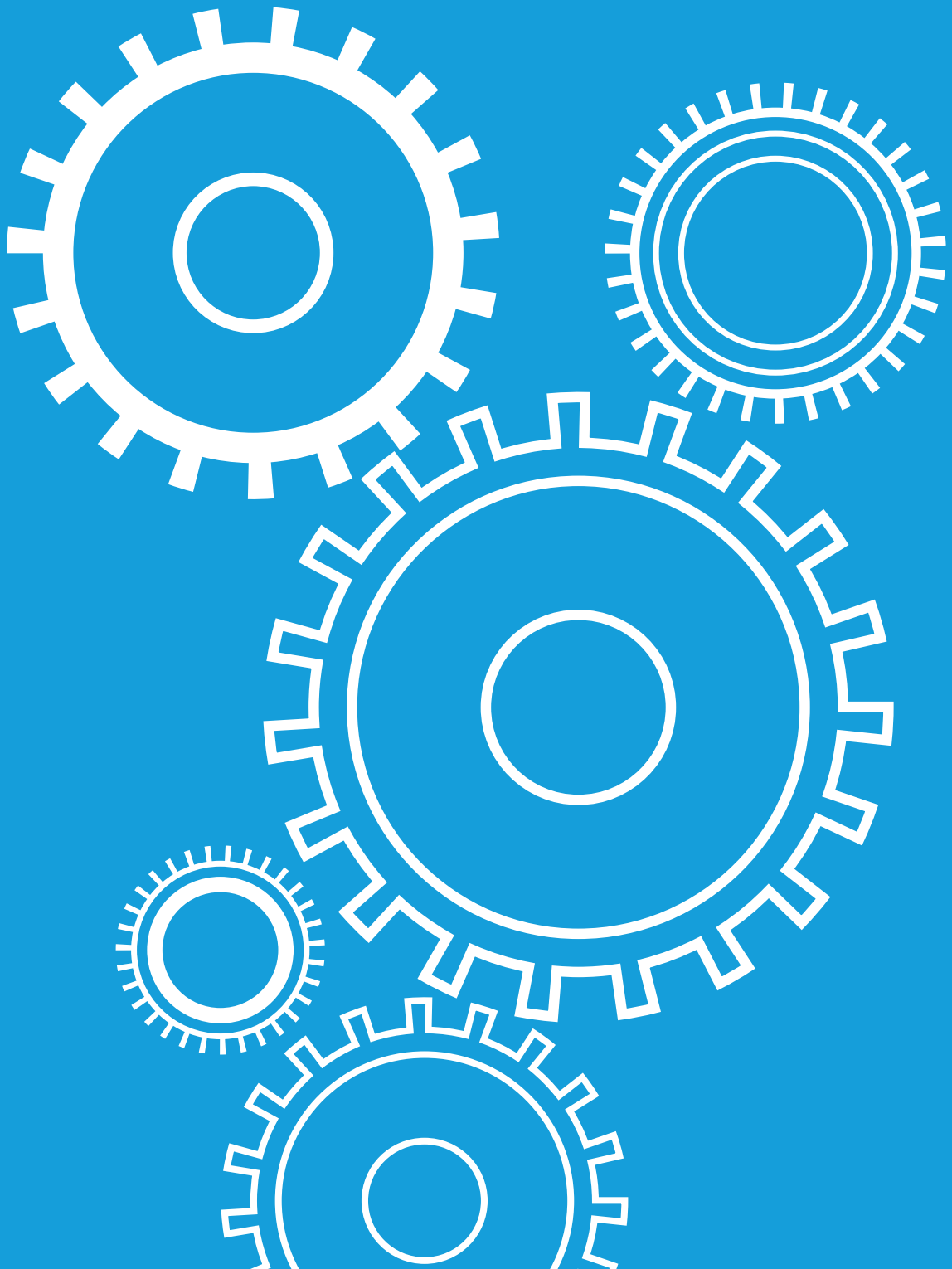
UN environment programme

A technical guideline

Governance mechanisms and institutional arrangements for preparing long-term low-emission development strategies



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Buddika Hemashantha and Anuradha Lakmini Dissanayake (Sri Lanka), Mao Hak (Cambodia), Sandra Roxana Aparcana Robles, Clarine Tania Ovando, Fernando Farias (UNEP Copenhagen Climate Centre), Gordon Mackenzie (UNEP Copenhagen) and Seraphine Haeussling (UNEP) reviewed an advanced draft of the report in their respective individual capacities.

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Glossary

Coordination	An interactive process among peers that involves activating formal connections to seek assistance from others in order to accomplish specific organizational goals.
Integration	The revision of sectoral policy plans and strategies through a process aims at achieving a balance between priorities driven by sectoral development goals and those driven by climate change management goals.
Human capacity	Adequate staffing levels, relevant skill sets, practical know-how, and supportive frameworks, including physical infrastructure, institutional arrangements, and financial capacity, are all necessary for effectively utilizing knowledge.
Long Term Strategies (LTS)	Official governmental documents submitted to the secretariat of the United Nations Framework Convention on Climate Change, through which parties to the Convention communicate their long-term plans for reducing greenhouse gas emissions.
Nationally Determined Contribution	Nationally Determined Contributions are climate-change management goals and targets to cut emissions and adapt to climate impacts. Each Party to the Paris Agreement is required to establish an NDC and update it every five years.
Net Zero	Net zero refers to a balance between anthropogenic carbon dioxide (CO_2) removals outweighing emissions over a specified period.
Primary legislation	Legislative laws issued by a government establish broad policy directions and principles that serve as the framework for the government's executive power
Ratification	Under the Paris Agreement, signatories to the United Nations Framework Convention on Climate Change are obligated to avoid actions that undermine the agreement's objectives. Ratifying the agreement indicates a willingness to be legally bound by its terms. Prior to ratification, countries engage in domestic legislative processes, commonly referred to as "acceptance" or "approval.
Regulatory Framework	The regulations, standards, administrative procedures, and enforcement mechanisms that are necessary for implementing a specific policy action make up the policy's implementation system
Reporting	The communication of updates on the implementation progress of a specific policy action.
Secondary legislation	Secondary legislation, consisting of regulations and statutory instructions, is issued by the executive power of a government. It serves to operationalize primary legislation by translating it into specific sectoral requirements
Sectoral action plan	A policy plan outlines a government's goals and actions for a particular sector, with varying levels of detail depending on the country and issues at hand. The term "sector" typically refers to economic activities, such as agriculture, road transport, or cement production. It may also refer to stakeholder groups, such as households, or to topics that span across economic activities and stakeholders, such as research and development.
Stakeholder	Stakeholders are individuals or groups who have the ability to influence or are impacted by a public policy program, and those who can contribute to shaping the development of a public policy program.

Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
AR6	Sixth Assessment Report by the Intergovernmental Panel on Climate Change
BAU	Business-as-usual
BEIS	Business, Energy, and Industrial Strategy
BC	Black Carbon
CBDR	Common But Differentiated Responsibilities
CC	Climate Change
CC Act	Climate Change Act
CCICD	Climate Change and International Cooperation Division
CCS	Climate Change Secretariat
CCUS	Carbon Capture, Utilization and Storage
CH_4	Methane
CNTE	Council for the Energy Transitions
COP	Conference of the Parties
CO_2	Carbon Dioxide
ETS	Emission Trading System
G7	Group of Seven
G20	Group of Twenty
GHG	Greenhouse Gas Emissions
GLCC	General Law on Climate Change
HFCs	Hydrofluorocarbons
INECC	National Institute for Ecology and Climate Change (in English)
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes, solvent and other Product Use
JNAP	Joint National Action Plan
LTS	Long-term Emission Reduction Strategies = LT-LEDS: long-term low greenhouse gas emission development strategies[1]
M&E	Monitoring and Evaluation
MECCNAR	Ministry of Environment, Climate Change and Natural Resources
MRV	Monitoring Reporting and Verification
NAP	National Adaptation Plan
NDCs	Nationally Determined Contributions
NGOs	Non-Governmental Organizations
O_3	Tropospheric Ozone
QCA	Qualitative Content Analysis
SDGs	Sustainable Development Goals
SIDS	Small Island Developing States
SLCPs	Short-Lived Climate Pollutants
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-CCC	United Nations Environment Programme – Copenhagen Climate Centre
UDP	UNEP Danish Technical University (DTU) Partnership
UNFCCC	United Nations Framework Convention on Climate Change
TTE	Tile Til Eo Committee
WMO	World Meteorological Organization
WRI	World Resources Institute

1 For reasons of simplicity, we use the abbreviation LTS

Preface

The window to limit global temperature increases to 1.5°C above pre-industrial levels is about to close. Keeping it open requires large emission reductions in the short term, followed by even larger reductions in the mid- and long-term. Against this background, the Paris Agreement requires that all Parties to the United Nations Framework Convention on Climate Change (UNFCCC) formulate and implement Long-Term Low Greenhouse Gas Emission Development Strategies (LTS).

