to define when the carbon footprint reductions are achieved. Let's assume that each year, the carbon footprint reduce by x%, compounded. In other words, the carbon footprint in these projections are in 2026, 334 * (100% - x%), in 2027, 334 x (100% - x%)^2, etc. Then we can solve for x that matches the unconditional target (x = 1.428%) and for x that matches the overall target (x = 3.85%) but assumes foreign assistance. NWSDB can commit to the unconditional target without relying on foreign financial support, while achieving the more stringent conditional target depends on receiving foreign financial support, and can, hence, only become a target when sufficient financial support is received. This approach mirrors the national NDC 3.0.

33. Based on these calculations, we would propose the following carbon footprint reduction targets for NWSDB: **unconditional, -6.94% in 2030 (311 gCO2e/m3 water) and -13.4% in 2035 (289 gCO2/m3 water); conditional, -17.82% (274.5 gCO2/m3 water) in 2030 and -32.47% (225.5 gCO2/m3 water) in 2035**.

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34. The unconditional targets can easily be reached with the identified portfolio of measures (the targets correspond to implementing 22.5% and 54.2% of the identified portfolio by respectively 2030 and 2035), The overall targets, including the conditional elements, can be implemented in 2030 (requiring implementing 57.9% of the identified portfolio), but in 2035, needs another 25,400 tCO2 in emission reductions over the pre-identified measures (an additional 28.1 MW of solar projects, for example).

B. Mitigation actions

35. No independent stakeholder consultation for the purpose of CFRR formulation could be conducted yet. However, the process followed in the sectoral CCR yields valuable information for confirming the mitigation action. The following paragraphs summarizes the approach and the insights gained.

36. Based on the GHG inventory, and the documents listed in Paragraphs 15-16, a total of 22 potential roadmap actions were identified. Table 5 provides the mitigation actions, including an indication of which emission sources are addressed by each action.

Table 5. Potential mitigation actions

No.	Action	Emission source addressed
1	Reduction of non-revenue water (NRW)	Power generation emissions
2	Pump and motor efficiency upgrades	Power generation emissions
3	Energy audits and efficiency improvements	Power generation emissions
4	Solar PV at water and sanitation facilities	Power generation emissions
5	Other renewable energy (micro-hydro, wind, biomass)	Power generation emissions
6	Wastewater reuse (reducing potable water demand)	Power generation emissions
7	Low-emission design of WWTPs, FSTPs, DEWATS	Methane + power generation emissions
8	Wastewater and fecal sludge GHG assessment	Methane emissions (identification)
9	Methane capture and biogas utilization	Methane emissions
10	Expanded fecal sludge management with resource recovery	Methane emissions
11	Constructed wetlands for wastewater treatment (NbS)	Methane + power generation emissions
12	Algae/aquatic plant wastewater treatment (NbS)	Methane + power generation emissions
13	Decentralized biogas units for fecal sludge (NbS)	Methane + fuel use emissions
14	Fleet decarbonization (electrification, alternative fuels)	Fuel use emissions
15	Route optimization and operational efficiency	Fuel use emissions
16	Climate-smart procurement standards	Power generation emissions
17	Water-efficiency standards for fittings	Power generation emissions
18	Building energy retrofits	Power generation emissions
19	Sector-wide GHG MRV system	All sources (enabling)
20	Climate disclosure and governance measures	All sources (enabling)
21	Capacity building for mitigation finance	All sources (enabling)
22	Carbon credit development	All sources (enabling)

37. A total of 22 potential roadmap actions is large for further analysis. To make the analytical task more manageable, the actions were grouped into clusters of similar actions (at the same time with some aggregation and renaming), which were presented to stakeholders in the form of cluster sheets, through which the clustering could be validated and an initial assessment of priorities could be carried out. A summary of the clusters is included in Box 2.

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Results of the analysis are presented in the next section, along with the results from the MCDA workshop.

Box 2. Action clusters as originally designed

M1. Water efficiency & NRW reduction

Mitigation package — Core low-regret measures that reduce water losses, pumping demand, treatment demand and operating costs.

1.1 Leak detection and repair; 1.2 Pressure management; 1.3 Metering expansion and meter management; 1.4 Efficient fittings regulation; 1.5 Demand management campaigns

M2. Energy efficiency in operations

Mitigation package — Utility measures that directly lower electricity use in treatment, pumping and buildings.

2.1 Pump and motor replacement; 2.2 Variable frequency drives (VFDs); 2.3 Hydraulic optimization; 2.4 Energy audits and SEC monitoring; 2.5 Building energy efficiency

M3. Renewable energy deployment

Mitigation package — On-site and distributed renewable-energy solutions for water and sanitation assets.

3.1 Solar PV for treatment plants and pumping stations; 3.2 Solar for rural and community schemes; 3.3 Battery storage at critical sites; 3.4 Other renewable feasibility studies

M4. Wastewater & fecal sludge mitigation and transformation

Mitigation package — Measures to understand, reduce and utilize emissions from wastewater and fecal sludge systems.

4.1 Baseline GHG assessment of wastewater and FSM; 4.2 Methane capture and biogas options; 4.3 Aeration and process optimization; 4.4 Low-emission design standards for WWTPs/FSTPs/DEWATS; 4.5 Resource recovery from sludge

M5. Fleet & operational emissions

Mitigation package — Operational measures for road-based emissions from the utility and related service providers.

5.1 Route optimization; 5.2 Fleet electrification pilots; 5.3 Alternative fuel trials

M6. Governance, MRV & climate finance readiness

Mitigation package — Enabling actions that make sector mitigation measurable, governable and financeable.

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6.1 Sector GHG accounting and MRV; 6.2 Climate-related disclosure 6.3 Institutional climate strategies; 6.4 Climate finance pipelines; 6.5 Carbon credit exploration

38. These clusters were shared with stakeholders in the form of customized cluster sheets,[19] with the request to 1) identify whether each of the action were similar or different from the other actions in the cluster, 2) to rank each action on the priority within the cluster, and 3) to rank, based on the highest priority action in the cluster, the various clusters against each other. The returned cluster sheets were analyzed prior to the MCDA workshop of 10 April 2026, to obtain an idea about likely priorities,[20] and to identify actions that were misaligned in their clusters.[21] Misaligned actions were removed from the clusters before the MCDA workshop.

