



# REPORT

## A ROADMAP FOR INTEGRATING THE COOLING SECTOR IN ETHIOPIA'S NDC

Ashwin Tomy, Alicia Schmid, Ikram Douba, Marc  
André Marr, Wondwossen Sintayehu,  
Stephan Hoch

Freiburg, Germany, 20.12.2024

**perspectives**  
climate research

SOUTH  
SOUTH  
NORTH  
TOWARDS CLIMATE RESILIENCE

## Content

<b>EXECUTIVE SUMMARY.....</b>	<b>5</b>
<b>INTRODUCTION &amp; CONTEXT .....</b>	<b>8</b>
<b>STEP-BY-STEP GUIDE FOR COOLING SECTOR INTEGRATION INTO A NDC .....</b>	<b>10</b>
<b>STEP 1: POLICY ANALYSIS.....</b>	<b>12</b>
ETHIOPIA’S CLIMATE RESILIENT GREEN ECONOMY STRATEGY.....	12
ETHIOPIA’S NATIONALLY DETERMINED CONTRIBUTIONS (2017-2021) .....	12
ETHIOPIA’S TEN-YEAR DEVELOPMENT PLAN (2021-2030).....	14
ETHIOPIA’S GROWTH AND TRANSFORMATION PLAN .....	15
ETHIOPIA’S LONG-TERM LOW EMISSION AND CLIMATE RESILIENT DEVELOPMENT STRATEGY .....	15
<b>STEP 2: MAPPING OF KEY STAKEHOLDERS.....</b>	<b>16</b>
KEY ENTITIES RESPONSIBLE FOR ETHIOPIA’S NDC (MITIGATION).....	16
KEY RAC RELATED ENTITIES IN ETHIOPIA.....	18
NON-GOVERNMENT STAKEHOLDERS ENGAGED IN THE RAC AND DAIRY SECTOR.....	19
<b>STEP 3: STAKEHOLDER CONSULTATIONS.....</b>	<b>20</b>
INITIAL CONSULTATIONS .....	21
VALIDATION WORKSHOPS.....	21
<b>STEP 4: ALIGNMENT OF INTEGRATION PROCESS WITH NDC AND OTHER SECTOR TARGETS ..</b>	<b>22</b>
<b>STEP 5: SECTOR ANALYSIS FOR MITIGATION.....</b>	<b>23</b>
SECTORAL STRATEGIES AND PLANS FOR THE COOLING SECTOR .....	25
<b>STEP 6: DEVELOPING A GHG INVENTORY FOR THE NEW SECTOR.....</b>	<b>27</b>
<b>STEP 7: DEFINE MITIGATION CONTRIBUTION TO THE NDC (UNCONDITIONAL/ CONDITIONAL TARGETS) .....</b>	<b>30</b>
<b>STEP 8: IDENTIFYING THE ENTRY POINT OF NEW SECTOR IN THE NDC.....</b>	<b>33</b>
<b>STEP 9: DEVELOPING THE MRV FRAMEWORK FOR THE NEW SECTOR .....</b>	<b>35</b>
<b>STEP 10: REGULAR ANALYSIS AND ENHANCEMENT OF TARGETS .....</b>	<b>37</b>
<b>REFERENCES.....</b>	<b>39</b>
<b>ANNEX A.....</b>	<b>41</b>



### Acknowledgements

This report was developed as part of the project "Establishing Access to Sustainable Cold Chains in Ethiopia" funded by the Clean Cooling Collaborative, an initiative of ClimateWorks Foundation.

### Disclaimer

Perspectives Climate Research prepared this research report, and it reflects the independent views of the authors who take sole responsibility for the information presented in this research report, as well as for any errors or omissions. Neither Perspectives Climate Research nor sponsoring organizations can be held liable under any circumstances for the content of this publication. The cover image is AI-generated and intended for illustrative purposes only. It does not depict real individuals, locations, or events, and any resemblance is purely coincidental. While generated from AI-trained patterns, efforts have been made to avoid copyrighted content.

### Figures

Figure 1: Overview of a roadmap for integrating a new sector into an NDC.....	7
Figure 2. The cooling sector in Seychelles’ updated NDC .....	10
Figure 3. Overview of the process to integrate the cooling sector into an NDC .....	11
Figure 4. Overview of relevant policy documents for Ethiopia's NDC updates .....	16
Figure 5. Illustration of cooling mitigation activity impacting other sectors in NDC and Kigali Amendment timelines .....	23
Figure 6. Overview of RAC sub sectors .....	28
Figure 7. Example figure illustrating BAU and mitigation scenarios in the identified sector .....	32

### Tables

Table 1: Mitigation and Adaptation targets of Ethiopia's first NDC.....	13
Table 2: Key government stakeholders for sector integration in Ethiopia’s NDC .....	18
Table 3: Key stakeholders for the RAC sector in Ethiopia.....	18
Table 4: Non-government stakeholders relevant for the RAC/dairy sector in Ethiopia .....	20
Table 5. Potential data requirements for designing the RAC GHG inventory (applicable to all cooling sub sectors depending on data availability).....	30

### Abbreviations

10YDP	Ten-Year Development Plan
ACs	Air Conditioners
BAU	Business as Usual
CRGE	Climate-Resilient Green Economy
EEA	Ethiopian Energy Authority
EPA	Environment Protection Authority
ETF	Enhanced Transparency Framework
FAO	Food and Agriculture Organization
GCF	Green Climate Fund
GHG	Greenhouse Gas
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
HPMP	HCFC Phase-out Management Plan
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ITMOs	Internationally Transferable Mitigation Outcomes
KPIs	Key Performance Indicators
LDI	Livestock Development Institute
LT-LEDS	Long Term Low Emission Development Strategy
MEPS	Minimum Energy Performance Standards
MoA	Ministry of Agriculture
MoPD	Ministry of Planning and Development
MoTRI	Ministry of Trade and Regional Integration
MoWE	Ministry of Water and Energy
MRV	Monitoring, Reporting and Verification
NCAPs	National Cooling Action Plans
NDC	Nationally Determined Contribution
NGO	Non-governmental Organization
ODS	Ozone Depleting Substances
PEA	Petroleum and Energy Authority
RAC	Refrigeration and Air Conditioning
UNFCCC	United Nations Framework Convention on Climate Change

## Executive Summary

The objective of this report is to guide Ethiopian government entities on integrating the cooling sector into Ethiopia's Nationally Determined Contributions (NDC). Integrating new sectors and expanding the scope of an NDC is crucial and is a demonstration of enhanced ambition expected from countries as they update their respective NDCs. It is also meant to advance climate mitigation and adaptation strategies and potentially unlock climate financing and carbon market opportunities.

This report outlines the required steps and processes in form of a roadmap to successfully incorporate a new sector into an existing NDC framework. This roadmap builds on experience from the authors in working on NDC implementation plans and NDC enhancements. It is further based on a literature review as well as the work conducted in the context of the project "*Establishing Access to Cold Chains in Ethiopia*".

The roadmap was developed in a way that it can be used as a guidance for integrating any new sector into a NDC, but at the same time be specific to the Ethiopian context. The cooling sector in Ethiopia is used as a case study throughout the report to describe certain steps and implications in an exemplary and practical way. Each step of the roadmap consists of a general description that would be relevant for any sector to be newly integrated in the NDC. In addition, text boxes within each step highlight specific features for the sub-sector of milk cooling in Ethiopia. This helps to further clarify the more general steps with a stronger practical relevance and to incorporate experiences gained during the project work. The sub-sector milk-cooling was chosen as it was identified as an important sub-sector of the Ethiopian cooling sector. As a result, a comprehensive roadmap for integrating the cooling sector into the next update of Ethiopia's NDC is provided.

Even though the roadmap can be applied and transferred to any other sectors or country, it is important to note that sector- and country-specific aspects would need to be considered.

The 10 steps outlined in the roadmap are listed below and are illustrated in Figure 1.

1. **Policy analysis:** understand existing NDC-related policies and review the NDC update cycle in the country, including gathering baseline information relevant to the respective sector.
2. **Mapping of key stakeholders:** stakeholders relevant to the NDC update process and the new sector to be integrated to be identified and mapped.
3. **Stakeholder consultations:** will be conducted throughout the process, tailored to the relevance and stage of sector integration. Initially, they will focus on identifying key processes and responsibilities (incl. data gathering), followed by validation consultations or focus group discussions to refine mitigation targets and sectoral contributions, ensuring an inclusive and efficient process.

4. **Alignment of integration process with NDC and other sectors:** the integration of a new sector should be in line with any existing national climate policy and mitigation targets, NDC targets or relevant international frameworks. This ensures consistency with the overall NDC and national sector strategies. Additionally, investigating potential overlaps or synergies with other sectors is important.
5. **Sectoral analysis for mitigation:** entails performing a thorough sectoral policy review including sectoral plans to identify potential mitigation measures based on existing barriers, market trends, mitigation cost and potential. Additionally, investigate potential overlaps or synergies with other sectors.
6. **Developing a GHG inventory for the new sector:** establish a sector-specific GHG inventory, using primary data from surveys and secondary data sources. This step is critical for understanding trends of GHG emissions and mitigation opportunities within the sector.
7. **Define mitigation contribution:** based on the GHG inventory and selected mitigation measures relevant to the country context, design sector-specific mitigation targets that align with national and international commitments.
8. **Identify the entry point of the new sector:** After setting the targets, the new sector's contribution can be integrated into the NDC either as a standalone sector or within existing sectors like energy and IPPU (Industrial Processes and Product Use), ensuring that there is no double counting of emissions.
9. **Development of a MRV framework:** establishment of a comprehensive MRV framework for tracking sector progress, aligned with UNFCCC (United Nations Framework Convention on Climate Change) guidelines and country's existing broader MRV systems.
10. **Regular analysis and enhancement:** By analyzing progress through the MRV, mitigation measures and targets can be regularly reviewed and updated to reflect changes in market trends, technological advancements, international cooperation, and local circumstances. This may involve introducing new mitigation measures or revising existing ones.

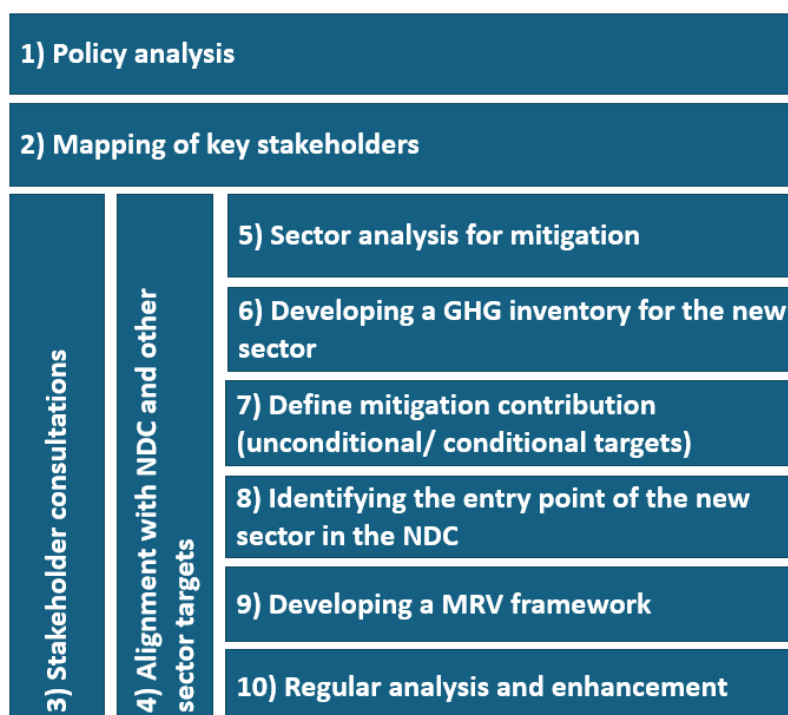
### Key takeaways for Ethiopia

In the context of Ethiopia, the following key take-aways should be considered when integrating a new sector, especially the cooling sector, into a future NDC update.