This publication provides an in-depth analysis of the institutional requirements associated with formulating and implementing LTS. In addition, the publication analyzes two elements that some Parties to the UNFCCC have included in their LTS: international cooperation aspects and short-lived climate pollutants (SLCPs). The latter in particular are absent from the literature on LTS.

The publication uses a range of qualitative data-analysis methods, including surveys and interviews, to illustrate challenges in countries' institutional arrangements. It does so while analyzing good practices and providing action-oriented recommendations.

The document outlines six essential institutional capacities required to implement climate change management actions found in LTS. It identifies areas where developing country government capacities are limited for each capacity type and provides recommendations for building these capacities. The document is based on a 2018 publication titled “Institutional Capacities for NDC Implementation: A Guidance Document,” covering most of the same institutional categories.

Although the analysis in this document is general, different readers may find different parts of it useful. However, by identifying and consolidating the relevant issues into a comprehensive document, we aim to provide guidance that is applicable to a wide range of stakeholders such as developing country government officials, national policymakers, and the experts on which they rely to conduct background work for the LTS development.

Global warming, Children with boat on cracked earth after the climate change
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Executive Summary

Long-term low greenhouse gas emission development strategies (LTS) have been contemplated as necessary tools to reach global climate goals, limit temperature increase to 1.5 degrees and achieve the transformation required to achieve the goals of the Paris Agreement (IPCC, 2023a; UNEP, 2022). UNFCCC Decision 1/CP 21 called on member states to communicate their LTS by 2020, as outlined in the Paris Agreement, Article 4.19. Nonetheless, by Mai 2025 only 76 parties had submitted their strategies to the UNFCCC. This is explained as the submission is still voluntary, no common terms of reference for the development nor the implementation of LTS are provided and many countries, especially developing countries are often limited by technical, financial, and human resources (Bakhtiari et al., 2018; Elliott et al., 2019; Rocha & Falduto, 2019). In this context, institutional shortcomings have been identified as a key reason for both the ambition gap reported by the IPCC and the poor response so far to the request included in UNFCCC Decision 1/CP 21 (IPCC, 2023a; UNFCCC Secretariat, 2022).

This publication follows up on the guidance document "Institutional Capacities for NDC Implementation: a guidance document" (Bakhtiari et al., 2018), albeit with a significantly strengthened analysis. Individually for six types of institutional categories, and with particular focus on gaps for developing countries, the analysis focuses on a selected sample of countries that have already submitted their LTS. For each component of institutional capacities, the report provides an overview of the most relevant findings and provides guidance on typical barriers and how to overcome them. Additionally, the analysis incorporates two components that are often neglected in the discussion on LTS: (i) international cooperation and (ii) short-lived climate pollutants (SLCPs).

The report is designed to inform technical staff in government agencies, national policymakers, and experts in charge of LTS development, implementation, and update. Thus, a qualitative content analysis (QCA) was carried out to explore countries' LTS and comprehend their approach to setting up institutional arrangements[2] and climate governance mechanisms[3]. Institutional arrangements are defined as structures, systems, processes, and policies used by various bodies such as governments or organizations to legislate, plan and manage activities and actions to fulfill their mandates. They refer to the allocation of clear roles and responsibilities, structures, and incentives to coordinate, capacity and procedures to manage and share information, or processes to encourage inclusive stakeholder engagement and facilitate governance and management of climate change actions (UNFCCC Secretariat, 2020).

This information was complemented with insights gained through interviews and the input collected through questionnaires and a written request targeting LTS governmental focal points in selected countries.

Twenty LTS were analyzed in the QCA:

- Annex-I: France (08.02.2021), Germany (17.11.2016), United Kingdom of Great Britain and Northern Ireland (19.10.2021) and the United States of America (01.11.2021).
- Non-Annex-I: Andorra (10.11.2021), Cambodia (30.12.2021), China (28.10.2021), Costa Rica (12.12.2019), Fiji (25.02.2019), Gambia (22.09.2022), Indonesia (22.07.2021), Republic of Korea (30.12.2020), Republic of the Marshall Islands (25.09.2018), Mexico (16.11.2016), Nepal (31.10.2021), Nigeria (08.12.2021), Singapore (31.03.2020), South Africa (23.09.2020), Thailand (07.11.2022) and Tonga (11.11.2021).

Coordination

The category of coordination investigated to what extent countries rely on a single entity to coordinate the development and implementation of the LTS, and how different roles and responsibilities are dispersed across different actors. In drawing up their LTS, most countries relied on a coordination structure led by a single governmental entity and included different roles and responsibilities of stakeholders and linked them across sectors.

Based on this analysis, it is suggested that a coordination entity has the following responsibilities:

- Securing high-level support for the LTS development and implementation process.
- Building on existing arrangements as relevant, mobilizing governmental and non-governmental partners to prepare a national climate policy plan or, for example, update NDCs in alignment with LTS.
- Mapping institutional climate-change related networks, to identify the key entities and their respective portfolios with various LTS priorities.
- Identifying gaps in institutional capacity related to defining and implementing long-term scenarios and targets and drawing up a plan for bridging these gaps.
- Supervising and steering the contributions of different committees, working groups and relevant actors involved in LTS implementation, to ensure that all parties deliver on their respective commitments. In some cases, formal working groups or technical entities may have to be set up in advance.
- Engaging sub-national agencies and stakeholder groups, including local businesses, in a manner that aligns with their capabilities and the implementation process's requirements is crucial.
- Reviewing and suggesting improvements in connection with the regulatory needs that are required to implement national long-term targets.

Stakeholder Engagement

The category of stakeholder engagement examines the extent to which different actors are involved in any processes relating to the development, implementation, and update of countries' LTS, and what constitutes an effective means of engagement. A stakeholder is defined as any individual or group that can affect, or is affected by, a public policy programme.

The qualitative analysis reveals the importance of countries following different consultative and participatory approaches of engagement and input-collection to design their LTS, such as through conducting workshops, open-dialogues, online meetings, or webinars. Based on the outcome of the analysis, a whole-of-society inclusion at all stages in the LTS process is advisable.

Key recommendations for bridging common gaps in capacity to carry out effective stakeholder engagement:

- Setting-up a steering committee for stakeholder engagement.
- Creating climate partnerships with private-sector organizations.
- Developing a climate platform to provide a long-term forum for dialogue on climate-change issues.
- Engaging with disenfranchised and marginalized groups.
- Facilitating sector-specific climate dialogues and partnerships with key stakeholders.
- Designing communication and awareness-raising strategies for higher visibility and widespread ownership of LTS objectives.
- Promoting citizens' climate assemblies.
- Engaging with sub-national authorities to support the implementation of national LTS commitments.

2 Institutional arrangements are defined as structures, systems, and policies employed by governmental bodies or organizations to legislate, plan, and manage activities, ensuring clear allocation of roles and responsibilities, coordination mechanisms, capacity-building procedures, and inclusive stakeholder engagement to facilitate governance and management of climate change actions.

3 Governance mechanisms are structures or processes designed to facilitate decision-making and coordination aimed at regulating actions, policies, and resources to address climate change challenges on local, national, or international scales.

Sectoral integration

The sectoral integration component focuses on countries' approaches to include different climate-affected sectors into their LTS, in particular with regard to sectoral and cross-sectoral measures and actions that have been planned or implemented. The analysis further supported the idea that integrating LTS priorities also into sectoral strategies is a pre-condition for successful LTS implementation: all LTS analyzed included a multi-sectoral approach, which differed from one another mainly as a reflection of countries' geographical differences and national circumstances.