39. A total of 9 usable cluster sheets were returned by NWSDB staff and subject to the cluster analysis described. First, one action was removed from a cluster because more than 30% of the retuned sheets considered them different from the other cluster actions and the average priority score was more than 0.5 different from the cluster average: M3.4 Other renewable feasibility studies was removed from Cluster M3.

40. Next, the average rank was calculated, and the clusters were ranked on the basis of the average rank. This is not methodologically without problems – averaging of ordinal numbers - but provides an initial idea about what are the preferred clusters, as found through the cluster analysis. Table 6 provides the mitigation cluster ranking resulting from the cluster analysis, with M2 Energy efficiency in operations the highest ranked cluster, and M6 Fleet & operational emissions the lowest priority.

Table 6. Cluster analysis ranking of mitigation clusters, NWSDB

Rank	Code	Cluster name
1	M2	Energy efficiency in operations
2	M1	Water efficiency & NRW reduction
3	M3	Renewable energy deployment
4	M4	Wastewater & fecal sludge mitigation and transformation
5	M6	Governance, MRV & climate finance readiness
6	M5	Fleet & operational emissions

Table 7. NWSDB priority actions per cluster, cluster analysis

Rank	Code	Cluster name respectively action name
1	M2	Energy efficiency in operations
	M2.1	*Pump and motor replacement*
	M2.2	*Variable frequency drives (VFDs)*
	M2.3	*Hydraulic optimization*
2	M1	Water efficiency & NRW reduction
	M1.1	*Leak detection and repair*
	M1.2	*Pressure management*

[19] For some water sector segments, only sanitation is relevant, for others, only drinking water supply, for others, both. The cluster sheets were customized to the stakeholders.
[20] Through calculation of the average rank.
[21] Any action that more than 50% of the respondents considered different was discarded. Additionally, for all actions that more than 30% of the respondents considered different, the average priority score was compared against the average cluster priority score. If more than 0.5, the action was dropped.

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3	M3	Renewable energy deployment
	M3.1	*Solar PV for treatment plants and pumping stations*
4	M4	Wastewater & fecal sludge mitigation and transformation
	M4.3	*Aeration and process optimization*
	M4.1	*Baseline GHG assessment of wastewater and FSM*
5	M6	Governance, MRV & climate finance readiness
	M6.3	*Institutional climate strategies*
	M6.1	*Sector GHG accounting and MRV*
6	M5	Fleet & operational emissions

41. Table 7 additionally includes information on what are the NWSDB priorities within each cluster. Both the clusters and the prioritized actions correspond very closely with the mitigation actions the 2024 CCRR proposed, which underpinned the targets discussed in section A.

42. The MCDA workshop of 10 April 2026 did not allow to distinguish between scores provided by NWSDB staff and other participants. For that reason, results related to mitigation are presented with limited description of the process. Criteria are included in Box 3, while the final options are included in Box 4. See

43. Table ***8*. MCDA outcome: weighted scores and sum of the weighted scores (Total)**

Code	**Criteria / Cluster name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
M1	Water efficiency & NRW reduction	19.05	13.71	11.43	13.71	8.00	7.62	14.57	88.10
M2	Energy efficiency in operations	15.24	17.14	10.29	15.24	12.00	6.86	16.19	92.95
M3	Renewable energy deployment	5.71	13.71	9.14	12.19	13.33	5.33	14.57	74.00
M4	Wastewater & fecal sludge mitigation and transformation	13.33	10.29	5.71	7.62	2.67	6.10	12.95	58.67
M5	Fleet & operational emissions	1.90	8.57	0.00	0.00	0.00	0.00	0.00	10.48
M6	Governance, MRV & climate finance readiness	11.43	12.00	10.29	10.67	1.33	4.57	8.10	58.38

Table 9. Cluster prioritization

MCDA score	Code	Cluster name
92.952	M2	Energy efficiency in operations
88.095	M1	Water efficiency & NRW reduction
74.000	M3	Renewable energy deployment
58.667	M4	Wastewater & fecal sludge mitigation and transformation
58.381	M6	Governance, MRV & climate finance readiness
10.476	M5	Fleet & operational emissions

44. The results have been grouped in Table 9. High priority clusters are in green, medium-high priority clusters in light green, medium priority clusters in yellow, medium-low priority clusters are in orange (none included), and low priority clusters are in red.

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Box 4. Finalized action clusters

M1. Water efficiency & NRW reduction

Core low-regret measures that reduce water losses, pumping demand, treatment demand and operating costs.

1.1 Leak detection and repair; 1.2 Pressure management; 1.3 Metering expansion and meter management; 1.4 Efficient fittings regulation; 1.5 Demand management campaigns

M2. Energy efficiency in operations

Utility measures that directly lower electricity use in treatment, pumping and buildings.

2.1 Pump and motor replacement; 2.2 Variable frequency drives (VFDs); 2.3 Hydraulic optimization; 2.4 Energy audits and SEC monitoring; 2.5 Building energy efficiency

M3. Renewable energy deployment

On-site and distributed renewable-energy solutions for water and sanitation assets.

3.1 Solar PV for treatment plants and pumping stations; 3.2 Solar for rural and community schemes; 3.3 Battery storage at critical sites 3.4 micro hydro (other renewable feasibility studies deleted) 3.5 solar regulation to address use limitation.

M4. Wastewater & fecal sludge mitigation and transformation

Measures to understand, reduce and utilise emissions from wastewater and fecal sludge systems.