- **Creating awareness:** Establishing a structured stakeholder consultation process, involving relevant government entities, local communities, and private sector actors, ensures that essential data is captured, and stakeholders are made aware of the importance and relevance of the NDC integration process.
- **Stakeholder engagement:** Engaging partners on the ground to collect primary data and validate secondary data (if needed), particularly in the milk-cooling sector, will be essential to developing a robust sectoral strategy and ensuring MRV compliance in context of Ethiopia.

- **Developing a strong and dynamic MRV system:** Ministry of Planning and Development (MoPD) should act as the primary custodians for the MRV framework, collecting data from relevant ministries and local partners. MRV in context of Ethiopia can potentially include the development of centralized databases for tracking refrigerant use, cooling appliance imports/exports, and reporting mitigation specific project activity progress.
- **Mitigation target alignment:** The report highlights the importance of aligning the targets of cooling sector with international agreements such as the Paris Agreement, the Montreal Protocol, and its Kigali Amendment. For example, the cooling sector targets should be aligned with HFCs phaseout timelines of the Kigali Amendment for Ethiopia.
- **Leveraging international funding:** Given Ethiopia's commitment to the Cooling Pledge at the COP 28 and the rise in cooling-related emissions, developing specific cooling targets and integrating them into the NDC will help attract climate finance and carbon market opportunities, in Ethiopia.

Integrating cooling into the NDC allows countries to identify alternatives to expanding high-emission cooling technologies by defining and implementing appropriate mitigation measures, set targets, and secure funding opportunities while formulating relevant policies. Beyond reducing emissions and achieving NDC targets, NDC-integrated cooling targets facilitate the transition to sustainable cooling, providing additional co-benefits such as enhanced productivity through improved thermal comfort, better food security, and improved healthcare access. These co-benefits contribute to the broader achievement of sustainable development goals.



**Figure 1: Overview of a roadmap for integrating a new sector into an NDC**

## Introduction & Context

The Paris Agreement, adopted in 2015, is an international treaty aiming to limit global warming to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels. Nationally Determined Contributions (NDCs) are central to the implementation of the Paris Agreement. They represent the efforts by each country to reduce national emissions and adapt to the impacts of climate change. Countries are required to submit their NDCs every five years, outlining the actions they plan to meet their climate goals. These goals vary by country but typically include targets for reducing greenhouse gas (GHG) emissions and strategies for adaptation to climate impacts. NDCs must be transparent, communicated to the public, and progressively economy-wide and more ambitious over time to reflect growing international efforts to combat climate change. The next round of NDC updates is scheduled for 2025.

Among the various sectors included in a country's NDC, cooling (or refrigeration and air conditioning - RAC) sectors are particularly crucial due to the high global warming potential (GWP) of cooling agents. However, they are often not included at all or only to a very limited extent in current NDCs, which typically include CO<sub>2</sub>, methane, and N<sub>2</sub>O, but often not yet the hydrofluorocarbons used as cooling agents. The cooling sector encompasses energy and refrigerant usage for space cooling in commercial buildings and residential homes, transport cooling, commercial refrigeration, industrial refrigeration, and transport refrigeration. All these subsectors collectively comprise the cooling sector. In this document, the terms "RAC" and "cooling" are used interchangeably. There are several reasons why countries have limited or no integration of cooling into their NDCs. One factor is that refrigerants, which not only have a high GWP but are also harmful to the ozone layer, have so far been regulated primarily under the Montreal Protocol and the Kigali Amendment. The authorities responsible here are often different from those responsible for the NDC. Another reason is the frequent lack of data to compile comprehensive GHG inventories for the sub-sectors relevant to cooling (an important prerequisite for integration into an NDC). In some NDCs, the cooling sector is only included indirectly, namely in cases where energy efficiency measures are taken into account, e.g. for air-conditioning or refrigeration. In these cases, however, it is only the emission reductions due to energy savings that are considered. With a few exceptions, emission reductions through the replacement or avoidance of climate-damaging refrigerants are not included in NDCs.

Including the cooling sector in an NDC can help reduce relevant GHG emissions and transform the sector sustainably. Having the cooling sector reflected in the NDC implies that information about the major emission sources is known. In addition, the mobilization of (international) financial resources may be better enabled, and mitigation measures be implemented and monitored in a targeted manner. For most international climate finance providers and most relevant carbon markets (incl. Article 6 under the Paris Agreement), an alignment with the host country NDC is essential.



Ethiopia's NDC addresses energy efficiency and recognizes the cooling sector as a potential area for future consideration. The government has yet to operationalize this by including HFCs from the cooling sector or other specific targets for the cooling sector (GoE, 2021a) in upcoming NDC update cycles. Concurrently, the Paris Agreement specifies that NDCs should gradually expand to have an economy wide scope. Therefore, the focus of any potential future NDC enhancement should be on the sectors with the highest need for sustainable cold chains, such as agriculture, health, industry, and transport sectors. Including the cooling sector to Ethiopia's NDC will not only reduce emissions and enhance energy efficiency, but it could also be a driver of introducing advanced technologies to the country to strengthen food security, improve the population's well-being, and boost economic growth.

In recent years, sustainable cooling has gained significant momentum related to climate change. Sustainable cooling aims to minimize environmental impact by using energy-efficient cooling systems or renewable energy sources to reduce electricity consumption and by using refrigerants with low GWP to further decrease overall greenhouse gas emissions. At the 28<sup>th</sup> Conference of the Parties to the Paris Agreement, over 60 countries came together and signed the "Cooling Pledge" (UNEP 2023). This initiative aims to mitigate rising cooling demand by raising ambition and enhancing international cooperation through collective global targets: reducing cooling-related emissions by 68% from today by 2050, significantly increasing access to sustainable cooling by 2030, and improving the global average efficiency of new air conditioners (ACs) by 50% by 2030 (UNEP 2023). Considering that Ethiopia is also a signatory to this pledge, this is an opportune time to integrate cooling into its NDC. Doing so will validate and reinforce the Global Cooling Pledge.





To integrate the cooling sector in a country's NDC, it is crucial to align emission reduction targets and reporting with international commitments outlined in the above-mentioned Montreal Protocol and the Kigali Amendment. The Montreal Protocol is a multilateral agreement regulating to the phase out of ozone depleting substances such as hydrochlorofluorocarbons (HCFCs). Hydrofluorocarbons (HFCs) have been promoted as alternative refrigerants under the Montreal Protocol with lower ozone depletion potential. They are, however, strong drivers of climate change with a high GWP. With the adoption of the Kigali Amendment, it was decided to internationally phase-down HFCs. For developing countries, this process will begin in the late 2020s with baselines determined in the early 2020s and will be finalized by 2040. At the same time, this schedule should inform the NDC baseline setting regarding HFC mitigation. This is crucial to prevent perverse incentives that might keep the production of HFCs high. Additionally, Monitoring, Reporting and Verification (MRV) systems and data reporting under the Kigali Amendment and Paris Agreement need to be harmonized to ensure that HFC emission reporting under the Kigali Amendment is reflected in NDCs accordingly (Michaelowa et. al 2019).

The objective of this report is to raise awareness for the potential of integrating the cooling sector in Ethiopia's NDC, by providing recommendations and guidance to policymakers on how to approach this process in a 10-step roadmap. The process commences with a policy analysis (step 1) and stakeholder mapping (step 2) followed by considerations regarding ongoing stakeholder engagement

(step 3). Step 4 ensures that the process of integrating the new sector considers international frameworks, existing NDC targets and other sector targets. This is followed by a comprehensive sector analysis (step 5) and the development of a GHG inventory for the new sector (step 6). Afterwards the mitigation contributions are defined (step 7). Step 8 outlines considerations on identifying the entry point in the NDC followed by step 9 highlighting the development of an MRV framework. Finally step 10 comprises regular analysis and enhancement of the newly integrated sector in the future.

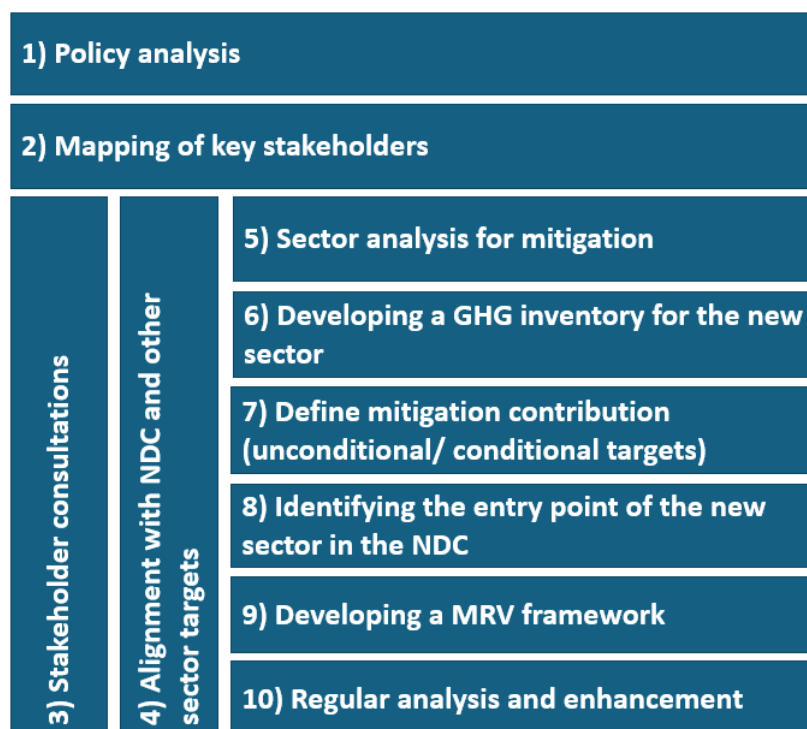
## Step-by-step guide for cooling sector integration into a NDC

Recognizing the global challenge of providing access to cooling while reducing GHG emissions, many countries have started acknowledging sustainable cooling as a critical (sub)sector to be included in their NDCs. Some countries have outlined specific mitigation measures for reducing climate impacting refrigerants (e.g. HFCs) while others have considered energy efficiency measures to reduce cooling energy demand in the cooling sector. About 70% of the currently available NDCs include HFCs as greenhouse gas (Lassmann and Michaelowa 2021). African countries such as Ghana, Seychelles, Namibia and Kenya have successfully integrated the cooling sector into their NDCs and can serve as best practice examples for other countries to follow. An example of the Seychelles is provided below in Figure 2.

	Dedicated section for Refrigeration and Air conditioning sector in the NDC of Seychelles
	Identified sub-sectors: <ul style="list-style-type: none"> <li>• Split air conditioners</li> <li>• Domestic refrigerators</li> <li>• Stand-alone refrigerators (commercial refrigeration)</li> </ul>
	Mitigation measures identified: <ul style="list-style-type: none"> <li>- Incentivize transition to low GWP refrigerants</li> <li>- Staggered levy system</li> <li>- VAT exemptions</li> <li>- Ban on high GWP refrigerants from 2025 in domestic and commercial refrigerators</li> <li>- Ban on high GWP refrigerants from 2030 in split ACs</li> <li>- Developing MEPS and labels for cooling equipment</li> <li>- Capacity building programmes for RAC technicians and custom officials</li> </ul>
	<ul style="list-style-type: none"> <li>- Total accumulated mitigation potential from Seychelles' cooling sector is projected to be around 80 ktCO<sub>2</sub>e until 2030. The country has committed to reduce absolute GHG emissions in all sectors of the economy by 294 ktCO<sub>2</sub>e by 2030.</li> </ul>

**Figure 2. The cooling sector in Seychelles' updated NDC (Source: Lassmann and Michaelowa 2021)**

To achieve a similar successful integration of a new sector in an NDC, a step-by-step approach is laid out in the following sub-sections. An overview of the steps is provided in Figure 3, and a detailed explanation of each of these steps is provided in the subsequent section. For each step, the general requirements for integrating any new sector into a country's NDC are listed. In addition, specific requirements for integrating the cooling sector are provided in text boxes, highlighting the context of Ethiopia. Breaking down this process considered helpful in delineating funding needs for the NDC update process. It is important to note that these steps are interlinked, and that integrating a new sector into the NDC would be an iterative process. Additionally, capacity building and creating awareness about the relevance of cooling sector within NDC are critical for securing funding and for incorporating the cooling sector into the NDC.