Key recommendations to bridge common capacity gaps to ensure successful sectoral integration in the development and implementation of LTS include:

- Engaging sectoral line ministries to integrate LTS targets into their programmes and strategies.
- Establishing a tracking system for LTS targets.
- LTS complementation by Sectoral Decarbonization Plan or Macroeconomic Analysis.
- Making sectoral targets legally binding.
- Providing training for government actors to enhance the robustness of modeling and scenario-development processes.
- Sharing collective resources and diffusing skills and knowledge to reach long-term climate strategies.

Regulatory Framework

This category examines a country's readiness to review and potentially revise its regulatory framework, with a view to streamlining and complementing existing laws and regulations in light of the requirements associated with achieving long-term climate targets. The regulatory framework is defined as the system of regulations, standards and administrative procedures that are relevant to LTS development and implementation, and the mechanisms used to enforce their application.

Countries followed either the approach of relying on an already existing regulatory framework and/ or opted to create new governing structures and enact new laws. The analysis further emphasized that having clear and robust institutional arrangements integrated into countries' LTS is advisable to track progress toward reaching climate targets.

For the recommendations, a step-to-step approach is proposed to bridge common gaps in capacity for an effective regulatory framework to develop and implement LTS:

1. Conducting a comprehensive analysis of the regulatory, legislative and policy environment, possibly leading to the review of elements such as legislative provisions, and institutional structures and processes:
   - Ensuring through factors such as public participation and buy-in that the regulatory body remains fit for the purpose and robust, even in sensitive and rapidly changing policy environments.
   - Updating legislation, as necessary.
2. Translating or breaking down LTS targets into specific policy objectives. This task involves setting clear targets, defining governance practices, allocating necessary funds, and linking policy to existing social structures[4].
3. Mapping the regulatory needs arising from the LTS against the elements of the existing regulatory framework in place.
4. Anticipating barriers to implementation and introducing regulations to overcome them.
5. Ensuring sufficient and timely communication flows between different stakeholders.

Human Capacities

Climate-change management requires several specialised skills. Therefore, assessing the extent to which these are available, and bridging the identified gaps, are preconditions for the successful implementation of climate-change policy. Human capacities in countries' LTS are analyzed with regard to aspects related to education and training, capacity-building, dissemination of knowledge and sharing of experience. All countries included elements for capacity-building in the categories for human capacities to develop their LTS and many recognized climate-related education, knowledge, and training as indispensable tools for citizens to be actively engaged in various decarbonization efforts.

We recommend the following actions to bridge gaps in human capacities, which is mostly for developing countries, who experience constraints in terms of the lack of technical, human, and financial resources:

- Avoiding high staff turnover.
- Strengthening incentives for ministries to train personnel within various government entities working in climate change.
- Introducing awareness-raising campaigns.
- Continuously updating skills, knowledge and technical expertise related to climate-change assessments, including modeling activities, and integrating strategic capacity for policy design and implementation.

Reporting

Reporting refers to the provision of information regarding progress with the implementation of a country's LTS. Hereby, it is of utmost importance to indicate who is responsible for reviewing the LTS process, what methods are applied and how frequently the LTS is to be revised. The analysis examined countries' review cycle, the extent to which it aligns with the NDC review cycle and whether or not countries have included aspects of transparency, open accessibility and monitoring.

Key recommendations for bridging common gaps in capacity include:

- Regularly updating processes related to data collection, analysis and review, drawing on inputs from a wide range of actors.
- Integrating in the LTS a fixed time frame for revisions, possibly to match the 5-year cycle of the NDC, as many countries are already doing.
- Outlining clear mandates for the LTS reporting process and linking roles and responsibilities to governance structures.
- Development of a MRV system for the LTS.

4 Social structure is the organized set of social institutions and patterns of institutionalized relationships that together compose society.

International Cooperation

The category of international cooperation is included as it can open room for countries to share knowledge, identify areas for collaboration, discuss common challenges and options to overcome them, support and shift capacities to countries that need it most and reach their long-term targets. Many countries included concrete action plans on how international cooperation efforts could be enhanced in their LTS. Approaches following a market-based structure[5] or regional cooperation character were mentioned.

As developing countries are still struggling with accessing financial and technical resources, to increase international cooperation efforts the following actions are recommended:

- Joining initiatives that support countries in developing and implementing their LTS, for example, the 2050 Pathway Platform.
- Establishing forums, whether regional or international, to reach consensus among various countries on technical and governance matters, and open room to share best-practices and lessons learned.
- Developing a LTS roadmap and investment plan as tools to facilitate international collaboration.
- Using aspects of Research, Development and Demonstration (RD&D) for international coordination efforts.

Beyond these seven categories, the integration of countries' attempts to reduce emissions caused by **Short-Lived-Climate-Pollutants (SLCPs)** in countries' LTS was assessed as the reduction in emissions provide immediate benefits by slowing down the rate of global warming and improving air quality. The analysis highlighted that many countries mentioned SLCPs, especially methane, but that only a few introduced concrete measures on how to reduce emissions caused by SLCPs for the long term.

Concluding remarks

The analysis concludes that, despite their non-mandatory nature, as outlined in Article 4.19 of the Paris Agreement, LTS are instrumental in successfully guiding the direction and approach of efforts to develop, implement, and update long-term climate targets that go beyond the short to medium term targets of NDCs. Thereby, LTS can be used to inform raising ambition of NDCs and setting a pathway for net-zero ambitions.

The analysis supported the view that there is no silver bullet for overcoming the institutional shortcomings that countries often face in the process of developing and implementing their LTS. However, good practices do exist, which countries can use, adjusted to their national needs, circumstances, and conditions.

As a first step, countries could consider identifying key factors and conditions that help to start the development process for the LTS. In this context, high-level political support and capacity-building efforts should not be left out, notably the training of government agency staff, to increase their technical and managerial skills.

The analysis also identified that strengthening institutional arrangements invariably requires heightened efforts on several fronts: coordination across different levels of government, and input from governmental and non-governmental parties; integration of strategies into sectoral and cross-sectoral programmes and projects, and identification of the required technologies; engagement of a broad range of stakeholders through consultation campaigns or participatory policy processes, to elicit their input; and ambitious initiatives to revise regulatory frameworks and streamline legislative provisions.

Not least, increased emphasis on international cooperation, and on monitoring and reporting are central to countries' efforts for reaching their long-term low-carbon targets. These activities should be considered in the LTS.

5 Market-based approaches for international cooperation are focused on the creation of incentives and disincentives to enhance the performance of public actors for sustainable outcomes. Incentives can take on various forms, e.g.: tax reliefs, subsidies, or levies.

Sandton, Gauteng/South Africa - 05/28/2019: Aerial photo of Discovery Head Office
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01 Introduction

The Paris Agreement invites all parties under the United Nations Framework Convention on Climate Change (UNFCCC) to formulate and communicate long-term low greenhouse gas emission development strategies considering their common but differentiated responsibilities and capabilities, in the light of national circumstances (UNFCCC, 2015, art. 4.19). UNFCCC Decision 1/CP 21 called on member states to communicate their Long-Term Strategies (LTS) by 2020, with a planning horizon of 2050. Further, the Conference of the Parties (COP)26 in Glasgow in November 2021, in Decision 1/CP.26, inter alia, encouraged Parties that had not yet submitted their LTS to communicate their LTS by COP 27 (UNFCCC COP26, 2022). By April 2025, only 76 parties had submitted their strategies to the UNFCCC (UNFCCC, 2023). Against this background, the Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment report calls for more ambitious greenhouse gas emissions (GHG) reduction efforts, to reach net-zero emissions after 2050, is a sobering reminder of the importance of developing Long Term Strategies and strengthening already developed strategies (IPCC AR6, WG3, 2022).

The effective implementation of long-term emission reduction strategies requires certain institutional arrangements, policies, and programmes. Effective governance and institutional arrangement mechanisms for designing countries' LTS and consequently framing the roadmap for the implementation play an essential role in the success of the process and can differ across different actor groups (Elliott et al., 2019; Rocha & Falduto, 2019). However, many developing countries lack the technical and financial capacities for developing their LTS, resulting in abstract and vague strategies that lack transparency in terms of scope, implementation plans, and investment plans, and are poorly anchored in their national policy processes. Institutional shortcomings, analyzed in a 2018 publication by the (at the time) UNEP DTU Partnership, are a key reason for both the ambition gap identified by the IPCC and the poor response thus far to the request under UNFCCC Decision 1/CP 21 (IPCC, 2023b; UNFCCC Secretariat, 2022). Indeed, the available case studies highlight that removing such institutional shortcomings is a key precondition for progress in this area (and in other related areas). Hence, this publication is a follow-up on the guidance document "Institutional capacities for NDC implementation (Bakhtiari et al., 2018)" published in 2018, with the inclusion of a more deep-going analytical part.