4.1 Baseline GHG assessment of wastewater and FSM; 4.2 Methane capture and biogas options; 4.3 Aeration and process optimization; 4.4 Low-emission design standards for treatment process of WWTPs/FSTPs/DEWATS; 4.5 Resource recovery from sludge 4.6 Reduce water infiltration

M5. Fleet & operational emissions

Operational measures for road-based emissions from the utility and related service providers.

5.1 Route optimization; 5.2 Fleet electrification pilots; 5.3 Alternative fuel trials

M6. Governance, MRV & climate finance readiness

Enabling actions that make sector mitigation measurable, governable and financeable.

6.1 Sector GHG accounting and MRV; 6.2 Climate-related disclosure 6.3 Institutional climate strategies; 6.4 Climate finance pipelines; 6.5 Carbon credit exploration

45. and Table 9 for the results.

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Box 3. Final list of criteria

1. **Alignment with drinking water and sanitation sector mandate**
2. **Climate impact:** Contribution to climate objectives (mitigation and/or adaptation)
3. **Value for Money / Cost effectiveness:** Expected impact relative to cost
4. **Feasibility (technical, institutional and financial) and sustainability:** Ease of implementation and manageability in Sri Lankan context
5. **Time to Impact:** How quickly benefits materialize
6. **Social, Economic and Environmental Co-benefits:** Additional benefits beyond core climate objective
7. **Policy alignment:** Alignment with climate and sector policies

Table 8. MCDA outcome: weighted scores and sum of the weighted scores (Total)

Code	Criteria Cluster name	1	2	3	4	5	6	7	Total
M1	Water efficiency & NRW reduction	19.05	13.71	11.43	13.71	8.00	7.62	14.57	88.10
M2	Energy efficiency in operations	15.24	17.14	10.29	15.24	12.00	6.86	16.19	92.95
M3	Renewable energy deployment	5.71	13.71	9.14	12.19	13.33	5.33	14.57	74.00
M4	Wastewater & fecal sludge mitigation and transformation	13.33	10.29	5.71	7.62	2.67	6.10	12.95	58.67
M5	Fleet & operational emissions	1.90	8.57	0.00	0.00	0.00	0.00	0.00	10.48
M6	Governance, MRV & climate finance readiness	11.43	12.00	10.29	10.67	1.33	4.57	8.10	58.38

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10.476	M5	Fleet & operational emissions

46. The results have been grouped in Table 9. High priority clusters are in green, medium-high priority clusters in light green, medium priority clusters in yellow, medium-low priority clusters are in orange (none included), and low priority clusters are in red.

Box 4. Finalized action clusters

M1. Water efficiency & NRW reduction

Core low-regret measures that reduce water losses, pumping demand, treatment demand and operating costs.

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1.1 Leak detection and repair; 1.2 Pressure management; 1.3 Metering expansion and meter management; 1.4 Efficient fittings regulation; 1.5 Demand management campaigns

M2. Energy efficiency in operations

Utility measures that directly lower electricity use in treatment, pumping and buildings.

2.1 Pump and motor replacement; 2.2 Variable frequency drives (VFDs); 2.3 Hydraulic optimization; 2.4 Energy audits and SEC monitoring; 2.5 Building energy efficiency

M3. Renewable energy deployment

On-site and distributed renewable-energy solutions for water and sanitation assets.

3.1 Solar PV for treatment plants and pumping stations; 3.2 Solar for rural and community schemes; 3.3 Battery storage at critical sites 3.4 micro hydro (other renewable feasibility studies deleted) 3.5 solar regulation to address use limitation.

M4. Wastewater & fecal sludge mitigation and transformation

Measures to understand, reduce and utilise emissions from wastewater and fecal sludge systems.

4.1 Baseline GHG assessment of wastewater and FSM; 4.2 Methane capture and biogas options; 4.3 Aeration and process optimization; 4.4 Low-emission design standards for treatment process of WWTPs/FSTPs/DEWATS; 4.5 Resource recovery from sludge 4.6 Reduce water infiltration

M5. Fleet & operational emissions

Operational measures for road-based emissions from the utility and related service providers.

5.1 Route optimization; 5.2 Fleet electrification pilots; 5.3 Alternative fuel trials

M6. Governance, MRV & climate finance readiness

Enabling actions that make sector mitigation measurable, governable and financeable.

6.1 Sector GHG accounting and MRV; 6.2 Climate-related disclosure 6.3 Institutional climate strategies; 6.4 Climate finance pipelines; 6.5 Carbon credit exploration

47. Also here, M2 Energy efficiency in operations, M1 Water efficiency & NRW reduction, and M3 Renewable energy deployment come out on top, confirming the assumptions earlier in this Section (Section A). M4 Wastewater & fecal sludge mitigation and transformation and M6 Governance, MRV & climate finance readiness are clearly medium priorities, while M5 Fleet & operational emissions is clearly a low priority, unlikely to be pursued.

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VI. BARRIERS, STRATEGY, FINANCING AND NEXT STEPS

48. Through a preliminary review of literature, barriers to each of the three prioritized mitigation clusters were identified. Each of these are discussed in turn, starting with energy efficiency, followed by non-revenue water and renewable energy. After that, we discuss the strategy, sources of finance to deal with the identified barriers and next steps. This is an initial analysis that would need to be built upon before implementation.

A. Barriers

Energy efficiency in operations

49. Based on a literature review, the following six barriers were preliminarily identified as significant constraints towards NWSDB investments in energy efficiency.

50. **Financial and capital constraints**. A primary barrier to pump-replacement projects in NWSDB is limited capital availability combined with competing investment needs. With NWSDB's national water supply coverage around 50.8%, resources are prioritized toward expanding service rather than efficiency improvements, even when savings potential exists. This creates an "efficiency gap," where cost-effective upgrades are delayed due to budget constraints and competing infrastructure demands.[22]

51. **Weak asset management and aging infrastructure**. Pump replacement decisions are constrained by incomplete asset management systems and aging infrastructure. NWSDB has had to introduce asset management frameworks to prioritize renewal and allocate funds effectively, indicating prior limitations in systematic planning. Without reliable asset condition data and prioritization mechanisms, efficient pump replacement may be delayed or poorly targeted relative to broader system rehabilitation needs.[23]

52. **Data and diagnostic limitations**. A major barrier to pump-replacement investments in NWSDB is the lack of continuous, system-wide monitoring data and analytical capability for system performance. Recent peer-reviewed research shows Sri Lanka's water sector relies largely on single-point or aggregated datasets rather than continuous time-series data, limiting the ability to assess system behavior, leakage dynamics, and operational efficiency. This constrains utilities' capacity to establish baselines and confidently quantify energy savings from pump-efficiency upgrades.