**Figure 3. Overview of the process to integrate the cooling sector into an NDC (Source: authors based on GIZ 2022)**

## Step 1: Policy Analysis

For an integration of a new sector into an NDC, it is crucial to understand the country's context—how the current NDC was developed, which sectors are covered, and what other policies and strategies are directly linked to the NDC, as well as how the NDC enhancement process works in the country. Additionally, the relevant social, economic, political, and legal context of the country should be considered. Countries often align NDC targets and objectives with their long-term national climate strategies, low-emission development strategies, or national and sectoral development plans. This process can vary significantly from country to country and may evolve over time. Therefore, conducting an analysis of the NDC-related policy context is essential for understanding the enhancement process and what needs to be considered when integrating a new (sub)sector. The most relevant policies and plans influencing the NDC development process in Ethiopia are described in the following sub-section.

Ethiopia has successively adopted policies, strategies and plans to address climate change. Among the prominent instruments, the country's NDC, its recent update, and the national economywide policy named the Ten-Year Development Plan (10YDP) (2021-2030) are notable. The historical development of Ethiopia's NDC and related strategies reflect a commitment to sustainable development and climate resilience, significantly impacting various sectors. The following is a short description of the pertinent policies.

### Ethiopia's Climate Resilient Green Economy Strategy

Ethiopia's NDC development process has evolved significantly since the launch of its Climate-Resilient Green Economy (CRGE) strategy in 2011. The CRGE aimed to achieve middle-income status by 2025 while developing a green economy, focusing on agriculture, forestry, renewable energy, and energy efficiency (GoE, 2012). This strategy laid the groundwork for Ethiopia's climate policy framework, setting the stage for future climate commitments and actions, including the NDC and its update as outlined below. In the case of Ethiopia, climate policies, plans, and the NDC are closely interrelated. The CRGE strategy served as the foundation for the NDC, with sectoral policies operationalizing its goals through sector specific measures and practices. The NDC, informed by the CRGE and sectoral plans, formalized Ethiopia's commitments under the Paris Agreement, translating broad policy goals into specific targets. This integrated approach has ensured coherence and synergy in Ethiopia's climate action efforts, facilitating a holistic approach to sustainable development.

### Ethiopia's Nationally Determined Contributions (2017-2021)

In 2015, Ethiopia submitted its Intended NDC ahead of the Paris Agreement, setting an ambitious target to reduce GHG emissions by 64% from the business-as-usual scenario by 2030 (GoE, 2015). This



initial NDC was closely aligned with the CRGE strategy, leveraging its existing framework and priorities to establish clear, measurable climate action goals.

In 2017, Ethiopia submitted its first NDC, reaffirming its commitment to reducing GHG emissions and enhancing climate resilience. It sets a goal of reducing the country's GHG emissions by 64% from the Business-As-Usual (BAU) scenario by 2030. The NDC includes various sectors, including agriculture, forestry, energy, and transport, with a strong focus on mitigation and adaptation strategies. It highlights the importance of sustainable agricultural practices, including the livestock sector, to mitigate climate impacts as outlined in Table 1 (GoE, 2017).

Mitigation	Adaptation
Reduce GHG emissions by 255 MtCO <sub>2</sub> e by 2030	Strengthen the resilience of the agricultural sector to climate impacts
Expand renewable energy production	Cope with rainfall variability and drought
Promote reforestation/ afforestation	Develop early warning systems
Improve energy efficiency across sectors	Improve disaster risk management

**Table 1: Mitigation and Adaptation targets of Ethiopia's first NDC. (Source: GoE, 2017)**

Ethiopia revised its initial NDC in 2021 and submitted it to the United Nations Framework Convention on Climate Change (UNFCCC). The updated NDC has an emissions reduction target of 68.8% by 2030. The implementation of the NDC relies both on national budget (unconditional target) and support from international finance (conditional target). Thus, Ethiopia requires USD 316 billion (whereof 20% are unconditional and 80% conditional financing) until 2030 to achieve its NDC targets. The NDC lays out a range of actions spanning from land use change and forestry, livestock, energy, waste, industry, health, water, transport, urban settlements, and disaster risk reduction (GoE, 2021a). The updated NDC builds upon several national climate policies and initiatives including the CRGE, the Green Legacy Initiative, and Ethiopia's 10-Year Development Plan. Based on all previous policies and plans, the country submitted its first Long Term Low Emission Development Strategy (LT-LEDS) in 2023 with a target of achieving net zero emissions by 2050 (GoE, 2023).

The NDC update process is overseen by the focal organization - the Ministry of Planning and Development (previously the Ministry of Environment, Forest and Climate Change). The process includes document review, data collection, model development and validation, as well as stakeholder consultations. During the previous update cycle (2021) the Intergovernmental Panel on Climate Change (IPCC) 2006 guideline was used for estimating the GHG emissions while the Green Economy Model was employed to project GHG pathways. For the NDC enhancement process, technical work usually includes preparation of updated business-as-usual (BAU) and GHG abatement policy scenarios, setting interim and final NDC targets, prioritization of mitigation interventions, indicator selections and

determining conditional and unconditional policy actions (NDC 2021, page 6). Similar steps are expected to be taken for subsequent update cycles.

### Cooling related mitigation measures under Ethiopia's NDC

The energy sector as part of the updated NDC may have some direct overlaps with the cooling sector, as cooling appliances and services are often using electricity for their operation. The energy sector is projected to contribute 5% of the total BAU emissions in 2030. With its own actions and resources, the Ethiopian government is keen to reduce the sector's emissions. With support from the international community, the government looks to reduce the sector's emissions to a level of 9.5 Mt CO<sub>2</sub>e by introducing policy interventions (GoE, 2021a, p.14).

The updated NDC (2021) partially includes refrigeration and air-conditioning under broader energy efficiency and climate mitigation strategies. As part of the renewable energy strategies in the NDC, supporting the use of sustainable cooling systems across sectors is mentioned (NDC 2021, page 27). Furthermore, the NDC hints at the potential to enhance Ethiopia's NDC ambition through incorporating emissions currently outside the scope of the NDC, especially HFCs in the context of the Kigali Amendment to the Montreal Protocol (GoE, 2021a, p.7).

The NDC highlights the need to improve energy efficiency across sub-sectors including in areas where cooling is typically required. The current NDC recognizes the potential increase in ambition by expanding it to include measures on HFCs, especially where sustainable cooling can promote government priority initiatives and further mitigation potential may become viable due to economic and technology development. Such technological improvements may include specific measures aimed at promoting the use of energy-efficient appliances and phasing out old, inefficient refrigeration and air-conditioning units. The NDC outlines the importance of enhancing efficiency across various livestock subsectors, including dairy (GoE, 2021a, p.13). Additionally, training programs and awareness campaigns are encouraged to promote best practices in energy management. Provisions for expanding renewable energy generation are included in the NDC, indirectly supporting cooling by expanding clean electricity supply as a basis for using sustainable cooling technologies.

### Ethiopia's Ten-Year Development Plan (2021-2030)

Ethiopia's Ten-Year Development Plan (10YDP) (2021-2030) sets forth ambitious targets and key performance indicators (KPIs) for enhancing productivity and sustainability across various sectors, including the dairy sector. The Ministry of Planning and Development (MoPD) is entrusted with the task of evaluating progress towards these targets according to the KPIs.

Both the NDC and the 10YDP share the goal of enhancing the country's economic development while considering sustainability. The NDC provides a climate-focused lens to the broader development objectives of the 10YDP. The climate actions outlined in the NDC are integrated into the 10YDP to ensure that development goals are achieved in close alignment with climate goals and in a sustainable and climate resilient way. Both the NDC and the 10YDP are governed by the MoPD, ensuring close alignment. MoPD seeks to integrate climate actions in their overall government planning, both

vertically and across sectors. For instance, energy sector plans in the 10YDP emphasize renewable energy development and energy efficiency, which are also key components of the NDC. The 10YDP's agriculture focus is on sustainable practices and improved livestock management to reduce emissions which is also a focus of the NDC under the agriculture/ livestock sections. The need for policy coherence and synergy across sectors is clearly spelt out in both documents.

### **Ethiopia's Growth and Transformation Plan**

Ethiopia's Growth and Transformation Plan has been set up in two parts: The first one was planned for the years 2010/11-2014/15, and the second for the years 2015/16-2019/20. With a focus on the second and more recent plan, it drafts the country's strategy for economic and social development towards shifting Ethiopia's economy to become lower-middle-income by 2025. The advancement of agriculture and industrial productivity are at the core of the plan, targeting a fast, broad, and inclusive economic growth. More specifically, infrastructure strengthening, manufacturing growth, and energy production expansion are highlighted as key strategies. A part of the plan builds on the CRGE strategy and has a focus on renewable energy and industrial efficiency towards emissions reduction and adaptation with economic growth, and the goals set in this plan are in-line with the country's NDC goals.

### **Ethiopia's Long-Term Low Emission and Climate Resilient Development Strategy**

Ethiopia's long-term low emission and climate resilient development strategy (2020-2050) is a roadmap, presenting the country's strategy to achieve net-zero emissions and to increase their climate resilience by the year 2050. The strategy aligns Ethiopia's development goals with the goals of the Paris agreement, examining the country's economic development with its climate-focused goals, including considerations for investment needs. It is oriented around different scenarios, including BAU, NDC-alignment and maximum ambitions, and it focuses on multiple sectors including energy, agriculture, and industrial processes among others. The strategy could be considered as a benchmark for future NDC developments, as it involves targets for sectoral emission reductions.

Figure 4 showcases the influences and interrelations of Ethiopia's policies over time and expected future impacts.

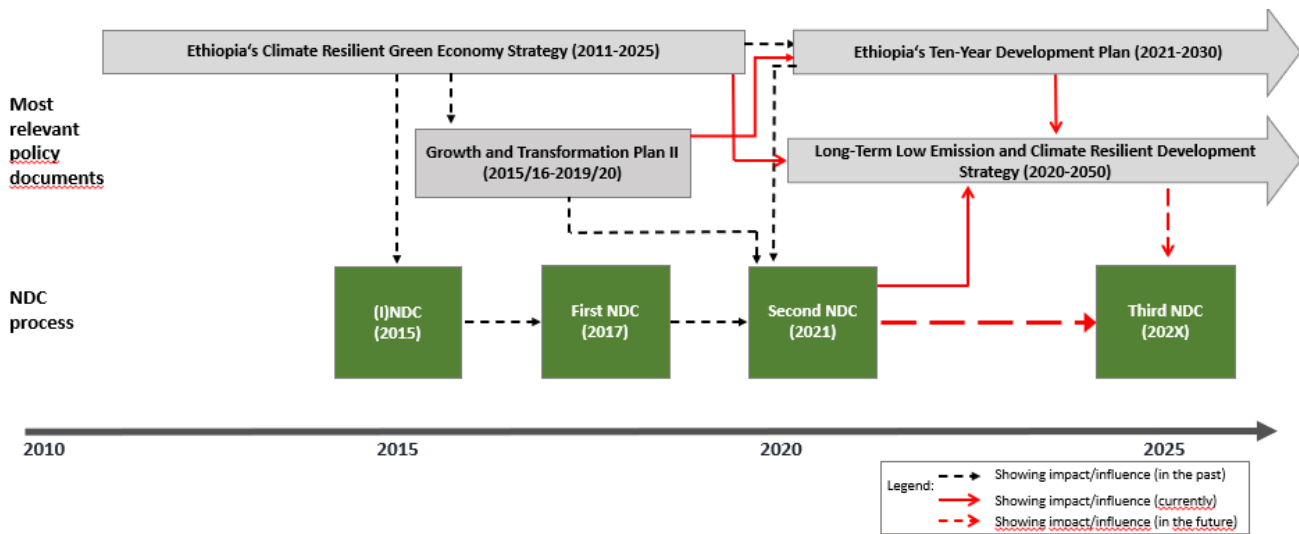


Figure 4. Overview of relevant policy documents for Ethiopia's NDC updates (Source: authors)

## Step 2: Mapping of key stakeholders

NDCs should be designed in a way that key stakeholders support the objectives formulated in the NDC, since the implementation of the NDC and the achievement of the objectives can only take place together with the relevant stakeholders (incl. line ministries). Any NDC enhancement process and integrating a new (sub) sector into the NDC requires consultations and interactions with various stakeholder groups. This includes stakeholders who are directly responsible for the NDC update process, but also stakeholders who are responsible for other relevant climate or development plans and strategies in the country. Sector or sub-sector specific stakeholders should at least be involved in certain stages of the NDC update process (see step 3). This chapter provides an overview of key stakeholders relevant for the NDC update process using the example of the stakeholder landscape relevant for the integration of the cooling sector. Such an overview is essential for understanding who is involved and which entities and organizations should be included in stakeholder consultations to ensure awareness raising and enable the integration of the cooling sector in future NDCs. Depending on which specific sector or sub-sector should be integrated the stakeholder landscape varies.