1.1 Long-Term Strategies and their role in the Paris Agreement

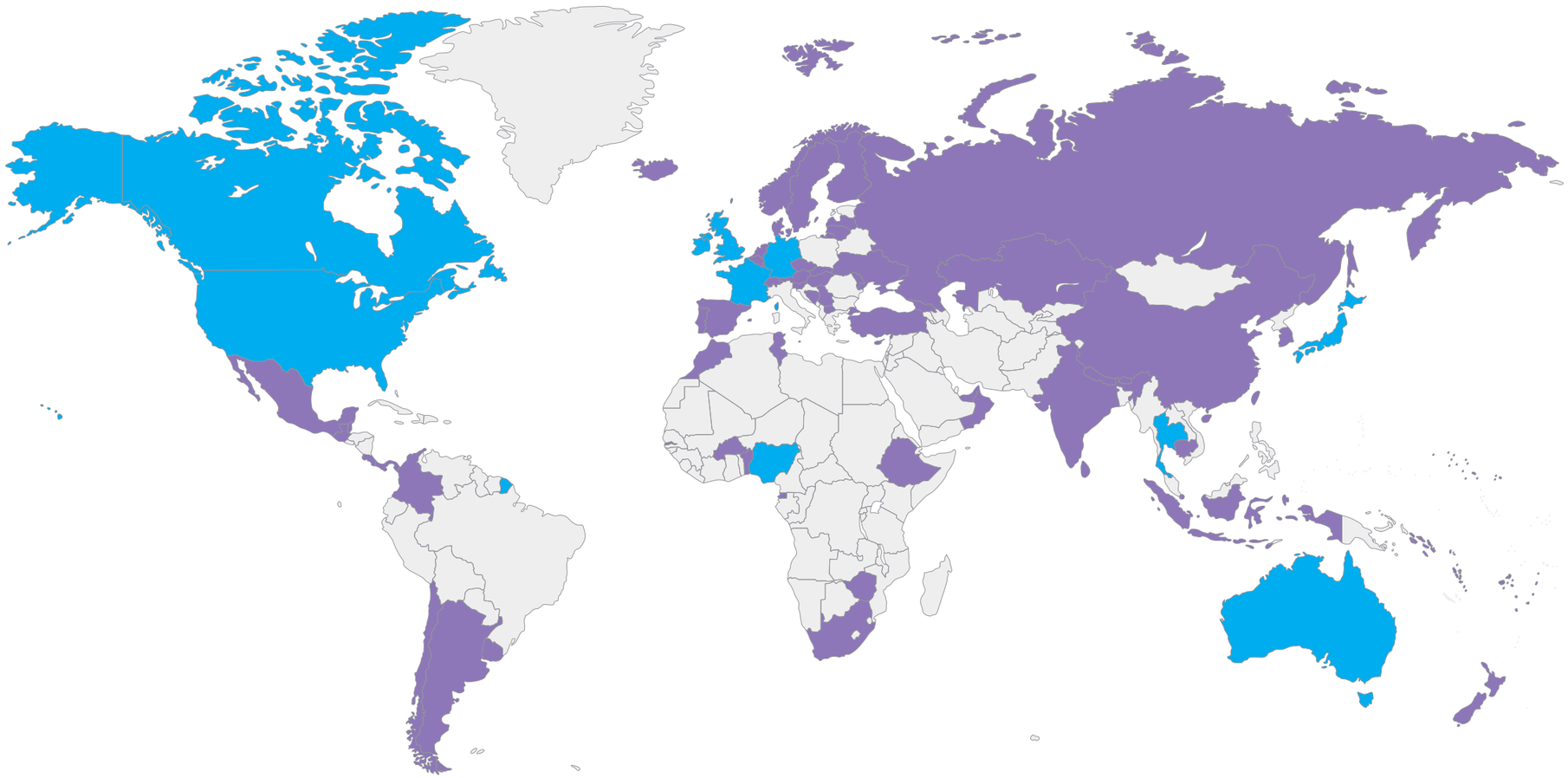
Strategies for long-term climate actions are gaining more and more importance in the national and international climate discourse. Parties' long-term strategies are central to achieving the overall goals under the Paris Agreement to limit global warming to well below 2 degrees Celsius above preindustrial level, while pursuing efforts to limit temperature increase to 1.5 degrees (UNFCCC, 2015, art. 2). Article 4.19 of the Paris Agreement further encouraged countries to submit their LTS voluntarily until 2020, but the global health pandemic caused delays in countries' submission (UNFCCC, 2015, art. 4.19). As the Paris Agreement does not provide any terms of reference for the development or implementation of LTS, enhanced efforts by the international community are indispensable. The Emissions Gap Report 2022 warned that, under the baseline scenario of current policies with no further action, the world is heading towards reaching global warming of 2.8 degrees by the end of the century. Hence, the world is in urgent need of a system-wide transformation to avoid closing the window of opportunity. LTS are envisioned as a necessary tool to achieve this transformation as incremental change to limit climate impacts is no longer an option (UNEP, 2022). The importance of long-term strategies is twofold: they provide an opportunity for national action to be in-line with the required ambition and they prevent countries from costly investments in irrelevant technologies (WRI, 2020). These strategies can lend support at national level to structure policies and integrate climate-action measures linked to other societal and economic objectives, as well as enhancing trust among other countries (ICF, 2020; Rocha & Falduto, 2019). LTS support a better understanding of how states are promoting the transition to decarbonization and carbon neutrality, based on their efforts to impose and replicate regulation, and to contributing catalytically to effects in other countries (Tan et al., 2022). Thereby, most of the LTS integrate an economy-wide, country-and national development-driven main goal to guide their path towards long-term decarbonization (Guerrero García, 2018). The characteristics are expanded as LTS provide a systemic roadmap to avoid lock-in of infrastructure and land-use with long-term emission implications and stranded assets. Further, they support a just transition, prepare countries for risks and uncertainties, encourage investment, identify technological needs and gaps and provide opportunities to include a cross-sectoral perspective (Vener et al., 2019). Consequently, LTS are important for countries to pursue a transition towards net-zero emissions by 2050, describing a state in which as the best scenario, more carbon dioxide is captured than is emitted much (WRI, 2018a).

COP15 in Copenhagen led to the emergence of climate negotiations around the concept of low-emission development strategies. The Copenhagen Accord (27CP.15 p.2) encouraged parties to develop these Low Carbon Development Strategies to decouple GHG emission growth from economic growth (UNFCCC, 2009) and notes that "a low emission development strategy is indispensable for sustainable development" in the Cancun Agreements (1/CP 16, p.6). It called upon countries to define a long-term vision, in most cases for mid-century, and a direction to promote more enhanced climate action with the inclusion of a pathway to a whole-of-society transformation (Rocha & Falduto, 2019; WRI, 2020). Consequently, carbon neutrality or an even more ambitious target, net zero, by mid-century is included by nearly all the 76 countries in their LTS as a quantified goal for emission reduction, excluding Morocco and Tonga. For example, the Republic of the Marshall Islands is set to reach net-zero emissions by no later than 2050. Although net zero is an important component, this publication focuses primarily on parties' overall strategies to boost human, financial and technical capacities and how certain institutional arrangements can be integrated, augmented, and employed to achieve this.