53. **Institutional and capacity constraints**. Institutional and capacity limitations remain a barrier to embedding energy efficiency within NWSDB operations. Recent ADB-supported work shows that the utility historically lacked tools, coordinated systems, and integrated frameworks to assess risks, monitor performance, and plan investments, requiring new roadmap-based approaches to strengthen governance and technical capacity. This indicates that energy

[22] JICA. 2021. The Project for Enhancement of Operational Efficiency and Asset Management Capacity of Regional Support Center-Western South of NWSDB in Sri Lanka. JICA Project Brief Note, October 2021.
[23] JICA. 2021. The Project for Enhancement of Operational Efficiency and Asset Management Capacity of Regional Support Center-Western South of NWSDB in Sri Lanka. JICA Project Brief Note, October 2021.

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efficiency interventions, including pump replacement, are constrained by evolving institutional capability and coordination challenges.[24]

54. **Procurement and lifecycle-costing barriers**. A key barrier to energy-efficient pump replacement in NWSDB is the limited integration of lifecycle-costing and asset-based decision-making in investment planning. Recent JICA-supported work highlights that NWSDB has needed to introduce structured asset management to prioritize renewal of aging assets and allocate investment funds effectively, indicating that prior decisions were not systematically optimized based on long-term performance or cost. This constrains timely adoption of efficient pump technologies despite lifecycle benefits.[25]

55. **System-level inefficiencies and uncertainty of savings**. Energy inefficiencies in NWSDB systems arise not only from pump performance but from broader system issues such as non-revenue water and network conditions. For example, energy losses linked to system inefficiencies, including leakage and operational factors, can reach significant levels. This creates uncertainty about realized savings from pump replacement alone unless integrated with broader system optimization measures.[26]

Water efficiency & NRW reduction

56. Based on a literature review, the following six barriers were preliminarily identified as significant constraints towards NWSDB investments in water efficiency and NRW reduction.

57. **Weak data systems and limited monitoring capacity**. Reducing technical losses requires accurate measurement of flows into and within the network, yet Sri Lankan NRW studies show that utilities often lack sufficient metering and localized monitoring. Without district-level flow measurement, utilities rely on system-wide estimates, making it difficult to identify leakage hotspots or quantify NRW components. This limits targeted interventions and slows loss reduction.

58. **Aging infrastructure and inadequate rehabilitation**. Deteriorated and aging pipe networks are a primary cause of technical losses in Sri Lanka. In systems such as Trincomalee, a large share of pipes are decades old, with encrustation and frequent leakages leading to pressure drops and high NRW. Limited periodic rehabilitation and reliance on reactive maintenance further exacerbate leakage and reduce system efficiency.[27]

59. **Financial constraints and investment limitations**. High levels of non-revenue water (NRW) reduce billable water and directly weaken the financial position of NWSDB, limiting its capacity to invest in infrastructure upgrades and loss-reduction programs. Recent evidence shows that NRW significantly affects revenue generation and sector sustainability, prompting

[24] Pedro Almeida et al. 2025. Climate Resilience Starts Here: Sri Lanka's Water Utility Roadmap. Development Asia, 5 November 2025.
[25] JICA. 2021. The Project for Enhancement of Operational Efficiency and Asset Management Capacity of Regional Support Center-Western South of NWSDB in Sri Lanka. JICA Project Brief Note, October 2021.
[26] Tesco Asia. 2017. The Completion Report of Verification Survey with the Private Sector for Disseminating Japanese Technologies for Non-Revenue Water Reduction Program. Produced for JICA. November 2017.
[27] Luxmanan Subaharan. 2019. Reduction of Non-Revenue Water (NRW) in Trincomalee Town – A Case Study. International Journal of Scientific and Research Publications, Volume 9, Issue 9, September 2019. http://dx.doi.org/10.29322/IJSRP.9.09.2019.p9302

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initiatives such as performance-based PPPs to mobilize financing and improve efficiency. These constraints slow the scaling of metering, rehabilitation, and monitoring investments.[28]

60. **Human resource and technical capacity gaps**. NRW management in Sri Lanka requires specialized skills in leak detection, hydraulic analysis, and system monitoring, yet capacity limitations persist within utilities. ADB-supported programs for NWSDB specifically emphasized the need for capacity development, indicating that existing staff skills and institutional knowledge were insufficient for effective NRW reduction and required targeted training and organizational strengthening.[29]

61. **Institutional and operational challenges within NWSDB systems.** NRW reduction requires coordinated operational control across network zones, yet Sri Lankan case studies show that without structured approaches such as district metered areas, utilities only have aggregate system data. This makes it difficult to manage losses systematically and leads to fragmented interventions. Effective NRW reduction depends on integrated operational planning rather than isolated actions.[30]

62. **Pressure variability and operational instability**. NRW levels in Sri Lankan distribution systems are strongly influenced by pressure fluctuations linked to demand variability. Studies using Colombo DMA data show a strong correlation between water consumption, pressure changes, and NRW levels, indicating that unstable operating conditions increase leakage. This makes consistent control of technical losses difficult without advanced pressure management systems.[31]

63. **Limited strategic planning and systematic NRW management**. Research on Sri Lanka’s water sector indicates that although NRW is recognized as a major issue, comprehensive, long-term planning frameworks for loss reduction are often lacking. Studies emphasize that the applicability, cost-effectiveness, and prioritization of NRW interventions have not been systematically evaluated, limiting the ability to design sustained, large-scale programs.[32]