### Key entities responsible for Ethiopia's NDC (mitigation)

The following table contains key government entities in Ethiopia that are relevant decision-makers with regards to the inclusion of a new sector, such as the cooling sector, in a future NDC update. This encompasses stakeholders that support GHG inventory and provide data for the biennial transparency reporting.



Institution/Entity	Mandate/Responsibility	Role in NDC Updates
<b>Ministry of Planning and Development (MoPD)</b>	<ul style="list-style-type: none"> <li>- Leads Government of Ethiopia's economic and development planning, including overseeing the implementation of 10YDP</li> <li>- Mainstreams climate change considerations into Ethiopia's planning processes.</li> <li>- Prepares, monitors and evaluates development plans and climate action projects to assess their effectiveness and ensure alignment with national goals.</li> <li>- Undertakes training and knowledge sharing initiatives to enhance the ability of sectors to deploy and implement climate resilient practices.</li> <li>- Oversees interministerial coordination committee on climate change.</li> <li>- Coordinates the national GHG inventory process, ensuring that data from various sectors, including the dairy sector is accurately collected, analyzed, and reported.</li> </ul>	Leads and coordinates stakeholders to undertake periodic updates to Ethiopia's NDCs.
<b>Environment Protection Authority (EPA)</b>	<ul style="list-style-type: none"> <li>- Monitors and regulates the implementation of international environmental agreements including Montreal Protocol to which it is also a focal point.</li> <li>- Reviews the Environmental Impact of projects vis-a-vis the national environmental standards.</li> <li>- In coordination with relevant institutions, monitors and regulates technologies that contribute to climate change adaptation and mitigation, are environmentally friendly, and are free from any environmental impacts.</li> <li>- Assists in data generation and analysis to improve the GHG inventory.</li> </ul>	Compliance & Enforcement Directorate under MoPD
<b>Ministry of Finance – CRGE Facility</b>	<ul style="list-style-type: none"> <li>- Leads Government of Ethiopia's climate finance mobilization in support of climate mitigation and adaptation strategies and integrates green economy components into key sectors (including agriculture, energy, and transport).</li> <li>- Ensures effective use of funds through its strategic and responsive windows.</li> <li>- Oversees fund governance through committees for policy guidance, investment plan assessments, and fund allocation.</li> <li>- Acts as an implementing entity of international climate finance sources such as the Green Climate Fund (GCF).</li> </ul>	Mobilizes climate finance from various sources for NDC implementation
<b>Ministry of Agriculture (MoA)</b>	<ul style="list-style-type: none"> <li>- Promotes climate smart agriculture to enhance productivity and reduce GHG emissions.</li> <li>- Strengthens sustainable land management practices to prevent land degradation, improve soil health, and increase carbon sequestration.</li> <li>- Promotes livestock productivity through better feeding practices, improved breeds, and efficient management systems to reduce methane emissions per unit of product.</li> <li>- Promotes high-yielding, drought-resistant crop varieties that require fewer inputs and have lower environmental impacts.</li> </ul>	Collects and reports data on GHG emissions from the agricultural sector to fulfil national and international reporting requirements.

	<ul style="list-style-type: none"> <li>- Fosters afforestation/ reforestation programs to enhance carbon sequestration.</li> </ul>	
<b>Ministry of Water, and Energy (MoWE)</b>	<ul style="list-style-type: none"> <li>- Promotes watershed management projects to enhance water availability, reduce soil erosion, and improve groundwater recharge.</li> <li>- Invests in the expansion of irrigation infrastructure to support climate-resilient agriculture and reduce the dependency on rain-fed farming.</li> <li>- Leads the development and implementation of renewable energy projects, including hydroelectric, solar, wind, and geothermal energy, to reduce GHG emissions from the energy sector.</li> <li>- Promotes energy efficiency measures in industrial, commercial, and residential sectors to reduce energy consumption and associated emissions.</li> </ul>	Collects and reports data on GHG emissions from the energy sector to fulfil national and international reporting requirements.

**Table 2: Key government stakeholders for sector integration in Ethiopia's NDC**

### Key RAC related entities in Ethiopia

The following stakeholders will be directly or indirectly affected by NDC targets related to the RAC sector and should be consulted periodically. Their input can provide valuable insights and expertise regarding the RAC sector. In addition, consultations should be held to ensure alignment between NDC and cooling sector related policies, development and mitigation targets and measures, and processes (e.g. on reporting).

<b>Institution/entity</b>	<b>Mandate/ responsibility</b>	<b>Role in NDC updates</b>
<b>Environment Protection Authority's (EPA's) National Ozone Unit</b>	National implementing body that coordinates the implementation of the country program for the phase out of ozone depleting substances (ODS).	Consult to ensure alignment with Montreal Protocol and Kigali Amendment
<b>Customs and Revenue Authority</b>	Enforces the control measures on imports and exports of controlled substances.	Provision of data on import and exports (e.g. of refrigerants)
<b>Ethiopia Standard Agency</b>	Conduct periodic monitoring inspections of importers and distributors of refrigerants to ensure compliance.	
<b>Petroleum and Energy Authority (PEA)</b>	PEA as a regulatory institution oversees the energy sector, including the promotion of renewable energy sources. It plays a role in ensuring that energy use across sectors (including the dairy sub-sector) is sustainable and contributes to lower GHG emissions. It sets Minimum Energy Performance Standards (MEPS) for cooling appliances and monitors implementation by stakeholders.	Energy Efficiency & Conservation Directorate
<b>Ministry of Trade and Regional Integration (MoTRI)</b>	Controls the issuance of import/export licenses (including equipment import licenses). Collaborates with Ethiopian Standard Agency with regards to inspection of equipment to ensure quality and safety of appliances.	

**Table 3: Key stakeholders for the RAC sector in Ethiopia**

### Non-government stakeholders engaged in the RAC and dairy sector

Not only government officials play a crucial role in updating a countries NDC. (International) civil society, academia, private sector, and others are vital in informing NDC updates and providing data and expertise to the process. Allowing broad stakeholder engagement is important to ensure that the NDC integration process is informed by the latest national (and international) expertise. In addition, this helps to ensure that after successful inclusion of new sector in the NDC, suggested measures will be funded, implemented, and monitored.

Institution/Entity	Mandate/ Responsibility
<b>Agricultural Research Institute</b>	Conducts research on agricultural practices, including dairy farming, and provides data on emissions from livestock and dairy operations.
<b>Chamber of Commerce and Sectoral Associations</b>	<ul style="list-style-type: none"> <li>- Promotes Ethiopian products and attracts foreign direct investment to foster a vibrant private sector environment.</li> <li>- Works to provide code of conduct for refrigeration technicians and assists the National Ozone Unit in data collection in the RAC sector from importers and main distributors in the country.</li> <li>- Assists to raise awareness and capacity building to customers and members of the association on the harmful effects of Ozone Depleting Substances (ODS) refrigerants to human health and the environment, and to the refrigeration sector on how to reduce consumption and emission of ODS.</li> </ul>
<b>Commercial Milk Producers Association</b>	<ul style="list-style-type: none"> <li>- Addresses the needs and challenges of the dairy farmers, with the aim of improving dairy production, promoting the interests of dairy farmers and enhance the quality and marketability of dairy products in Ethiopia.</li> <li>- Prominent dairy companies that are members include: Elemtu Integrated Milk Industry, Lame Dairy, Sebeta Agro Industry, Bora milk, Hibret Dairy Producers marketing Cooperative and Jacaranda Integrated Agro-industry.</li> </ul>
<b>Livestock Development Institute (LDI)</b>	Focuses on the development and modernization of the livestock sector, providing critical data and support for improving livestock management practices, which are essential for accurate GHG inventory and emission reduction strategies in the dairy sector.
<b>Environment and Forest Research Institute</b>	Provides research and data on land use, forestry, and environmental changes, which are relevant to understanding emissions from dairy farming and food production.
<b>Agricultural Transformation Agency</b>	Works to improve agricultural productivity and sustainability. It provides support and data for best practices in dairy farming that can reduce GHG emissions.
<b>Ethiopian Statistical Service</b>	Collects statistical data on agricultural production, including livestock and dairy farming.
<b>National Meteorological Institute (NMI)</b>	Provides essential climate and weather data that help model and understand the environmental conditions affecting dairy farming.
<b>Non-governmental organizations (NGOs) and development partners</b>	NGOs such as SNV Netherlands Development Organization, Solidaridad and Heifer International work on projects related to sustainable dairy farming practices and provide data and support for emissions reduction initiatives.
<b>Academia</b>	Institutions such as Debrezeit Veterinary Institute, Addis Ababa University and Haramaya University conduct research on dairy farming practices and their environmental impacts, contributing to data collection and analysis for the GHG inventory.

<b>International Livestock Research Institute</b>	Conducts research on livestock management and health, providing valuable insights into reducing GHG emissions from the dairy sector. It collaborates with local and international stakeholders to develop and promote sustainable livestock practices.
<b>International Fund for Agricultural Development</b>	Supports projects aimed at improving agricultural productivity and sustainability, including those in the dairy sector. It provides funding, technical assistance, and policy support to enhance dairy farming practices and reduce GHG emissions.
<b>Private sector organizations</b>	Dairy processing companies, cooperatives, and individual dairy farmers provide data on production practices and engage in initiatives to reduce their carbon footprint.
<b>Multilateral organizations (e.g.: FAO and World Bank Group)</b>	Organizations such as the United Nations Food and Agriculture Organization (FAO) and the World Bank Group provide technical assistance, funding, and support for projects aimed at improving sustainability in the dairy sector and reducing GHG emissions.

**Table 4: Non-government stakeholders relevant for the RAC/dairy sector in Ethiopia**

## Step 3: Stakeholder consultations

The process of developing and updating NDCs involves consultation with a wide range of stakeholders, including local governments, businesses, civil society, and communities. This engagement ensures that NDCs are inclusive and reflect the needs and priorities of different sectors within the country, fostering collaboration and ownership of climate action.

NDCs are critically important for stakeholders in any country for several reasons:

- NDCs are at the heart of the Paris Agreement and outline a country's climate action plans, including targets for reducing greenhouse gas emissions and climate resilience efforts. These plans provide a clear framework for stakeholders, such as government agencies, businesses, and civil society, to align their actions toward national and global climate goals.
- For stakeholders like businesses, NDCs create policy certainty by establishing long-term government commitments to climate action. This predictability helps companies plan investments, adopt sustainable technologies, and shift towards low-carbon practices. It reduces the risk associated with sudden regulatory changes.
- NDCs often include commitments to transition toward green energy, improve energy efficiency, and promote sustainable practices, which open new economic opportunities.
- Countries with ambitious and well-structured NDCs may attract international climate finance, technical assistance, and support from development organizations. Stakeholders benefit from these financial flows, which can enhance capacity building, technological innovation, and infrastructure development.
- A country's NDC reflects its commitment to global climate agreements, such as the Paris Agreement. Strong and effective NDCs enhance the country's international reputation and show leadership in addressing climate change. This can lead to stronger diplomatic ties and influence in global climate negotiations.