Rooted in their voluntary nature combined with their non-binding requirement, LTS have taken several different forms, for different policy instruments, and differ widely regarding the nature of commitment. The latter depends on whether the country linked its strategies to existing laws, mandates, or decrees to enhance the legal binding element. Therefore, recent scholars envisioned the provision of guidelines for Parties' on how to set up their LTS under a defined governance structure, solid institutional arrangements under the pursuance of a whole-of-governance and societal approach (Bakhtiari et al., 2018; Hinostroza et al., 2014; Rocha & Falduto, 2019). Even though there is no one-size-fits-all model for designing LTS, research has identified central aspects and elements to boost countries' LTS. These include low-emission pathways, sustainable development considerations, mitigation and adaptation components, implementation approaches, sectoral strategies, monitoring plans and revision processes (Abeysinghe, 2018; WRI, 2018a). Above all, it is also crucial to gain the support of stakeholders with different perspectives, objectives, and values to effectively bring about systemic change. LTS can provide a clear and transparent framework to evaluate the effects of different policy options and structure policy debates at the national level. Additionally, LTS can serve as an "ambition backstop" to remind actors of the need for short-term actions to bring about deep systemic change (Ross, Schumer, et al., 2021).

As of publishing this report, 76 parties have submitted their LTS to the UNFCCC, 10 out of the 76 parties have already submitted a revised version of their LTS (source updated in bibliography to 2025).

FIGURE 1 **World map of countries LTS submission**



World map of countries who already submitted their first version of their LTS (Purple) and the ones that already submitted an updated version of their LTS (blue color), created: 13.11.2023.

Blue countries: countries that already submitted an updated version of their LTS

- Australia
- Canada
- France
- Germany
- Ireland
- Japan
- Nigeria
- Thailand
- United Kingdom of Great Britain and Northern Ireland
- United States of America

Purple countries: countries that only submitted their first LTS version

- Andorra
- Argentina
- Armenia
- Austria
- Belgium
- Belize
- Benin
- Bhutan
- Bosnia and Herzegovina
- Burkina Faso
- Cambodia
- Chile
- China
- Colombia
- Costa Rica
- Cyprus
- Czechia
- Denmark
- Equatorial Guinea
- Ethiopia
- *European Union submitted one as the Union, but we did not mark it on the map
- Fiji
- Finland
- Gambia
- Georgia
- Guatemala
- Hungary
- Iceland
- India
- Indonesia
- Kazakhstan
- Latvia
- Lithuania
- Luxembourg
- Malta
- Marshall Islands
- Mexico
- Morocco
- Nepal
- Netherlands
- New Zealand
- North Macedonia
- Norway
- Oman
- Panama
- Portugal
- Republic of Korea
- Russian Federation
- Serbia
- Singapore
- Slovakia
- Slovenia
- Solomon Islands
- South Africa
- Spain
- Sri Lanka
- Sweden
- Switzerland
- Tonga
- Tunisia
- Türkiye
- Ukraine
- United Arab Emirates
- Uruguay
- Vanuatu
- Zimbabwe

1.2 Purpose and Scope of Publication

This publication aims to provide an in-depth technical qualitative analysis of countries' LTS, considering six components of the institutional arrangements: coordination, stakeholder engagement, sectoral integration, regulatory framework, human capacities and reporting; including a number of samples with particular focus on the gaps encountered by developing countries in developing their LTS. Two additional LTS elements are analyzed: (i) components related to international cooperation and (ii) short-lived climate pollutants (SLCPs)[6], that have rarely been touched upon by previous scholars (Rocha & Falduto, 2019; Ross, Schumer, et al., 2021, 2021; Vener et al., 2019) nor analyzed in the sample selection applied in this publication. The publication is the first of its kind to conduct deep qualitative analyzes using a qualitative software combined with surveys and interviews to illustrate challenges in countries' capacities to develop and implement their LTS, while emphasizing an analysis of best practices and providing potential solutions. These challenges will be applied to the categories of institutional capacities analyzed in the 2018 publication (Bakhtiari et al., 2018). For each of these categories, the publication provides guidance on typical barriers and how to overcome them.

The target groups of this publication are developing country government officials, national policymakers, and the experts on which they rely to conduct background work for the LTS development. Arguably, the document is also of relevance for international donors and teams in their developed country counterparts.

1.3 Institutional Capacities for Long-Term Strategy Implementation

Even though LTS are not mandatory for parties, their development and implementation are highly encouraged to reduce global emissions. Strong governance mechanisms and institutional arrangement play a vital role in the success of the development and implementation of LTS, which can differ among diverse actor groups. Thus, institutional arrangements backed-up by strong governance are desired to implement strategies effectively while ensuring credibility and public acceptance. Institutional arrangements assign clear roles and responsibilities, structures, and incentives to coordinate; capacity and procedures to manage and share information; and processes to encourage inclusive stakeholder engagement. Often, the creation of dedicated climate-change agencies, intergovernmental bodies, committees, task forces, or public-private partnerships is in focus. Institutional arrangements aim to establish the necessary structures, encourage decision-making and policy-making processes, collaboration and accountability efforts among various stakeholders and institutions involved in addressing climate change. In contrast, institutional capacities are defined as capabilities, resources and expertise within an organization or institution to address challenges effectively. This involves establishing the knowledge, skills, technology, financial and human resources, and infrastructure needed to develop and implement climate-related policies, programmes, and projects. Based on research and experience with implementing Nationally Determined Contributions (NDCs), there are several components that should be included when creating the necessary infrastructure for the development and implementation of LTS. The key components in the previous publication have been selected based on interviews with government officials and experts (Bakhtiari et al., 2018).

The six main categories of institutional arrangements taken into closer consideration in the empirical analysis are:

1. **Coordination:** refers to the ability to launch and coordinate a whole-of-government process, incorporating contributions from all relevant governmental agencies and non-governmental parties. Coordination mechanisms set out clear roles and responsibilities for all relevant stakeholders. (Chapter 2)
2. **Stakeholder Engagement:** links various actors via mechanisms such as consultations or participatory processes to coordinate, design and implement on a common-agreed strategy. In general, it oversees how far different stakeholders are involved in the development process. (Chapter 3)
3. **Sectoral Integration:** refers to the capacity of government and non-government officials to integrate long-term targets and strategies into sectoral and cross-sectoral programmes and projects. (Chapter 4)
4. **Regulatory Frameworks:** are essential for every LTS and defined as a system of regulations, standards and administrative procedures relevant for its implementation. In the following, it will be analyzed in how far countries have linked their LTS to already existing frameworks or planned to establish new ones. It also includes the competence to conduct a revision of the framework, streamline it and complement with existing laws to strengthen the process. (Chapter 5)
5. **Human Capacities:** include the ability to train government agency staff as well as non-government agency staff while increasing technical and managerial skills of individuals. (Chapter 6)
6. **Reporting:** is explained by the ability to monitor progress and report on it, making use of existing data collection mechanisms and strengthening capabilities. (Chapter 7)

In addition, the category of international cooperation is included in the analysis and the category for SLCPs (Annex B).

- **International Cooperation:** Our initial search and interview results indicated that coordination efforts are closely connected to international cooperation and whether a country has integrated aspects of it, therefore we have included this subcomponent in our analysis. It refers to all the international market mechanisms that the country adopts (as the main way or a complementary solution to reach its commitments as defined in the LTS) including attempts of countries to coordinate and collaborate with other countries to reach their climate goals and support one another. (Chapter 8)

1.4 Structure of the document

The report is structured around eight chapters and three annexes. Chapters 2 to 8 discuss each of the six institutional capacities plus international cooperation as outlined above. Each area is structured consistently: (i) introduction to literature and capacities required, (ii) findings of the empirical assessment, (iii) gaps and challenges (iv) potential solutions and recommendations. Chapter 9 presents concluding remarks and suggests likely short-, mid- and long-term challenges associated with institutional capacities for LTS implementation. The information provided in the following chapters represents a snapshot of the material in the existing literature that has been analyzed and which is judged to be most relevant for this report[7].

To this end, this report provides analytical information that can be used by countries yet to submit their LTS, in order to establish and enhance the necessary institutional capacities. It can also be useful for countries that have already submitted, but that wish to revise their Long-Term Strategies. LTS submitted by Annex I and Non-Annex I parties are examined on common characteristics. It is based on a brief review of existing literature and reports, followed by an extensive qualitative content analysis of countries' LTS documents and coupled with country interviews and questionnaires, leading to a result evaluation including different country examples and derived recommendations. In addition, clarification on the linkage between NDCs and LTS is provided.