64. **Multiple causes of NRW beyond physical losses complicating interventions**. In Sri Lanka, NRW arises from a combination of technical losses (leaks) and non-technical factors such as illegal connections, metering errors, and administrative inefficiencies. This mix complicates investment decisions because utilities must address both physical infrastructure

[28] The Daily FT. 2025. ADB supports first performance-based non-revenue water PPP project in Galle. 3 June 2025.
[29] ADB. 2022. Democratic Socialist Republic of Sri Lanka: Strengthening the Institutional Capacity of the National Water Supply and Drainage Board. Technical Assistance Report.
[30] Pedro Almeida et al. 2024. From Water Loss to Savings: A Nonrevenue Water Intervention in Sri Lanka. Development Asia, 19 September 2024.
[31] Ashan Pathirane, Shinobu Kazama, Satoshi Takizawa. 2024. Dynamic analysis of non-revenue water in district metered areas under varying water consumption conditions owing to COVID-19. Heliyon, Volume 10, Issue 1, 2024.
https://doi.org/10.1016/j.heliyon.2023.e23516.
[32] B.A.K.S. Perera et al. 2018. A Water Management System for Reducing Non-Revenue Water in Potable Water Lines: The Case of Sri Lanka. Engineer - Vol. LI, No. 02, pp. [53-62], 2018. http://doi.org/10.4038/engineer.v51i2.7295

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and management issues simultaneously, reducing the effectiveness of purely technical interventions targeting leakage alone.[33]

Renewable energy deployment

65. **Grid connection approvals and CEB gatekeeping**. CEB's control over interconnection studies, feeder capacity, and protection approvals makes it the primary gatekeeper for large NWSDB solar deployments. While formally technical, these processes can reflect institutional resistance where distributed generation reduces CEB sales but not its obligations. Sri Lanka's renewable planning explicitly ties project viability to transmission availability and CEB coordination, meaning delays, conditions, or refusals at this stage can materially constrain NWSDB investments.[34]

66. **Grid absorption limits and curtailment risk**. CEB's concerns about system stability and solar intermittency translate into limits on how much distributed solar can be connected or exported. Planning documents emphasize the need for storage, grid upgrades, and centralized control to integrate renewables safely. For NWSDB, this means even technically feasible projects may face curtailment or size restrictions, reflecting CEB's preference for controllable generation and its caution about large daytime injections from distributed assets.[35]

67. **Tariff uncertainty shaped by CEB financial pressures**. Recent solar tariff reductions reflect broader tensions over cost recovery within CEB. Because large customers like NWSDB provide stable revenue, their shift to self-generation can worsen CEB's financial position. This creates pressure to lower export tariffs or introduce less favorable compensation mechanisms, reducing project returns. The 2025 tariff cuts highlight how policy changes—often influenced by utility concerns—can undermine the financial viability of new solar investments.[36]

68. **Revenue erosion and institutional resistance.** CEB's opposition is partly rooted in the financial impact of distributed solar on utility revenue. Sri Lankan research shows that rooftop solar reduces electricity purchases from the grid, leading to direct revenue losses for the utility, while it must still maintain generation capacity and system reliability. This mismatch between declining sales and fixed obligations creates strong incentives for CEB to resist large-scale self-generation by major consumers like NWSDB.[37]

69. **Financial and governance constraints within NWSDB**. Sector-level policy documents emphasize the need for financial sustainability, improved governance, and investment strategies in Sri Lanka's energy and infrastructure sectors. These challenges affect public utilities broadly, including NWSDB, which must balance capital-intensive infrastructure development with energy

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[33] B.A.K.S. Perera et al. 2018. A Water Management System for Reducing Non-Revenue Water in Potable Water Lines: The Case of Sri Lanka. Engineer - Vol. LI, No. 02, pp. [53-62], 2018. http://doi.org/10.4038/engineer.v51i2.7295

[34] SLSEA. 2022. Renewable Energy Resource Development Plan 2021-2026. Sri Lanka Sustainable Energy Authority.

[35] NSTC. 2023. Renewable Energy. Ninth Biennial Sri Lanka Conference on Science and Technology. National Science and Technology Commission.

[36] PUCSL. 2025. Decision on Electricity Tariffs. Public Utilities Commission of Sri Lanka.

[37] J.J. Kodikara et al. 2024. Financial Implications of Rooftop Solar Penetration in Sri Lanka from Utility Point of View. Engineer - Vol.LVII, No. 02, pp. [01-08], 2024. https://doi.org/10.4038/engineer.v57i2.7646.

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investments. Limited financial flexibility and governance capacity can constrain large renewable programs and reduce resilience to policy or regulatory uncertainty.[38]

70. **Operational mismatch and limited flexibility**. NWSDB's energy demand is driven by continuous pumping and treatment operations, while solar output is intermittent. Its corporate planning emphasizes expanding large-scale water supply infrastructure and continuous service provision, indicating limited flexibility in shifting loads to match solar generation. This reinforces CEB's argument that NWSDB remains dependent on grid capacity, supporting the case for standby charges or restrictions on large-scale solar deployment.[39]

71. **Land, siting, and infrastructure constraints**. Renewable project development in Sri Lanka is constrained by land availability, environmental exclusions, and proximity to infrastructure. National planning identifies land-use restrictions, conservation areas, and access to roads and substations as key determinants of project feasibility. These siting constraints are particularly relevant for solar PV installations at distributed facilities, where suitable land and grid access may vary significantly.[40]

72. **Carbon finance and revenue uncertainty**. Sri Lanka's energy policy discussions emphasize the need for diverse financing strategies, including green finance and investment mechanisms, to support renewable development. However, the evolving nature of climate finance frameworks and reliance on policy support create uncertainty for project developers. This limits the reliability of supplementary revenue streams for solar PV projects and increases dependence on domestic tariff structures.[41]

B. Solution strategy

Energy efficiency in operations

73. A solution strategy to address the barriers identified could incorporate, elaborate and expand the following elements, which could form the core of a note to request support from MDBs either in preparing funding proposals, or in elaborating the barrier analysis and solutions preparation as an input for the preparation by NWSDB of a funding proposal.