Overall, NDCs provide a roadmap for national climate action, guiding key stakeholders in making informed decisions that contribute to both sustainable development and the global fight against climate change. Stakeholder consultations are required throughout the whole process of integrating a new sector in the NDC. Below, the most crucial stakeholder interactions are described:

### Initial consultations

Before starting the NDC integration process, it is important to create general awareness among stakeholders most relevant for the NDC enhancement process and the sector to be integrated. Informing them about the relevance of including the sector in the NDC may be one objective besides gaining further insights into the process of NDC enhancement including understanding responsibilities and timelines. To ensure political buy-in, it is recommended to conduct an initial stakeholder consultation with relevant government decision-makers. An initial overview of relevant stakeholders for the NDC enhancement process and the cooling sector of Ethiopia is provided under *Step 2: Mapping of key stakeholders*. The consultations can help to identify relevant sub sectors along with the tentative timelines for the NDC-update process and discuss any potential challenges that might arise during the process. Additionally, this workshop might serve as a platform to showcase best practices from other countries in integrating the sector, to identify suitable funding sources for the process, and to ensure support from stakeholders, which is vital in ensuring the successful integration of a new sector into the NDC.

### Validation workshops

It is important to inform the stakeholders regularly throughout the whole process of integrating a sector into the NDC. For certain milestones, validation workshops are recommended to be held, to engage with key stakeholders, receive feedback and ensure alignment with stakeholder expectations and priorities. Validation workshops are considered relevant during various stages, to present the results of e.g. the assessment carried out in steps 1 to 4. Related to the cooling sector, findings would be presented including potential mitigation measures, mitigation scenarios, and identified cooling sector targets (conditional and unconditional). Validation workshops can create enhanced awareness about the entire process and importance of the cooling sector in a country specific context and seek validation from relevant stakeholders about the findings. The feedback collected from stakeholders is used to refine the mitigation measures, mitigation scenario, and final targets. Finally, the workshop could discuss tentative roles and responsibilities of key stakeholders in implementing the respective mitigation measures for reaching the target along with the indicative timelines. In addition, as a later stage main parameters that need to be reported for developing the GHG inventory and measuring the progress of NDC targets can be addressed (see also *Step 9: Developing the MRV framework* for the new sector).

## Step 4: Alignment of integration process with NDC and other sector targets

It is crucial to understand any potential interactions or overlaps of the new sector with other sectors or sub-sectors of the NDC to ensure that the new sectoral targets are aligned with the overall NDC and do not contradict any overarching international frameworks. Apart from aligning the mitigation targets between sectors, any implication of these on adaptation should be examined to ensure alignment with adaptation targets and harness potential co-benefits. This involves closely mapping any potential linkages between mitigation activities, measures, or targets of the new sector and the targets of other (sub)sectors. In cases of interaction, the targets for these sectors should be adjusted accordingly, based on the extent and type of impact. If it is difficult to estimate the potential impact of these interactions, they should still be acknowledged and monitored through the MRV framework (see *Step 9: Developing the MRV framework* for the new sector). This allows for refinement and better integration of the targets later, as synergies from different sectors can help design more cohesive and aligned NDC targets. To address any information or data gaps regarding these linkages, relevant stakeholder consultations may be conducted as necessary. In the next section, steps for aligning the cooling sector with other sectors are defined. Similar steps can be applied to any other sector that needs to be integrated within the NDC.

### Alignment of cooling sector targets

Most mitigation measures in the cooling sector have a direct impact on the quantity and type of refrigerants. Since the monitoring and mitigation of HCFC and HFC-based refrigerants is carried out under the MP or KA, close coordination is required with the MP/KA when integrating the cooling sector into the NDC. This coordination relates to the exchange of information between the different stakeholders, the alignment between existing and planned sector plans, strategies and mitigation targets, as well as the sources of funding and the MRV.

Any cooling sector specific mitigation activities proposed for being included in the NDC (conditional and unconditional), should be closely aligned with phase-out/phase-down plans for HCFC and HFC under the MP/KA. At the same time such phase-down pathways should be aligned to national climate change strategies/plans and to the NDC targets. For example, if there are specific targets mentioned in the NDC for RAC sector, those need to be considered while developing the HCFC/HFC pathway. Moreover, it is crucial to consider the refrigerant phase-out timelines for respective countries while devising the mitigation pathways under the NDC. For instance, consider adhering to respective HCFC and HFC phase-out timelines under the MP and KA while developing more ambitious mitigation scenarios for the cooling sector.

Besides aligning between NDC and MP/KA, it may be relevant to align closely to other sectors that overlap with the cooling sector. Mitigation measures and targets in the cooling sector often have close linkages with other sectors, especially the energy sector. For example, energy efficiency targets in the energy sector can influence the energy efficiency and type of equipment used for cooling (e.g. air conditioners, refrigerators). The increase in renewable energy-based power generation would lead to lower energy related emissions from electricity-based cooling appliances.

The potential impact of mitigation targets on adaptation should also be explored. Cooling measures can directly affect adaptation by reducing food loss through cold chains, decreasing heat stress, and preventing deaths during high temperatures through efficient space cooling. These measures can ultimately improve health, conserve energy resources, and save money that would otherwise have been spent on adaptation efforts. In general, the successful implementation of mitigation measures will have a positive effect, reducing the need for adaptive actions and, consequently, lowering the resources or budget required for adaptation.

Related to the milk-cooling sector, solar-powered milk cooling for small-farmers may impact various sectors. An example of how a mitigation activity in a cooling subsector (milk cooling) can potentially impact different sector targets is shown in Figure 5. Similarly, it is advisable to assess how each cooling mitigation measure and target interacts with other sectors and explore synergies that can be utilized to iteratively design the NDC targets for all sub sectors of the cooling sector

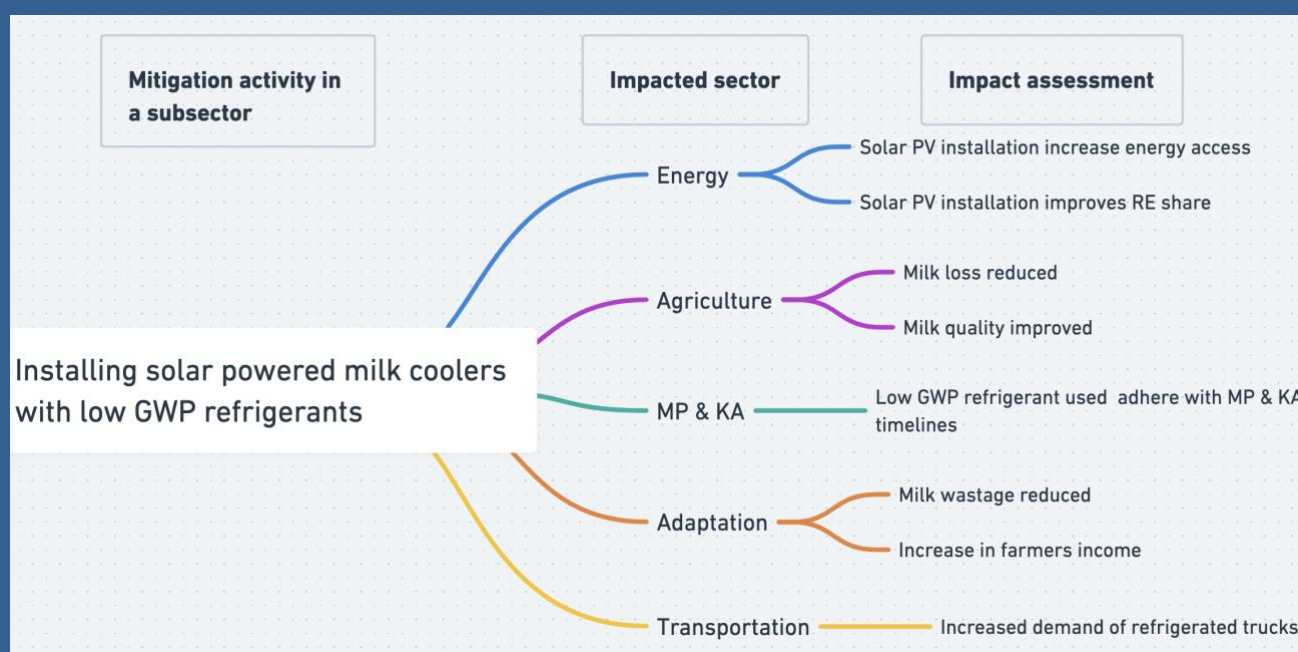


Figure 5. Illustration of cooling mitigation activity impacting other sectors in NDC and Kigali Amendment timelines (Source: authors)

## Step 5: Sector analysis for mitigation

The objective of this step is to create a comprehensive overview of the new sector through existing secondary literature and potentially stakeholder consultations wherever deemed necessary. The sector's boundaries should be clearly defined, identifying the relevant subsectors within it, major GHG sources associated with these subsectors, data sources, potential mitigation measures, and their mitigation potential. An overview of this process is provided below:

- Identify sector boundary and subsectors:** Conduct an in-depth sector analysis to understand the sectoral policies, demand projections for the sector, sector boundary and the various subsectors within it. All these subsectors should be outlined as this will help in developing a

detailed GHG inventory in the next step (see also *Step 6: Developing a GHG inventory for the new sector*).

- **Identify GHG sources and data sources:** Within the sector (and subsectors), GHG sources should be identified, categorized from high to low intensity, and relevant data sources earmarked. Stakeholder consultations may be conducted to verify the critical GHG sources and associated data sources, which will be further complemented during the GHG inventory development phase (see also *Step 3: Stakeholder consultations*).
- **Identify potential mitigation measures:** For each prioritized subsector, the mitigation potential, and associated costs should be evaluated based on current market trends and barriers to identify potential mitigation measures. From the potential measures, a thorough analysis will be conducted to select suitable measures considering country's local context and government priorities. These selected measures will be used to develop mitigation targets and contributions to the NDC (see also *Step 7: Define mitigation contribution to the NDC* (unconditional/conditional targets). General factors that should be considered when identifying potential mitigation measures in context of cooling are listed below.
  - 1) *Technology assessment:* assess the types of cooling/refrigeration technologies and measures currently used in each sector and identify which potential technologies or measures can reduce emissions.
  - 2) *Understanding market trends and barriers:* after identifying the potential technologies and measures, it is required to critically analyze the current situation, market trends and challenges associated with the identified potential measures in the sector. These could be regulatory (e.g., poor implementation of regulations), financial (e.g., lack of access to capital, low budget allocated, limited access to climate finance or carbon markets), technical (e.g., non-availability of efficient technology in-country), lack of market and societal challenges (e.g., low awareness among users, low affordability).
  - 3) *Mitigation potential and cost:* the mitigation potential of measures and the corresponding costs (in USD or local currency/tCO<sub>2</sub>e) needs to be considered. If the cost of introducing a measure is too high, then the mitigation potential from the measure could be limited. Efforts should be made to identify suitable low-hanging fruits (like minimum energy performance standards (MEPS) for RAC sector, adhering to timelines for HFC phase-down and HCFC phaseout) which have lower associated mitigation costs. Access to the carbon markets, and climate finance should be considered for implementing measures that can achieve high hanging fruits with higher associated mitigation costs.

### Potential mitigation measures for Ethiopia's cooling sector

- MEPS and labelling program for cooling and refrigeration equipment
- Tax rebates for efficient cooling equipment especially for solar powered milk coolers.
- Accessing climate finance through Article 6.2 and other funders (like mitigation action facility, green climate fund etc.)
- Using bulk procurement to aggregate demand for cooling equipment (for example in real estate, commercial buildings, milk cooling) and to reduce the initial cost of efficient cooling solutions by purchasing efficient cooling appliances in bulk.
- Capacity building for RAC technicians, including training them on the best practices for maintenance, commissioning, and installation, would help reduce operational emissions from RAC equipment.
- Establishment of refrigerant reclaim facilities in combination with mandatory regulations to ensure proper handling (GIZ 2022)

### Sectoral strategies and plans for the cooling sector

Additionally, to economy-wide plans and strategies, Ethiopia specifies targets and goals in sectoral strategies. Those documents provide an important basis to ensure alignment between new sector targets in the NDC with existing plans. For this report, the national policy frameworks for cooling related sectors are especially relevant.

#### National plans under the Montreal Protocol and Kigali Amendment

The government of Ethiopia has adopted an HCFC Phase-out Management Plan (HPMP) in reaction to the country's response to the Montreal Protocol and its Kigali Amendment. The Stage I HCFC phase out management plan for Ethiopia was approved in December 2012. The HPMP Stage-II was approved in December 2021. The government is committed to phase down net imports of all HFCs. As a result, Ethiopia drafted the National Ozone Depleting Substance and Hydrofluorocarbons Management strategy in 2021 (GoE, 2021b).