6 Annex B

7 The complementary information will be available upon request

1.5 Methodology

The following section provides information on the applied methodology including our research design and sampling strategy. To explore countries' long-term low-carbon emission reduction strategies and revise categories for institutional arrangements, we primarily carried out a qualitative content analysis (QCA) for 20 long-term emission reduction strategies from different countries submitted to the UNFCCC. In addition, we conducted interviews and sent out questionnaires to selected country's governmental focal points[8]. The chosen qualitative methods allowed for higher flexibility and a systematic categorisation of the data, which solely quantitative research would not have provided. The findings are arranged according to the thematic content areas for the institutional arrangements: coordination, stakeholder engagement, regulatory framework, sectoral integration, human capacities and reporting. The category of international cooperation is also included. In addition to countries' attempts on how to integrate aspects of each category, the literature and the empirical assessment also revealed barriers. To complement the assessment, small case studies are included to illustrate how some countries are fulfilling the criteria of the institutional arrangements in practice and to share good practices. Additional information for the methodology including limitations and coding selection in form of a codebook are found in Annex A.

1.5.1 Data Collection and Sample

The sample selection of countries for the QCA is based on countries that have already submitted strategies to UNFCCC. To leave the coding process simple, the sample was restricted to parties that have submitted their strategies in English. Only strategies that were submitted by October 2022 are included, updates of LTS or new submissions after October 2022 are not considered in the QCA[9]. In addition, it was agreed to focus primarily on developing countries, as the literature has covered these to a lower degree. However, it was decided to also include four selected Annex-I countries which historically have had strong institutional arrangements for international reporting and could be learned from. No other exclusion criteria were given, e.g., regarding focus or geographical area.

The final sample for the QCA includes LTS from 20 different countries. The countries included can be clustered into four Annex-I (France, Germany, United Kingdom of Great Britain and Northern Ireland and United States of America) and sixteen Non-Annex-I (Andorra, Cambodia, China, Costa Rica, Fiji, Gambia, Indonesia, Republic of Korea, Republic of the Marshall Islands, Mexico, Nepal, Nigeria, Singapore, South Africa, Thailand and Tonga) countries.

In addition, to the countries that have submitted their LTS, we have collected information from some countries that have not yet submitted their LTS to indicate some general potential challenges they may have faced. Detailed information on the countries is displayed in Table 1.

TABLE 1 Parties analyzed

Parties	Annex (A)/ Non-Annex I (NA)	Geographics	Income level	Share of global GHG	Quantified GHG emission target (yes or no)
Andorra	NA-I	Central Europe	High	0.00%	Yes
Cambodia	NA-I	South East Asia	Lower middle	0.14%	Yes
China	NA-I	East Asia	Upper middle	24.23%	Yes
Colombia	NA-I	South America	Upper middle	0.54%	Yes
Costa Rica	NA-I	Central America	Upper middle	0.02%	Yes
Fiji	NA-I	Oceania	Upper middle	0.00%	Yes
Gambia	NA-I	West Africa	Low	0.01%	Yes
Indonesia	NA-I	Southeast Asia	Lower middle	3.48%	Yes
Mexico	NA-I	Central America	Upper middle	1.42%	Yes
Nepal	NA-I	South Asia	Lower middle	0.10%	Yes
Nigeria	NA-I	West Africa	Lower middle	0.71%	Yes
Republic of Korea	NA-I	East Asia	High	1.38%	Yes
Republic of the Marshall Islands	NA-I	Oceania	Upper middle	0.00%	Yes
Singapore	NA-I	South Asia	High	0.14%	Yes
South Africa	NA-I	South Africa	Upper middle	1.06%	Yes
Thailand	NA-I	Southeast Asia	Upper middle	0.88%	Yes
Tonga	NA-I	Oceania	Upper middle	0.00%	No
France	A- I	Europe	High	0.74%	Yes
Germany	A-I	Europe	High	1.59%	Yes
United Kingdom of Great Britain and Northern Ireland	A-I	Europe	High	0.90%	Yes
United States of America	A-I	North America	High	11.60%	Yes

Creation: author, information from: (UNFCCC, 2023)

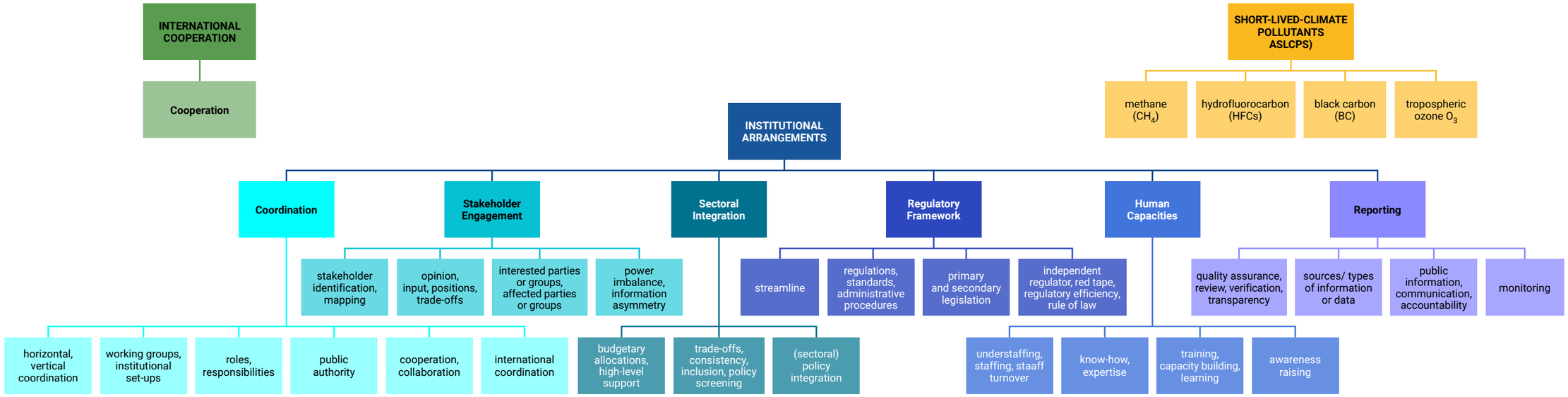
1.5.2 Qualitative Content Analysis

A QCA is an evaluation method often used for social science research projects that process and analyze large amounts of collected data. The qualitative approach is based on Mayring's theoretical foundations and is one of the most common methods to analyze qualitative data (Mayring, 2014). With the application of the QCA, the content and aspects of texts can be investigated in a systematic and comprehensible way, while the complexity can be reduced (Früh, 2017). This approach enabled us to investigate sizable collections of textual data in the form of parties' LTS with identification of trends, word use, patterns, and relationships. We conducted a QCA, using a deductive approach for the structure and development of main categories (coding units), to organize and elicit meaning from the collected data and to draw realistic conclusions from it (Bengtsson, 2016).

8 Questionnaires were shared with countries that have submitted their LTS and countries that are part of our NDC action project and are preparing their LTS. For information on the NDC Action project: https://www.unep.org/ndc/about/what-we-do

9 New submissions after October 2022: Singapore (03.11.2022), Argentina (06.11.2022), Thailand (revised version, 07.11.2022), Zimbabwe (08.11.2022), India (14.11.2022), Cyprus (07.02.2023), Oman (02.05.2023), Belize (03.05.2023), Ireland (16.05.2023), Vanuatu (17.05.2023), Sri Lanka (05.06.2023), Ethiopia (21.06.2023), Bosnia and Herzegovina (19.07.2023), Georgia (25.07.2023), Solomon Islands (04.09.2023), Bhutan (22.09.2023) (UNFCCC, 2023)

FIGURE 2 **Categorical Classification of codes and subcodes used for the QCA in MAXQDA**



Source: author

A full list of the six main categories of institutional arrangements with all relevant subcodes, coding-categories and the two additional categories of short-lived climate pollutants[10] and international cooperation are displayed in Annex A - Codebook and Methodology expansion.

The subcodes/subcategories were selected based on synonymous meanings and acronyms of the main coding categories and in which context-relevant information might occur. Most of the codes were defined deductively, but some subcodes have been added and identified inductively, such as the subcategory of "streamline" under the institutional arrangement of the regulatory framework (Hsieh & Shannon, 2016). An expanded list of all codes and sub-codes including synonyms and acronyms can be found in Annex A in form of a Codebook. The Codebook provides further information on single selection criteria for each coding category and potential difficulties during the coding process.