74. **Institutionalize integrated, data-driven operational management**. NWSDB could consider establishing a utility-wide, data-driven management system integrating energy, hydraulic, and NRW performance indicators. This would shift decision-making from periodic audits to continuous optimization of pumping, pressure, and leakage. Sri Lankan research shows the need for system-level analytics to improve efficiency outcomes in water schemes, enabling better prioritization of interventions and reducing uncertainty in both energy and water efficiency investments.

75. **Embed lifecycle and performance-based approaches in asset planning and procurement**. NWSDB could consider integrating lifecycle costing, energy efficiency, and

[38] Cabinet Sub-Committee Report. 2022. National Energy Potentials, Strategies and the Roadmap for Next Decade. December 2022.
[39] NWSDB. Undated. Corporate Plan 2020-2025. National Water Supply and Drainage Board.
[40] SLSEA. 2022. Renewable Energy Resource Development Plan 2021-2026. Sri Lanka Sustainable Energy Authority.
[41] Cabinet Sub-Committee Report. 2022. National Energy Potentials, Strategies and the Roadmap for Next Decade. December 2022.

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water-loss reduction criteria into asset planning and procurement processes. The NWSDB energy-efficiency roadmap highlights the need to move beyond upfront cost considerations toward lifecycle-based decision-making for pumps and related infrastructure. This approach ensures that investments simultaneously optimize energy use, reduce leakage, and improve long-term operational performance.

76. **Develop scalable financing and implementation mechanisms for efficiency investments**. NWSDB could consider establishing dedicated financing and implementation mechanisms—such as revolving funds, performance-based contracts & PPPs, and programmatic investment pipelines—to overcome capital constraints and scale efficiency improvements. World Bank analysis highlights the need for innovative financing structures to unlock energy-efficiency investments in Sri Lanka. These mechanisms can support integrated investments addressing both pumping efficiency and NRW reduction.

Water efficiency & NRW reduction

77. A solution strategy to address the barriers identified could incorporate, elaborate and expand the following elements, which could form the core of a note to request support from MDBs either in preparing funding proposals, or in elaborating the barrier analysis and solutions preparation as an input for the preparation by NWSDB of a funding proposal.

78. **Climate-smart digital water loss and energy management**. NWSDB could consider expanding integrated digital monitoring systems combining DMAs, smart metering, pressure sensors, and SCADA analytics to enable real-time control of water losses and system performance. This directly addresses weak data systems, pressure variability, and limited operational visibility while improving decision-making. Evidence from Sri Lanka highlights the importance of digitalization and data integration in strengthening climate resilience, operational efficiency, and utility-wide performance management.

79. **Performance-based NRW reduction and infrastructure optimization**. A structured, performance-based approach to NRW reduction potentially including PPP mechanisms could be scaled across high-loss areas, integrating pipe rehabilitation, pressure management, metering upgrades, and active leakage control. This addresses aging infrastructure, financial constraints, and fragmented implementation by linking investments to measurable outcomes. In Sri Lanka, performance-based NRW interventions have demonstrated potential to improve efficiency, reduce losses, and strengthen financial sustainability through accountable, results-driven mechanisms.

80. **Institutional strengthening and integrated planning capacity**. NWSDB could consider strengthening institutional capacity for long-term planning, asset management, and cross-functional coordination, including dedicated units for NRW and system optimization. This addresses capacity gaps, governance challenges, and weak strategic planning. Evidence from Sri Lanka's water sector shows that improving financial sustainability, operational efficiency, and climate resilience depends on strengthened institutional systems, staff training, and integrated monitoring and evaluation frameworks.

81. Note that the last solution proposed for energy efficiency, not repeated here, could also benefit water efficiency and NRW reduction investments.

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Renewable energy deployment

82. A solution strategy to address the barriers identified could incorporate, elaborate and expand the following elements, which could form the core of a note to request support from MDBs either in preparing funding proposals, or in elaborating the barrier analysis and solutions preparation as an input for the preparation by NWSDB of a funding proposal.

83. **Introduce cost-reflective tariffs and grid access charges**. A key strategic thrust is reforming tariffs to reflect capacity, standby, and network costs rather than relying mainly on volumetric energy charges. This would allow NWSDB to invest in solar without undermining CEB's financial stability, while ensuring fair cost recovery for grid services. Sri Lanka's regulatory framework already recognizes the need for cost-reflective tariffs and utility financial viability in tariff setting decisions.

84. **Integrate solar investments with storage and grid planning**. Coordinating NWSDB solar PV with storage and national grid planning can mitigate CEB concerns about intermittency and curtailment. Sri Lanka's long-term generation expansion planning emphasizes the need for energy storage, system flexibility, and coordinated renewable integration. Embedding NWSDB projects within this framework would improve technical acceptance and reduce grid constraints.

85. **Establish structured inter-agency coordination mechanisms**. Institutional misalignment between CEB and NWSDB can be addressed through formal coordination platforms, including joint planning, data sharing, and approval processes. Sri Lanka's water-sector reform efforts highlight the importance of cross-agency coordination to improve infrastructure efficiency and resilience. Such mechanisms would reduce delays, align incentives, and enable integrated energy-water planning.

86. **Mobilize concessional and climate finance for solar deployment**. Given financial and governance constraints, NWSDB can scale renewable investments through concessional loans, blended finance, and climate funds. Sri Lanka's policy discussions emphasize green finance as critical for renewable expansion and infrastructure resilience. Structured financing can reduce upfront costs, manage risk, and compensate for tariff uncertainty, making solar investments more viable despite regulatory and institutional barriers.

C. Financing strategy and next steps

87. Using the tools and frameworks developed for the parallel climate fund guidance being developed for NWSDB, it could be confirmed that all prioritized clusters and prioritized actions therein could, in principle, be suitable for climate funds. The main challenges are that the amount of GHG mitigation that can be achieved is somewhat limited for climate funds targeting mitigation, and that usually it will not be possible to submit more than one proposal to a single climate fund for a single sector within a country.