The Plan identifies its key objectives to attain ozone and climate benefits through the implementation of integrated plans for reducing HCFCs consumption in the RAC sector, as well as to promote the adoption of ozone-friendly and energy efficient technologies in Ethiopia. Stage I of the plan aims to reduce HCFC consumption by 35% compared to the baseline in 2013, targeting the RAC service sector focusing on three control measures:

1. Freeze the consumption of HCFCs in 2013 to the agreed baseline
2. Reduce consumption of HCFCs by 10% from 2015
3. Reduce consumption of HCFCs by 35% from 2020

The HPMP Stage-II aims to meet 67.5% reduction of HCFCs by 2025, and 97.5% reduction by 2030 while keeping an annual allowance of 2.5% of for meeting essential servicing needs until 2040 as set under the Montreal Protocol. The plan promotes the adoption of energy efficient alternative technologies to HCFCs which have low or zero GWP such as natural refrigerants consistent with the Kigali Amendment (GoE, 2021b). To achieve this goal, the Stage II HPMP proposes a mix of measures focused on the establishment of certification schemes, development of national technical standards in the RAC sector, enforcement of ODS legislations and capacity building.

Ethiopia ratified the Kigali amendment in 2019 and is currently in the process of submitting its HFC phase down plans to the National Ozone Unit for the purpose of soliciting funding from the Multilateral Fund<sup>1</sup>. The goal of the plan is to achieve 80% reduction of HFC consumption by the beginning of 2045 (aligned with the target set for Group 1 Parties that include Ethiopia). Over the course of the coming years, HFC import quotas will be allocated based on a permit system. The quota allocation will be according to individual percentage consumption in relation to a baseline. There will be an implementation plan as well as monitoring and evaluation to track progress.

A country's plan to phase out HCFCs impacts many sectors in the country. These sectors must be taken into consideration alongside the plans, with considerations to improve their sustainability and resilience while contributing to the climate goals.

### **Ethiopia's national dairy related strategies and plans**

Ethiopia's strategies and policies provide a comprehensive framework for advancing the dairy sector's sustainability and resilience. Aligned with the 10YDP, the government of Ethiopia has developed its dairy development strategy spanning the 10 years from 2022-2031. In the National Dairy Development Strategy, the government sets the goal of enhancing milk production from cattle, camels, and goats from the current level of about 7.1 billion to 28.4 billion liters by 2031 through measures that include better breeding practices, feed quality and milk processing technologies. A challenge identified by the strategy is the lack of sufficient storage facilities and inaccessibility of milk collection centers, cooperatives, and unions. As a short-term measure, the strategy envisages to organize and capacitate milk collection points in inaccessible areas and at the village level to collect quality milk and supply to dairy cooperatives; link collection centers to dairy processing cooperatives and unions establish cold chain with innovative technologies such as solar powered facilities and build the capacity of technicians on installation, operation, and maintenance of dairy equipment and machinery. In the medium to the long term, the strategy intends to set up a mechanism for

---

<sup>1</sup> The Multilateral Fund for the Implementation of the Montreal Protocol was established in 1991 to assist developing countries in complying with the Montreal Protocol's control measures on ozone-depleting substances (ODS). As a continuation of the support provided by the Multilateral Fund, the Fund also covers activities related to the Kigali Amendment. Its role under this amendment is to provide financial and technical assistance to developing countries, helping them transition away from HFCs.



monitoring and strengthening cold chains with innovative technologies and to provide in-service training for technicians engaged in maintenance and supply of spare parts for milk facilities (GoE, 2022). By integrating climate-smart practices, reducing emissions, and ensuring sustainable land use, the dairy sector can significantly contribute to Ethiopia's climate goals while enhancing its productivity and economic viability. One of the key targets included in the 10YDP for the dairy sector is the improvement of livestock productivity. Ethiopia's LT-LEDS (2020-2050) also includes references specifically to the dairy sector. Those targets of a cooling sub-sector should be considered for a potential integration in the NDC.

## Step 6: Developing a GHG inventory for the new sector

Developing the GHG inventory for a new sector is a fundamental step towards integrating this sector into the NDC. The aim of a GHG inventory is to quantify the country's GHG emissions from a certain sector, based on widely recognized inventory guidance from the Intergovernmental Panel on Climate Change (IPCC). A GHG inventory of a sector systematically quantifies emissions, tracking them by sub-sectors to identify key sources. The IPCC provides a standardized framework for these inventories, ensuring consistency and transparency across countries. These inventories are crucial for NDC reporting through Biennial Transparency Reports (BTRs), which demonstrate a country's progress toward its climate goals by detailing emissions and tracking changes over time.

### Developing a GHG inventory for the cooling sector

GHG emissions from the cooling sector can be distinguished between direct emissions stemming from the actual refrigerants used in the cooling equipment, whereas indirect emissions are produced by the energy required for operating the cooling equipment. One would need to clarify the term direct/indirect as these terms may be used in different contexts already (e.g. inside the NDC, in other sectors or by climate funds) and could lead to confusion. Emissions related to the refrigerants (direct emissions) are categorized into three subsets:

1. Manufacturing emissions: Occur during the domestic production of appliances when new equipment is initially filled. This includes emissions from on-site activities post-installation or during the filling of imported uncharged equipment.
2. In-use or operating emissions: In RAC equipment, refrigerant losses occur due to leakage during operation, necessitating regular top-ups performed by service technicians.

3. Disposal emissions: These occur when RAC equipment is decommissioned at end-of-life. Ideally, refrigerants should be reclaimed or destroyed; however, they often escape into the atmosphere during decommissioning, especially in developing countries.

Subsector	Systems
Unitary air conditioning	Self-contained air conditioners Split residential air conditioners Split commercial air conditioners Duct split residential air conditioners Commercial ducted splits Rooftop ducted Multi-splits
Chillers	Air conditioning chillers Process chillers
Mobile air conditioning	Car air conditioning Large vehicle air conditioning
Domestic refrigeration	Domestic refrigeration
Commercial refrigeration	Stand-alone equipment Condensing units Centralised systems for supermarkets
Industrial refrigeration	Stand-alone equipment Condensing units Centralised systems
Transport refrigeration	Refrigerated trucks/trailers

Figure 6. Overview of RAC sub sectors (Source: GIZ 2022)

To develop the GHG inventory, it is essential to gather data across various subsectors of a specific sector. The focus should be on the most relevant sub-sectors in terms of historical and future GHG emissions. Obtaining data to develop the GHG inventory can be challenging. Data requirements can vary from technical data (such as refrigerant charge, cooling capacity, and efficiency) to stock data (imports, exports, production, and sales), alongside emission factors for different applications. Efforts should be made to conduct literature reviews and interviews with stakeholders to identify data sources, assess current data availability and quality and pinpoint data gaps. Where data gaps exist, default factors or assumptions may be applied as long as more accurate data sources are available. For example, in industrial refrigeration and commercial cooling, associated emissions data could be estimated by using data on the volume of food produced, volume of food refrigerated (from the FAO database<sup>2</sup>), and energy used for cooling (from literature review). For transport refrigeration, it would be prudent to

<sup>2</sup> Link to FAO database: <https://www.fao.org/faostat/en/#home>

consult the transportation sector about the stock of transport vehicles used for cooled products, the refrigerant charge, and the coefficient of performance of the refrigeration systems.

For data gathering, priority sectors with the highest expected GHG emissions or number of appliances should be identified, and data should be collected and sorted according to target groups (residential, commercial, and industrial). The GHG inventory should be developed by technical staff or consultants, who are familiar with the local conditions, have access to key stakeholders in the sector and are able to access relevant data sources. A sample of the technical and sales data required for developing the GHG inventory is illustrated in Table 5.

Based on the data available, historical data for each sub-sector can be determined and complemented with approximate growth rates, the future refrigeration demand, and stock data. As a result, RAC sector emissions can be estimated sub sector-wise. The expected GHG emission projections would build the basis and support the next steps in listing potential measures to reduce emissions from each RAC sub-sector, identifying the GHG mitigation potential, and setting sectoral targets. To maintain data quality, it is important to avoid double counting of emissions across different (sub)sectors. Therefore, close alignment with already existing (GHG) data in the country or other sectors should be ensured to avoid duplications and ensure using same general underlying assumptions, like economic development, population growth, etc. For example, if emissions (due to electricity usage) from a solar PV-powered milk cooler is accounted for in the energy sector, the same emissions should not be counted in the cooling sector, and vice versa. Besides aligning to the GHG inventories of other sectors, it should be ensured that the developed GHG inventory for the new sector is aligned with GHG reporting requirements for other sectors to ensure consistency with national and international reporting standards and requirements.

### Overview of key data required for the GHG emissions inventory of the cooling sector

Market and production data	Technical data
Domestic production data of units from the year 2010 (Year taken for estimating baseline emissions in Ethiopia) to the present	Dominant refrigerants and blowing agents used for the different applications (in case data is not available or large gaps remain, estimates by experts on shares can be used)
Expected future growth rates of stock and sales	Average initial charge of units (and expected future trends until 2030)
Units produced for export (from the year 2010 to the present)	Average emission factors for refrigeration and air conditioning (manufacture, in-use and disposal emission factors and expected future trends until 2030); for foam production the relevant factors are first year loss (in %), annual loss (in %) and maximum potential end-of-life loss (in %)
Units imported (from the year 2010 to the present)	Average product lifetime

Domestic sales figures of units (from the year 2010 to the present)	Average cooling capacity
Refrigerant distribution of sold units for the year 2010 to present (i.e. percentage of different refrigerant type units and blowing agent type units, respectively)	Average Coefficient of Performance
Stock data of units (from the year 2010 to the present)	Average cost per unit
Refrigerant distribution of stock for the years 2000 and 2010 (i.e. percentage of different refrigerant-type units and blowing-agent-type units, respectively)	Average runtime hours
	Country-specific emission factors for electricity and expected changes (e.g. due to the increasing importance of renewable energy)

**Table 5. Potential data requirements for designing the RAC GHG inventory (applicable to all cooling sub sectors depending on data availability) (Source: GIZ, 2021)**

## Step 7: Define mitigation contribution to the NDC (unconditional/ conditional targets)

The primary objective of this step is to conduct a country-specific analysis of the potential measures identified in the previous sections and based on the GHG inventory. The objective of this step is to critically analyze the data and information received from the GHG inventory, thoroughly examine sector emission growth in each sub sector and identify potential mitigation policies and measures for the sector to be integrated in the NDC. This analysis will aid the government in understanding priority areas for developing suitable mitigation measures and understanding timelines and associated costs. Mitigation measures should be suitable and implementable within the context of the country. This analysis will be used to develop mitigation scenarios for the sector, to estimate the mitigation potential, and accordingly set targets for the sector. This will help to develop concrete implementation plans and targets for the mitigation to be achieved in the sector. Based on the results of the sector analysis and the GHG inventory data, actual mitigation measures need to be identified and further defined. Any measures identified need to fully align with the NDC and with current and planned policies, strategies and regulations for the respective sector.

Identified mitigation measures should be discussed with relevant stakeholders (see also section *Step 3: Stakeholder consultations*) and classified as either contributing to the conditional or unconditional climate action targets of the NDC. Unconditional targets commit to be achieved without any international financial or technical assistance. These targets are a core part of each country's efforts to reduce GHG emissions and adapt to the impacts of climate change. Unlike conditional NDC targets,

which depend on international support (like funding, technology transfer, or capacity building), unconditional targets reflect what a country pledges to do using its own resources and capacities. The distinction between unconditional and conditional NDC targets helps clarify how much progress a country can make independently versus how much additional support they require from the global community to meet more ambitious goals. Conditional measures should include those with significant costs and high mitigation potential, which would require additional funding. The government could seek funding through climate finance sources such as the GCF, the Mitigation Action Facility, carbon markets, or through Article 6.2 cooperation with countries like Switzerland, Japan, or Singapore.