The software MAXQDA, version 22 (VERBI Software, 2021) was applied for the qualitative analysis, namely the text analysis using defined codes/key words and synonyms. In order to speed up the search process and avoid double counting redundant elements displayed in long-term strategies, the documents were shortened before being used in MAXQDA. Thus, the "original submissions" were cut into a more approachable form. Chapters and parts that have been excluded, were: cover, foreword, preface, table of content, executive summary and references parts. Then, an automatic code alignment generator was used to match relevant text segments with codes for the different categories, like "human capacity" or "regulatory framework". The software automatically included variations in the wording for different coding units, e.g.: for coordination, to coordinate, coordinating. Afterwards, the authors manually double-checked the work to assure that the codes matched the actual contextual meaning. Any codes that did not fit the unit were removed. Finally, the coded textual segments were summarized and grouped according to countries' level of capacity for each institutional arrangement to draw conclusions.

1.5.3 Interviews and Questionnaires

Complementary data was collected through questionnaires, interviews, and written requests from developing country officials involved as technical staff for the LTS submissions. Information from the data obtained through the country officials are included in the results section and combined with the empirical findings of the QCA.

- **Interviews:** The interviews were conducted following a semi-structured approach. A semi-structured interview was applied as it allows deviations from the questions asked and thus gives more freedom of establishing an engaging conversation between the interviewees and interviewer. The course of conversation could be individually adapted. The interview focused on two parts:
  - **PAST:** From the point of view of the process of preparing the long-term strategy, what were the main institutional challenges (for example, in the context of (i) coordination between ministries, or (ii) coordination between the national government and the provincial or local governments, or (iii) consulting with the private sector, non-governmental organizations and civil society, or (iv) the appropriateness of the regulatory framework, or (v) the extent to which government has the right human resources).
  - **FUTURE:** From the point of view of the process of implementing the long-term strategy, what are the main institutional challenges that can be foreseen (see (i), (ii), (iii), (iv) and (v) above).
- **Questionnaires**[11]**:** Surveys were sent out to two groups of countries: i) Countries that have submitted their LTS and ii) Countries that have not submitted their LTS which were mostly countries supported under UNEP NDC Action Project[12] that are in the process of developing their LTS. Thus, the questionnaires have been used as complementary source of accessing information and data.

The rationale behind the questions for the interviews and for the survey is to explore the institutional arrangements challenges that countries are facing and their potential solutions.

10 *Evaluation for the category of SLCPs in Annex B*

11 *Questionnaires are available on request. Nine Non-Annex I Parties are covered through the interviews: Andorra, Cambodia, Colombia, Ecuador, Indonesia, and Thailand; questionnaire responses: Ghana, Mongolia, and Uganda; and on written request from Morocco. As Morocco submitted their LTS in French, additional information was acquired through a written request by a technical focal point and added to the sample after the analysis has been already finalised.*

12 *The NDC Action Project assists ten partner nations in transforming their Nationally Determined Contributions (NDCs) into practical sector strategies and actions that are prepared for financing and implementation, as well as enhancing the ambition of their NDCs. https://unepccc.org/project/ndc-action/*

BOX 1 Linkages between LTS and NDCs

This section provides a brief overview of the linkages between LTS and NDCs and the relation to the Paris Agreement, indicating resemblances and divergences.

Current short-term national climate plans and parties' Nationally Determined Contributions (NDCs) aim at limiting global warming to 2.7-3.7 degrees, thus ambitious long-term strategies are vital and unavoidable (UNEP, 2022; WRI, 2018b, p. 201). LTS give life to the concept of the Paris Agreement while providing a link between short-term NDCs and their long-term objectives (WRI, 2020). NDCs are perceived as tools for the LTS and connecting element to the goals set in the Paris Agreement (ICF, 2020). Various scholars have emphasized the need to harmonize the LTS review process with future NDCs cycles. Consequently, LTS can be used to inform target setting in the medium and short term to put a sector or the economy on a pathway towards decarbonization, and save costs and resources later (Hans et al., 2020; Levin & Fransen, 2019). While NDCs focus on a timeframe of 5-10 years, LTS usually have a time horizon of 30 years. Parties can use their LTS as guidance for NDCs to identify short-term gaps and integrate proper action plans for addressing them (Vener et al., 2019). One of the major distinctions between the NDCs and LTS is that Parties to the UNFCCC are required to submit their NDCs (2015, p. Paris Agreement, article 4, paragraph 2), whereas the submission of LTS is still voluntary. Therefore, countries' submission to the UNFCCC does not presently provide the complete level of global long-term climate action and this should be kept in mind while reading this publication. The same applies to the process for updating LTS. Starting from 2020, parties are required to update their NDCs every 5 years, there is no timeline nor guidance on updating LTS. The Paris Agreement included a mandate for the accounting, tracking and reporting process towards NDCs, which is not the case for LTS (Levin & Fransen, 2019).

A coordinated timing for the revision of LTS with processes of communicating new and updated NDCs every five years entails many benefits, as the inclusion of the long-term vision can provide a better understanding of countries' barriers and how to overcome them. This can be supported by an example from Rocha & Falduto (2019) where the substitution of coal with natural gas is perceived as an effective emission-reduction measure in the short term. When including the long-term effects of this action, it is recognized that the transition from coal to natural gas alone, without further implementation efforts and development of carbon capture, utilization and storage (CCUS) technologies may be insufficient to meet the transformational needs for the long run (Rocha & Falduto, 2019). Further benefits are the reduction in costs and the increased efficiency of planning processes if NDCs and LTS are aligned (Levin & Fransen, 2019). A detailed distinction of the differences and similarities is shown in Table 1. Chapter 7 - Reporting clarifies further the extent to which countries are updating, reviewing, and aligning their LTS targets to the cycle of their NDCs and vice versa.

TABLE 2 Overview differences and similarities between NDCs and LTS[13]

DIFFERENCES		
	NDCs	**LTS**
Planning horizon	5-10 years	Approximately 30 years
Frequency of Updating	Every 5 years started in 2020	Not specified
Targets	Most targets contain economy-wide quantified emission reduction targets and non-GHG targets	No targets required to be specified, but countries have included one or several quantitative GHG reduction targets
Alignment	Aligned with national climate-change policies	Aligned with long-term national development priorities
Requirements	Mandatory, requirements for accounting, reporting, and reviewing process	Voluntary, no requirements on accounting, reporting nor reviewing
Legal character	"Each party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve"	"All Parties should strive to formulate and communicate long-term low greenhouse gas development strategies"

SIMILARITIES AND BENEFITS	
NDCs	**LTS**
NDCs can align near-term decisions with LTS	
LTS offer countries a long-term perspective to inform the design of development trajectories that align with the Paris Agreement goals and inform NDC target setting for the medium-term	
Provision of systematic roadmaps for parties to take enhanced climate action	
LTS can guide and enhance the design and implementation of more ambitious NDCs	
Both can underpin sustainable and inclusive growth	
Synergies with 2030 Agenda for Sustainable Development and Just Transition	
International climate finance might flow more easily to a country with a clear long-term pathway aligned with its national short and medium-term strategies	
Harmonized approach for NDCs and LTS is more resource-efficient than developing separate analysis for each sector, strategies, plan	

13 Source: (Hans et al., 2020; Levin & Fransen, 2019; Rocha & Falduto, 2019; Vener et al., 2019)

BOX 2 SLCPs

In addition to the linkages between NDCs and LTS, international attention to air pollution and short-lived climate pollutants (SLCPs) has grown. SLCPs, including greenhouse gases like methane and HFCs, as well as air pollutants such as PM2.5 (including black carbon) and non-methane ozone precursors, are responsible for nearly half of the anthropogenic warming experienced today. Between 2015 and 2022, progress was made, but only 62 Nationally Determined Contributions (NDCs) recognized the importance of air pollution co-benefits. Many countries still do not prioritize SLCPs or air pollution mitigation in their NDCs. Researchers argue that increasing focus on SLCP and air pollution mitigation could help raise climate ambition in future NDC updates (Malley et al., 2022). This study evaluates how SLCP and air pollution mitigation are reflected in NDCs. Initial findings also highlight that Long-Term Strategies (LTS) are essential for avoiding lock-in to high-emission technologies and minimizing risks from stranded assets.

For example, the Climate and Clean Air Coalition (CCAC) is a voluntary partnership of over 200 governments, intergovernmental organizations, and non-governmental organizations founded in 2012, and convened within UNEP – focused on reducing powerful but ***short-lived climate pollutants*** – methane, black carbon, hydrofluorocarbons, and tropospheric ozone – that drive both climate change and air pollution.