88. Based on these considerations, it is proposed to group and aggregate to the extent possible, and to seek to prepare programs that go beyond NWSDB but also encompass other interested actors. Two programs are recommended, comprising the renewable energy cluster and the energy efficiency and water efficiency & NRW reduction cluster respectively.

89. For renewable energy, this could include industrial and commercial enterprises interested in solar rooftop projects and project developers of solar PV parks. For energy

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efficiency, water efficiency and NRW reduction, the topic targeted could be “resource efficiency” and include, among others other Sri Lankan utilities (in the water and energy sector) and government entities.

90. While the Green Climate Fund might be the ideal climate fund, it is likely that this fund will need to be targeted with adaptation focused proposals. Therefore, the recommendation is to target two funds: IKI (International Climate Initiative)[42] and the Mitigation Action Facility.[43] Which fund could be best targeted with which proposal depends to a large extent on how calls for proposals of IKI are formulated, so it is difficult to present final recommendations at this point.

91. A common theme for both proposals would be the development of financial mechanisms to promote mitigation investments. This could, for example, include green bonds, PPPs, green revolving funds, and other mechanisms, as elaborated in Sri Lanka’s Climate Finance Strategy.[44] The two proposals would diverge on the other main components: while the renewable energy proposal would focus on eliminating the constraints resulting from CEB concerns on the impacts of decentralized renewable energy development on system stability and cost recovery of past investments (through new storage technologies, new tariff structures, and better coordination), the resource efficiency proposal would focus on data-driven management and lifecycle-based planning:

- Data-driven management is fundamental for both energy and NRW reduction, as leakage detection, pressure optimization, and pump efficiency all depend on accurate, continuous system data.
- Lifecycle-based planning ensures that infrastructure decisions (e.g., pumps, pipes, valves) are optimized jointly for energy use and water loss reduction.

92. For both funding programs, the initial step is to develop a concept note covering the core mitigation core framework, as developed in the guidance for applying to any climate fund. The preceding sections indicate the main barriers that would need to be covered in the note, and the solution strategies that may be proposed in the concept notes, without aiming to provide full coverage.

93. The concept notes will be used to either request support from development partners in further elaborating the proposals and potentially provide co-financing in parallel to the targeted funds, or to directly approach the recommended funds, taking also into account the funds’ procedural requirements.

94. Another fundamental step that NWSDB needs to take is to start reporting regularly on its carbon footprint. Both for reporting at the corporate level and for parts of NWSDB such as the Regional Support Centers, the recommendation is to use the format included in Table 4. This is a clean way to present the GHG inventory and the resulting carbon footprint, expressed in gCO2e/m3 water consumed. This table format is backed up by a spreadsheet that in a transparent manner calculates GHG emissions from the inputs provided.

95. One technical challenge is that new activities may be developed by NWSDB, not yet covered in the spreadsheet. For example, if a new type of wastewater treatment plant is established, the determination of the methane correction factor (MCF) requires special attention.

[42] https://www.international-climate-initiative.com/en/
[43] https://mitigation-action.org/
[44] Ministry of Finance, Planning and Economic Development. 2025. National Climate Finance Strategy of Sri Lanka (2025-2030).

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While the IPCC source used[45] provides guidance on the MCF, it may be necessary to call in the assistance of a GHG inventory expert to confirm the choices made.

96. Similarly, if parameters used in the calculation are changed, e.g. to reflect changing scientific insights, it will be necessary to recalculate the baseline against which the progress in reducing the carbon footprint are formulated. This may also require the assistance of a GHG inventory expert.

[45] IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste. Chapter 6. Wastewater Treatment and Discharge.

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VII. CONCLUSIONS

97. The main conclusions and recommendation of this report are as follows:

- The total GHG emissions of NWSDB in 2025 were 211,693 tCO2e, and the carbon footprint was 334 gCO2e/m3 water consumed. The table below provides the details of the inventory and the carbon footprint calculation.
- Based on an analysis of initially identified mitigation actions and Sri Lanka's NDC 3.0, the following carbon footprint reduction targets are proposed:
    - Unconditional (without international financial support), -6.94% in 2030 (311 gCO2e/m3 water) and -13.4% in 2035 (289 gCO2/m3 water);
    - Conditional (with sufficient international financial support), -17.82% (274.5 gCO2/m3 water) in 2030 and -32.47% (225.5 gCO2/m3 water) in 2035.

  Of these targets, only the conditional target for 2035 requires mitigation actions beyond those identified in the NWSDB 2024 CCRR.
- The main mitigation actions through which the carbon footprint reduction targets will be achieved are energy efficiency in operations, water efficiency and NRW reduction, and renewable energy deployment.
- To finance the proposed mitigation measures, two programs are proposed, one focusing on resource efficiency (comprising energy efficiency in operations and water efficiency & NRW reduction) and renewable energy deployment, targeting the Mitigation Action Facility and IKI.
- In both cases, as a first step the development of concept notes is proposed, targeting the creation of financial mechanisms and elimination of specific barriers (both the main barriers and the main strategies to address the barriers have been preliminarily identified in this report).
- It is proposed that NWSDB starts reporting on its carbon footprint on a regular basis, using the same format as included below, and using a spreadsheet tool backing up this table format for facilitating the calculations.

Table 10. GHG inventory and carbon footprint of NWSDB, 2025.