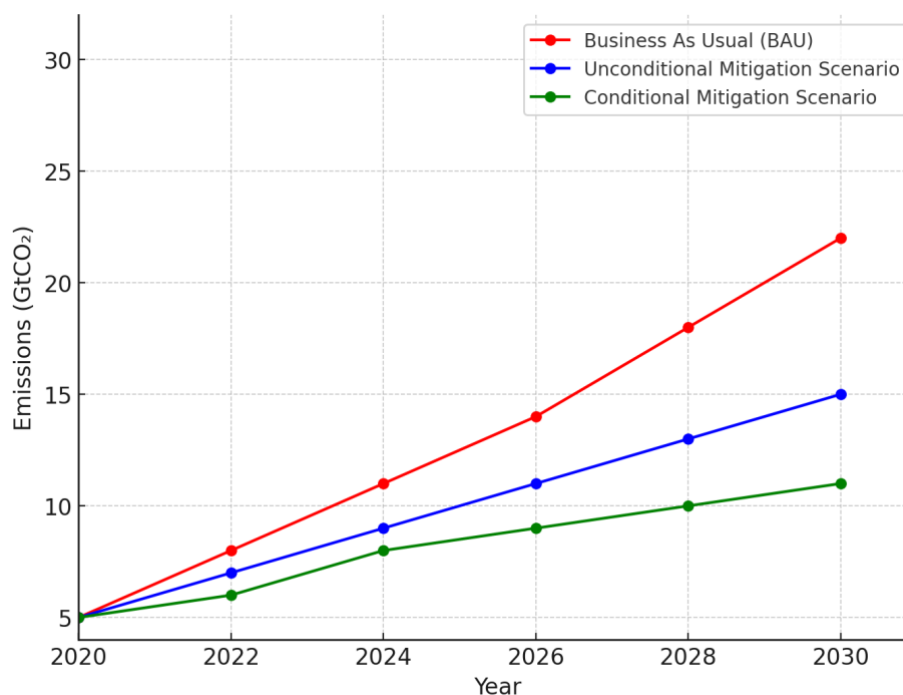
### Define mitigation contributions from the cooling sector

In the context of the cooling sector, low-cost, easily implementable measures (such as Minimum Energy Performance Standards for air conditioners and refrigerators) should be funded by the government using its own budget and resources, classifying them as unconditional measures. Conversely, high-cost mitigation measures (such as solar-powered bulk milk cooling and the adoption of low-GWP refrigerants) may be classified as conditional measures. After identifying the suitable measures, the cooling energy demand in the priority (sub)sectors should be estimated under a business-as-usual scenario<sup>3</sup>. Subsequently, comprehensive sector scenarios considering both conditional and unconditional measures and their mitigation potential, including costs and potential technology penetration should be developed. For modeling these scenarios, it is important to account for macroeconomic conditions such as gross domestic product growth and urbanization, enforcement, and compliance of the country in addition to sector-specific considerations like stock turnover, sales, and energy efficiency improvements.

It is advisable that the approach for defining the scenarios and the type of NDC target for the new (sub)sector (e.g. cooling) should be consistent with those used in other sectors. For example, if an absolute emission reduction target has been used in other sectors, a similar approach should be employed for the cooling sector. Alternatively, if emission intensity targets are utilized in other sectors of the NDC, then for cooling, the same type can be applied. Based on the conditional and unconditional mitigation scenarios and business as usual scenario, unconditional and conditional targets for the cooling sector can be defined. An indicative figure of these scenarios is shown in Figure 7.

---

<sup>3</sup> A Business-as-Usual (BAU) scenario refers to a projection of future outcomes based on the assumption that no significant changes or new policies are implemented beyond what is already in place. In climate change and environmental contexts, it typically represents the trajectory of GHG emissions, energy use, or other environmental impacts if a country, region, or organization continues operating under existing practices, regulations, and technologies without adopting further mitigation or adaptation measures.



**Figure 7. Example figure illustrating BAU and mitigation scenarios in the identified sector (Source: authors)**

In addition to the overall sectoral target for cooling, some countries have set specific sub-sector targets. The advantage is that this helps in tracking, reporting and steering progress, thus feeding into the broader cooling sector target. Some examples of indicative cooling sector targets for different sub sectors of cooling are given below.

### Examples of targets for different sub sectors of cooling<sup>4</sup>

#### 1. Economy-wide

- Achieve additional mitigation benefits equivalent to X tCO<sub>2</sub>e from phasing down F-gases in line with the Kigali Amendment and implementing MEPS for room air conditioners and refrigerators by 2035.

#### 2. Agriculture and food

- Increase the capacity of renewable power for milk and food cold storage by 50%, including off-grid renewable solutions by 2030.
- Transition 50% of supermarket cooling systems to low-GWP, high-efficiency technologies by 2030.

#### 3. Health sector

- Ensure 50% of all vaccines are stored using efficient, low-GWP cooling technologies through replacement initiatives or new rollouts by 2030.

<sup>4</sup> The targets and timelines mentioned here are indicative and not taken from actual NDCs. The sectors described here could be different based on country specific contexts



### 4. Transport

- Implement efficient, low-GWP air conditioning in 60% of the new urban mass transit fleet by 2030.

### 5. Buildings

- Develop policies for well-designed, adaptive urban environments, including the allocation of 60% more green space in urban areas by 2030.
- Enforce energy efficiency building codes across all buildings by 2030.

### 6. Industry

- Implement policies to improve the efficiency of manufactured cooling appliances, including MEPS and making the highest efficiency product lines affordable.
- Ensure 50% of all industrial cooling systems are powered by renewable energy and are highly efficient.

### 7. Appliances

- Increase the MEPS for air conditioners and refrigerators by at least 20% by 2030.
- Boost the market penetration of efficient appliances to 30% by 2030.
- Align with the United for Efficiency's model regulations for residential refrigerators.
- Achieve 100% reclamation of refrigerants by 2035 (KCEP 2021)

### Developing a National Cooling Action Plan (NCAP)

Some countries have addressed the growing emissions in the cooling sector by mapping their energy emissions and developing NCAPs. A NCAP involves identifying relevant sub-sectors, assessing current and potential new technologies and measures, forecasting future cooling demand across these sub-sectors, setting targets, and formulating policy recommendations to mitigate emissions related to cooling. Presently, over 30 NCAPs have been developed based on the Cool Coalition methodology (SE4ALL 2022). In Africa, countries like Kenya, South Africa, Ghana, and Nigeria are currently in different stages of developing NCAPs. Developing an NCAP with a long-term outlook (20-25 years) will provide an overview of different growth sectors, define responsibilities, improve data collection, and support in developing effective MRV systems. The methodology for developing NCAPs is provided in a study by Kumar et al. 2021 and can be modified based on the country context and challenges. Implementing the NCAP will lead to significant reductions of cooling associated emissions. For example, it is estimated that by implementing India's Cooling Action Plan, India aims to reduce its cooling energy requirement by up to 40% in 2038 as compared to the business-as-usual scenario with baseline year 2018 (MoEFCC 2019).

## Step 8: Identifying the entry point of new sector in the NDC

The objective of this step is to formally incorporate the new sector into the country's NDC. Based on the analysis of the previous steps, the mitigation measures and targets for the sector to be integrated have been identified, and alignment with the corresponding targets of other sectors is ensured. Additionally, while developing reporting procedures, targets, and measures for the new sector, strict

adherence to UNFCCC guidelines for the Enhanced Transparency Framework according to the Paris Agreement and alignment with any existing national and international reporting mechanisms should be ensured. The new sector can either be integrated into an existing sector, such as IPPU or energy, or as a completely new sector, depending on the nature of the sector. It is crucial that the ministry responsible for the integration is involved from the outset and fully supports the inclusion of the sector. The legislative process for the approval of the revised NDC varies by country, depending on the local context and legal and political processes. In some countries, after the new sector is integrated, the revised NDC is made available for public consultation, during which comments are received. Afterward, the revised NDC may be sent to the cabinet for discussion and approval. Finally, it can be approved and submitted to the UNFCCC.

Additionally, the ministry responsible for the NDC update and reporting process should be involved from the outset, as they will ultimately be responsible integrating the new sector targets and measures into the NDC during the next revision cycle and report on the progress. The country should adhere to UNFCCC guidelines for the Enhanced Transparency Framework while developing the reporting procedures, targets, measures (e.g. for the cooling sector) and any other existing reporting mechanisms relevant for the sector and the mitigation measures.

### Identifying the entry point for the cooling sector into Ethiopia' NDC

Similarly, in the context of cooling, based on the identified measures and targets, it is important to determine where and how the cooling target should be integrated into the NDC. Ethiopia's situation is special, as access to cooling has been historically very low. This means that the key priority is to expand the use of cooling technologies, preferably using low-GWP refrigerants. IPCC guidance should be utilized to ensure that cooling-related emissions are accurately categorized within the NDC. Depending on the NDC, sector definitions, boundaries, and the specific cooling-related emission sources and measures to be integrated, cooling measures or targets should typically be incorporated into either the energy sector (for energy-related emissions), the Industrial Processes and Product Use (IPPU) sector (for refrigerant-related emissions), or as a distinct Refrigeration and Air Conditioning (RAC) or "cooling" sector that encompasses both energy and refrigerant-related emissions. If there is a separate "cooling" sector defined in the NDC, it is essential to ensure comprehensive tracking of all cooling-related emissions and avoid double counting. As per an assessment done on the submitted NDCs, most countries prefer to submerge the RAC sector either in energy or IPPU sector (Lassmann and Michaelowa 2021).

Expanding the scope of GHGs in the NDC to include HFCs is strongly recommended, especially if mitigation measures target HFC emission reductions. HFCs, commonly used as refrigerants in cooling equipment, have a high GWP and are significant contributors to climate change. Including HFCs in the NDC's GHG scope should be aligned with IPCC guidance and the Kigali Amendment timelines, providing a complete emissions profile, supporting accurate progress tracking in the cooling sector, and demonstrating a commitment to comprehensive climate action in line with global mitigation goals.

As described in Step 2 (stakeholder mapping) the MoPD is responsible for the NDC update in Ethiopia and reporting and needs to fully support the process of incorporating cooling sector targets in the

NDC. In the context of Ethiopia, the cooling sector target should be aligned with sectoral plans, such as the 10YDP, LT-LEDS, NDC targets, HCFC phaseout plans and adhere to the UNFCCC guidelines for the Enhanced Transparency Framework when submitting the Biennial Transparency Reports. Additionally, while developing reporting and setting targets for sub-sectors like the dairy sector, it should be ensured that the reporting procedure and targets are consistent with the goals mentioned in the National Dairy Strategy and the 10YDP. Only after proper assessment of the sector and alignment with relevant sectors and respective stakeholders, the sub-sector targets should be incorporated into the NDC.

## Step 9: Developing the MRV framework for the new sector

Under the Paris Agreement, each country needs to report on the progress of its NDC. The reporting requirements for NDCs are designed to ensure transparency, accountability, and global progress in reducing GHG emissions. The main requirements related to mitigation include:

- Submission of NDC updates: Countries must submit more ambitious versions of their NDCs every five years, outlining their climate action goals, mitigation strategies, and adaptation plans.
- Biennial Transparency Reports (BTRs): Countries must provide regular updates on the progress of their NDCs through Biennial Transparency Reports, which detail the implementation status of the NDC, emissions reductions, and support received or provided. These reports are meant to track progress against the NDC targets.
- Greenhouse gas inventories: As part of the BTRs, countries are required to submit updated national greenhouse gas inventories, showing emissions and removals by sector related to the NDC.

This progress not only includes mitigation but also other aspects such as sustainable development indicators, adaptation, and any support received from other countries, whether financial or technical assistance. Effective monitoring and tracking of these components is crucial for understanding a country's progress towards the overarching targets of the NDC. However, this report focuses on the mitigation related MRV.

In general, the identified measures and targets of a sector form the foundation of a strong MRV. As there could be interlinkages and interactions between targets, like target setting, the MRV should be aligned to avoid double counting and reduce effort in monitoring and addressing inefficiencies. Special care should be taken to ensure that the MRV for one sector or measure aligns with all relevant MRV requirements (internationally, national, sectoral) including the UNFCCC guidelines for the Enhanced Transparency Framework, reporting requirements under the Montreal Protocol /Kigali Amendment, existing or planned national or NDC specific MRV procedures or other sectoral MRV processes. The identified sectoral targets of the NDC and the underlying mitigation measures are essential for

monitoring the progress of the entire NDC. At the same time, MRV of mitigation activities in each subsector helps track sectoral and sub sectoral targets (e.g., space cooling). MRV will also feed into the GHG inventory and assist in tracking and reporting on the progress of policies and strategies.