Source of GHG emissions	Key input value	Unit	Estimated GHG emissions (tCO2e/yr)
Diesel for vehicles	3,613,448	liters/year	9,639
Diesel for generators	70,560	kW	6,396
CH4 emissions from wastewater treatment	140.90	tCH4/year	3,804
N2O emissions from wastewater treatment	3.81	tN2O/year	1,039
Total wastewater treatment			*4,844*
CH4 emissions from septage treatment	83.02	tCH4/year	2,242
N2O emissions from Septage treatment	1.17	tN2O/year	321
Total septage treatment			2,562
Total scope 1 emissions			***23,441***
Grid power consumed	372,146,694	MWh/year	188,252
Of which offices	*7,513,387*	*MWh/year*	*3,801*
Of which pumps	*364,634,747*	*MWh/year*	*184,452*
Total scope 2 emissions			***188,252***
Total emissions			**211,693**
Total water produced	851,481,716	m3/year	
Total water consumed	632,998,762	m3/year	
GHG emissions m3 water consumed	**gCO2e/m3 per year**		**334**

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VIII. REFERENCES

ADB. 2022. Democratic Socialist Republic of Sri Lanka: Strengthening the Institutional Capacity of the National Water Supply and Drainage Board. Technical Assistance Report.

ADB. 2024. Sri Lanka: Water Supply and Sanitation Reform Program. Project Number 56281-001.

Pedro Almeida et al. 2024. From Water Loss to Savings: A Nonrevenue Water Intervention in Sri Lanka. Development Asia, 19 September 2024.

Pedro Almeida et al. 2025. Climate Resilience Starts Here: Sri Lanka's Water Utility Roadmap. Development Asia, 5 November 2025.

Cabinet Sub-Committee Report. 2022. National Energy Potentials, Strategies and the Roadmap for Next Decade. December 2022.

Climate Change Secretariat. 2016. National Adaptation Plan for Climate Change Impacts in Sri Lanka. Climate Change Secretariat, Ministry of Mahaweli Development and Environment, Sri Lanka.

Forster, P., T. Storelvmo, K. Armour, W. Collins, J.-L. Dufresne, D. Frame, D.J. Lunt, T. Mauritsen, M.D. Palmer, M. Watanabe, M. Wild, and H. Zhang, 2021: The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 923–1054, doi:10.1017/9781009157896.009. See Table 7.15.

Government of Sri Lanka. 2022. Climate Prosperity Plan: Preliminary Report.

Government of Sri Lanka. 2025. Nationally Determined Contributions 3.0 (2026-2035). Government of Sri Lanka, 22 September 2025.

IFI TWG. 2022. Harmonized IFI Default Grid Factors 2021 v3.2. International Financial Institutions Technical Working Group on Greenhouse Gas Accounting (IFI TWG).

IPCC. 2006. IPCC Guidelines for National Greenhouse Gas Inventories. Intergovernmental Panel on Climate Change.

IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy. Chapter 3. Mobile Combustion.

IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5: Waste. Chapter 6. Wastewater Treatment and Discharge.

INTERNAL. This information is accessible to ADB Management and staff. It may be shared outside ADB with appropriate permission.

JICA. 2021. The Project for Enhancement of Operational Efficiency and Asset Management Capacity of Regional Support Center-Western South of NWSDB in Sri Lanka. JICA Project Brief Note, October 2021.

J.J. Kodikara et al. 2024. Financial Implications of Rooftop Solar Penetration in Sri Lanka from Utility Point of View. Engineer - Vol.LVII, No. 02, pp. [01-08], 2024. https://doi.org/10.4038/engineer.v57i2.7646.

Ministry of Environment. 2021. Updated Nationally Determined Contributions. Amended version of September 2021.

Ministry of Environment. 2022. Third National Communication of Climate Change in Sri Lanka. Submission to the UNFCCC Secretariat. Prepared by the Climate Change Secretariat, Ministry of Environment.

Ministry of Environment. 2023. Carbon Net Zero 2050 Roadmap and Strategic Plan.

Ministry of Environment. 2024. First Biennial Transparency Report of Sri Lanka. Submission to the UNFCCC Secretariat.

Ministry of Finance, Planning and Economic Development. 2025. National Climate Finance Strategy of Sri Lanka (2025-2030).

NSTC. 2023. Renewable Energy. Ninth Biennial Sri Lanka Conference on Science and Technology. National Science and Technology Commission.

NWSDB. 2024. Climate Change Resilience Roadmap. February 2024.

NWSDB. Undated. Corporate Plan 2020-2025. National Water Supply and Drainage Board.

Ashan Pathirane, Shinobu Kazama, Satoshi Takizawa. 2024. Dynamic analysis of non-revenue water in district metered areas under varying water consumption conditions owing to COVID-19. Heliyon, Volume 10, Issue 1, 2024. https://doi.org/10.1016/j.heliyon.2023.e23516.

B.A.K.S. Perera et al. 2018. A Water Management System for Reducing Non-Revenue Water in Potable Water Lines: The Case of Sri Lanka. Engineer - Vol. LI, No. 02, pp. [53-62], 2018. http://doi.org/10.4038/engineer.v51i2.7295

PUCSL. 2025. Decision on Electricity Tariffs. Public Utilities Commission of Sri Lanka.

SLSEA. 2022. Renewable Energy Resource Development Plan 2021-2026. Sri Lanka Sustainable Energy Authority.

Luxmanan Subaharan. 2019. Reduction of Non-Revenue Water (NRW) in Trincomalee Town – A Case Study. International Journal of Scientific and Research Publications, Volume 9, Issue 9, September 2019. http://dx.doi.org/10.29322/IJSRP.9.09.2019.p9302

Tesco Asia. 2017. The Completion Report of Verification Survey with the Private Sector for Disseminating Japanese Technologies for Non-Revenue Water Reduction Program. Produced for JICA. November 2017.

INTERNAL. This information is accessible to ADB Management and staff. It may be shared outside ADB with appropriate permission.

The Daily FT. 2025. ADB supports first performance-based non-revenue water PPP project in Galle. 3 June 2025.

WRI and WBCSD. 2015. A Corporate Accounting and Reporting Standard: Revised Edition. The Greenhouse Gas Protocol.

https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html.
https://www.international-climate-initiative.com/en/
https://mitigation-action.org/

INTERNAL. This information is accessible to ADB Management and staff. It may be shared outside ADB with appropriate permission.