Keeping the sectoral MRV aligned with existing procedures and international reporting mechanisms would reduce the need for introducing a new MRV reporting procedure, improve efficiencies and ensure that data quality, data sources and measurement and reporting procedures following same principles and procedures. This would facilitate the collection and reporting of data by all involved stakeholders, building upon existing procedures and processes. Relevant stakeholder consultations or assessments of sectoral regulations should be conducted prior to the design of the sectoral MRV system to ensure such alignment.

General steps that can be followed for developing an MRV for the RAC sector are described below:

- 1. Define the scope of MRV:** This will encompass defining what needs to be covered under the MRV system for the new sector, define sub sectors of cooling, target groups, stakeholders, MRV obligations, processes to be followed (e.g., UNFCCC, project activity MRV, NDCs), and general quality standards and requirements.
- 2. Objectives, outputs, and timelines:** The objective of the RAC MRV could be to integrate cooling into the NDC, to develop national tracking and verification databases, or to report to the Paris Agreement or other international commitments.
- 3. Define MRV requirements:** The MRV requirements should be defined including which standards and monitoring methodologies should be used, which parameters to measure, the quality of data required, frequency of measurement and measurement equipment to be used. The data requirements should ideally be based on internationally recognized monitoring methodologies and standards and be closely aligned to other national, NDC, sector MRV processes and requirements.
- 4. Status quo analysis:** Based on the MRV requirements defined (see step 3 above), this step is to understand already existing current MRV procedures on national, sectoral, activity and facility level. This is very important to build on existing systems where possible and to consider existing framework conditions (including financial and technical capacities, data availability and data quality). This in turn helps to design and set up an MRV system that considers the real conditions in the respective context. Aspects to assess include: What data is already being gathered (e.g. due to regulations, etc.)? What data is available and in what quality? Frequency in which the data is made available? What data is reported? What is the flow of data and responsibilities? To access this information and data, it is recommended to conduct surveys or interview queries about each (sub)sector and review secondary literature. This could be done as part of the sector analysis and during initial stakeholder consultations described in earlier sections of the roadmap.

5. **Analysis of collected data:** The collected data needs to be analyzed to understand the data quality and identify gaps. Assess the types of gaps and check if they can be accomplished by using international reports, assumptions, or follow up with stakeholders for non-published data. In addition, plausibility checks are required on the data assessed with respect to the overall sector. If any queries regarding data quality exist, these would need to be addressed e.g. by referring to additional sources or conducting field surveys to validate and properly justify the same. Some factors like leakage rates and GWP can be taken from IPCC guidelines (IPCC 2006). The priority of data hierarchy should be field surveys, country data, international data and default factors.

6. **Stakeholder consultation and institutional setup:** The preliminary structure of the MRV system should be discussed with stakeholders (governmental and private) to make them aware and build capacity for them. During the consultations, the institutional setup for following the MRV: who needs to report what data to whom, who will act as the custodians for central MRV, which sectoral ministries are responsible for reporting which data in what frequency should be discussed and incorporated into the MRV, what infrastructure (e.g. central database, measurement equipment) is supposed to be used. Technical committees for each sub sector of RAC can enable focused discussion (like air conditioning, refrigeration, industrial refrigeration, etc.).

7. **Periodic review and MRV refinement:** After the MRV is developed, it should undergo regular reviews to identify and address inefficiencies in reporting, data quality, or data flow. Continuous improvements will help keep the MRV adaptable to evolving reporting needs and data availability.

These steps can be modified, or additional sub-steps can be added based on the country context, sectoral considerations, etc.

## Step 10: Regular analysis and enhancement of targets

A functional MRV system established (see Step 9: *Developing the MRV framework for the new sector*) is essential for tracking a country's progress towards its committed targets. The MRV provides an overview of the successful implementation of identified mitigation measures, the mitigation potential achieved, and the progress made by these measures towards the targets for each subsector within the overarching sector. An additional advantage of MRV is its ability to continuously monitor and periodically review targets, allowing for refinements or revisions of the targets and measures before the next scheduled NDC update every five years.

By analyzing the progress made in each subsector through the MRV, the mitigation measures and targets can be periodically reviewed and updated by considering market trends, technology growth, international cooperation, and the local context. This may involve introducing new mitigation measures (and targets) or updating existing ones. For example, in the context of cooling, MEPS for appliances could be made more stringent by assessing the current market situation, GHG refrigerant

phase-out timelines could be revised if Kigali Amendment timelines are met prematurely, or access to milk cooling or efficiency targets for milk coolers could be increased. While revising the sectoral targets and measures, alignment with other sectors, the overall NDC, and the long-term goals of the country should be considered.



## References

- Clean Cooling Collaborative (2022): Show me the money: Financing the transition to efficient, climate-friendly cooling for all. <https://www.cleancoolingcollaborative.org/blog/financing-the-transition-to-efficient-climate-friendly-cooling-for-all/>
- GIZ (2021): MRV in practice. [https://www.green-cooling-initiative.org/fileadmin/Publications/GIZ2021\\_Measurement\\_Reporting\\_Verification\\_MRV\\_Handbook.pdf](https://www.green-cooling-initiative.org/fileadmin/Publications/GIZ2021_Measurement_Reporting_Verification_MRV_Handbook.pdf)
- GIZ (2022): Raising ambition in NDCs through holistic -mitigation approaches in the cooling sector- Guidance for policymakers. <https://www.giz.de/de/downloads/giz2022-en-proklima-raising-ambition-in-ndcs-through-holistic-mitigation-approaches-in-the-cooling-sector.pdf>
- Government of Ethiopia (GoE) (2012): Ethiopia's Climate Resilient Green Economy (CRGE) Strategy. <https://www ldc-climate.org/wp-content/uploads/2018/01/crge-strategy.pdf>
- Government of Ethiopia (GoE) (2015): Ethiopia's INDC. [https://www4.unfccc.int/sites/submissions/INDC/Published\\_Documents/Ethiopia/1/INDC-Ethiopia-100615.pdf](https://www4.unfccc.int/sites/submissions/INDC/Published_Documents/Ethiopia/1/INDC-Ethiopia-100615.pdf)
- Government of Ethiopia (GoE) (2017): Ethiopia's First NDC. <https://unfccc.int/documents/497472>
- Government of Ethiopia (GoE) (2021a): Ethiopia's updated NDC. [https://unfccc.int/sites/default/files/NDC/2022-06/Ethiopia%27s%20updated%20NDC%20JULY%202021%20Submission\\_.pdf](https://unfccc.int/sites/default/files/NDC/2022-06/Ethiopia%27s%20updated%20NDC%20JULY%202021%20Submission_.pdf)
- Government of Ethiopia (GoE) (2021b): HPMP stage II plan for Ethiopia, Environment, Forest and Climate Change Commission
- Government of Ethiopia (GoE) (2021c): Ten-Years Development Plan, Planning and Development Commission of the Federal Democratic Republic of Ethiopia. <https://faolex.fao.org/docs/pdf/eth215704.pdf> (accessed 01.02.24)
- Government of Ethiopia (GoE) (2022): Ethiopia National Dairy Development Strategy (2022-2031). <https://cgspace.cgiar.org/server/api/core/bitstreams/246012fe-9c0b-4130-a9fe-8ea14e01f55/content>
- Government of Ethiopia (GoE) (2023): Long-Term Low Emission and Climate Resilient Development Strategy (2020-2050). [https://unfccc.int/sites/default/files/resource/ETHIOPIA\\_LONG TERM LOW EMISSION AND CLIMATE RESILIENT DEVELOPMENT STRATEGY.pdf](https://unfccc.int/sites/default/files/resource/ETHIOPIA_LONG TERM LOW EMISSION AND CLIMATE RESILIENT DEVELOPMENT STRATEGY.pdf)
- IPCC (2006): Guidelines for National Greenhouse Gas Inventories. <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>
- KCEP (2021): Guidance on Incorporating Efficient, Clean Cooling into the Enhancement of Nationally Determined Contributions. <https://www.k-cep.org/wp-content/uploads/2019/07/Guidance-on-Incorporating-Efficient-Clean-Cooling-into-the-Enhancement-of-Nationally-Determined-Contributions.pdf>
- Kumar, S., Sachar, S., George, G., & Goenka, A. (2021). Holistic methodology for developing a national cooling action plan. <https://www.unescap.org/kp/2021/national-cooling-action-plan-methodology-holistic-methodology-developing-national-cooling>

- Lassmann, Daniela & Michaelowa, Axel (2021): Green Cooling in updated NDCs – Are we embarking on an ambitious path or a journey into a cooling crisis?. [https://perspectives.cc/wp-content/uploads/2024/01/GIZ\\_2021\\_Green\\_Cooling\\_in\\_updated\\_NDCs.pdf](https://perspectives.cc/wp-content/uploads/2024/01/GIZ_2021_Green_Cooling_in_updated_NDCs.pdf)
- Ministry of Environment, Forest and Climate Change (MoEFCC) (2019): India Cooling Action Plan. <https://ozonecell.nic.in/wp-content/uploads/2019/03/INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf>
- Michaelowa, Axel; Espelage, Aglaja; Hoch, Stephan; Acosta, Mariana (2019): Interaction between Art. 6 of the Paris Agreement and the Montreal Protocol/Kigali Amendment. Discussion Paper. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn. [https://www.green-cooling-initiative.org/fileadmin/user\\_upload/Interaction\\_between\\_Art6\\_of\\_the\\_Paris\\_Agreement\\_and\\_the\\_Montreal\\_Protocol-Kigali\\_Amendment.pdf](https://www.green-cooling-initiative.org/fileadmin/user_upload/Interaction_between_Art6_of_the_Paris_Agreement_and_the_Montreal_Protocol-Kigali_Amendment.pdf)
- Papst, Irene; Laßmann, Daniela; Michaelowa, Axel; Sharma, Neeta (2022): Raising ambition in NDCs through holistic mitigation approaches in the cooling sector – Guidance for policymakers, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn
- SE4ALL (2022): Chilling Prospects 2022: The role of National Cooling Action Plans in delivering the global environment agenda. <https://www.seforall.org/data-stories/role-of-national-cooling-action-plans>
- UNEP (2023): Global Cooling Pledge for COP 28. [https://drive.google.com/file/d/1G9oBA5juJSenyo0M8P\\_nsdKkc\\_h8Z4jq/view](https://drive.google.com/file/d/1G9oBA5juJSenyo0M8P_nsdKkc_h8Z4jq/view)

## Annex A

### Guiding questions to assess the current situation in milk cooling sub sector

Source: GIZ 2021

Guiding questions	Information/Data (No data/information: "No data" Not applicable: "NA")
<b>Legislative queries</b>	
Is there a legislative/regulatory basis for monitoring and reporting the data for dairy sector?	
Which Ministry is responsible overall for collecting the data? (concerned department, contact person)	
<i>Technical queries</i>	
Cooling technology used (define their cooling capacity, energy efficiency, refrigerant used, refrigerant charge, powered by diesel generator/grid electricity)	
Electrical data (transmission and distribution loses, emission factor of grid, emission factor of diesel generator)	
Refrigerant type and emissions during production, disposal, operation of milk cooling equipment	
Are milk cooling equipment and refrigerants collected for recycling, reclamation, or destruction?	
Milk and livestock data	
Annual milk produced (last 10 years data)	
Milk producing livestock (last 10 years)	
Annual milk cooled (last 10 years data)	
Stock and Sales	
Imported, exported, sales and stock of milk cooling equipment (last 10 years)	
Average lifetime	
Average cost of the milk cooling equipment	



## **Perspectives**

Climate Group GmbH  
Hugstetter Str. 7  
79106 Freiburg, Germany  
[info@perspectives.cc](mailto:info@perspectives.cc)  
[www.perspectives.cc](http://www.perspectives.cc)