The CCAC provides support to countries to integrate non-CO_2 pollutants into their NDCs to enhance climate ambition and deliver multiple near-term benefits. Its latest publication (reference to: ***Leveraging the Benefits of non-CO_2 Pollutants and Air Quality in NDC 3.0***) outlines practical and strategic recommendations for experts and teams involved in preparing NDC 3.0 on how to set goals and identify specific measures suitable to the national context. The Guidance recommends that countries' NDC 3.0 include non-CO_2 mitigation targets across key sectors, align air quality and climate planning, leverage complementary policies and initiatives, and adopt robust assessment and reporting frameworks to enhance transparency and attract resources.

Including SLCP reduction in LTS can help countries pursue more sustainable development paths (Levin et al., 2019). The new emerging component of LTS and further explanation on why countries should include aspects to reduce SLCP emissions is elaborated in ***Annex B***.

Fishing village,Takawiri Island Lake Victoria,Kenya,Africa
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02 Coordination

Coordination is the process of working together with others to achieve a common goal. This can be done through formal or informal means and can involve any number of people. The inclusion of coordination efforts is essential as the lack of understanding of climate-related issues among key government decision-makers and in priority given to other development area can hinder the production of ambitious LTS. Hereby, it is important for organizations, ministries, and other relevant governmental bodies to coordinate their activities, actions, and strategies. Thus, climate change and sustainable development are complex problems that require the involvement of much of the government, and hence coherent and coordinated response across scales. Some key questions have guided our set-up of this category including (El Haite, 2018; Elliott et al., 2019; Rocha & Falduto, 2019):

- Is there a high-level political mandate in the country for setting up a LTS? Is there an institutional leader supporting the strategy?
- Has a special committee /task force been set up to develop, coordinate and lead the strategy?
  - Does a committee/ task force already exist or would it need to be created?
  - Will the committee/ taskforce be an inter-ministerial body?
  - What are the roles and responsibilities of and with the committee/ task force?
  - Will the task force seek inputs from other stakeholders?

There exist different mechanisms for coordination. One approach is to include different ministries and subnational or local governments to broaden the scope and enhance political support. The other is to build on pre-existing sectoral, regional, and urban strategies to deepen policy coordination (Jaber et al., 2020). The public policy literature (Peters & Pierre, 2006) distinguishes between three dimensions of coordination: coordination through hierarchy involving vertical and horizontal aspects, coordination through markets and coordination through networks:

- Coordination through hierarchy is a system of organization in which structures and rules define roles and responsibilities to achieve a common goal. This system can be divided into two categories: vertical coordination, which is between the national level of government and any relevant sub-national levels, and horizontal coordination, which is between ministries working directly in climate change.
- Market-based coordination uses incentives, such as tax reliefs, subsidies, or levies, to get public actors to work together more effectively.
- Network coordination measures are used to create and share knowledge between actors. Additionally, policy coordination with other ministries and actors secures the incorporation of technical knowledge of experts while adding more credibility and reliability to the LTS.

Previous scholars have assessed how the four Annex-I countries, Germany, France, United Kingdom of Great Britain and Northern Ireland and United States of America have their coordination component in place:

- The development of the "Climate Action Plan, 2050" in Germany involved the whole of government including primer Chancellor Merkel. The creation of the LTS was led by the Federal Ministry of Environment, Nature Conservation, Building and Nuclear Safety and supported by other relevant Ministries (Elliott et al., 2019; Jaber et al., 2020).
- France involved relevant ministries and subnational entities in the modeling of its reference scenario, by creating a Steering Committee. The Steering Committee was co-chaired by the Ministry of Ecology, Sustainable Development and Energy, and the Agency for the Environmental and Energy Efficiency. Beyond this, the Minister for Ecological Transition played a supervisory role as the Environmental Ministry was responsible for developing the LTS. France ensured strong political commitment for the creation of the plan by having it endorsed by the former prime minister (Jaber et al., 2020).
- In the United Kingdom of Great Britain and Northern Ireland, the Department for Business, Energy, and Industrial Strategy (BEIS) used inputs from other departments as the basis for potential sectoral targets with division into national and local areas of action. The United Kingdom of Great Britain and Northern Ireland did not establish a Steering Committee, but involved other relevant ministries such as the Department of Food and Agriculture (Jaber et al., 2020).
- In the case of the United States of America, the LTS was produced primarily by the Obama Administration through the Council on Environmental Quality and the Domestic Policy Council with technical support from various Agencies. However, due to time constraints before the end of Obama's Presidency, the White House did not consult the broader public through an engagement process (Elliott et al., 2019; Rocha & Falduto, 2019).

2.1 Qualitative analysis of coordination in countries submitted LTS

Coordination efforts and aspects are integrated to a wide extent in nearly all the examined LTS. Most of the countries acknowledged increased coordination efforts and elaborated on aspects of why both horizontal and vertical coordination measures are important. Many LTS additionally emphasized the role and responsibilities of stakeholders and inter-sectoral connections.

Countries' arrangement with regard to 'coordination entity for long-term strategy':

Coordination efforts and aspects are integrated to a wide extent in nearly all the examined LTS. Most of the countries acknowledged increased coordination efforts and elaborated on aspects of why both horizontal and vertical coordination measures are important. Many LTS additionally emphasized the role and responsibilities of stakeholders and inter-sectoral connections.

Countries' arrangement with regard to 'coordination entity for long-term strategy':

Looking at the countries' past practices in preparation of reports and pledges such as national communication and NDCs, most countries have assigned a single governmental entity, "a lead institute", which can be called the coordinating entity. Our findings supported this, as for most cases a "single coordination entity" was dedicated to lead the development process of the LTS, more detail in Table 3. The coordinating entity cooperates and works with assigned teams within line ministries and with relevant non-governmental groups such as non-governmental organizations (NGOs) and non-state actors. Countries established new public authorities or used existing teams/committees in order to structure and coordinate the process. Some countries also made use of engaging their high-level political leaders in the process of preparation of their long-term strategy. The Republic of the Marshall Islands emphasized that high-level support from the government or certain entities can act as an enabler to achieve certain goals, such as the integration of educational plans (The Republic of the Marshall Islands, 2018, p. 63).

TABLE 3 Summary of organizational structures in case studies

COUNTRY	LEAD ENTITY
France	Ministry for an Ecological and Inclusive Transition had supervisory role as Ministry for Environment was in charge to develop LTS
Germany	Federal Ministry for Environment, Nature Conversation and Nuclear Safety
United Kingdom of Great Britain and Northern Ireland	Secretary of state within the Department for Business, Energy and Industrial Strategy (BEIS)
United States of America	The White House, Executive Office of the President
Andorra	Ministry of Environment, Agriculture and Sustainability
Cambodia	The Department of Climate Change of the General Directorate of Policy and Strategy /Ministry of Environment/the National Council for Sustainable Development and Cambodia Climate Change Alliance Phase 3 coordinated the development of the LTS with support from development partners (international organizations and countries)
Colombia[14]	Ministry of Environment
Costa Rica	Ministry of the Environment and Energy and Ministry of Economic Planning
Fiji	Climate Change and International Cooperation Division (CCICD) at the Ministry of Economy with support from the Global Green Growth Institute (GGGI). CCICD also set up a Steering Committee serving as advisory group, providing guidance, information, recommendations, and advice to CCICD
Gambia	Ministry of Environment, Climate Change and Natural Resources (MECCNAR), in close partnership with the Ministry of Finance and Economic Affairs. The Climate Change Secretariat (CCS), working under MECCNAR, oversaw the overall coordination of the LTS elaboration process
Indonesia	Ministry of Environment and Forestry
Mexico	Ministry of Environment and Natural Resources
Nepal	Ministry of Forests and Environment
Nigeria	Federal Ministry of Environment at the Department of Climate Change
Republic of Korea	Korean government: the Ministry of Environment, who established a 2050 Low-carbon Vision Forum allowing participation by different actors to gather input, which shaped the development process
Marshall Islands	Tile Til Eo Committee (TTE), a committee independent to government decision-making processes
Singapore	The Inter-Ministerial Committee on Climate Change, led by Senior Minister Teo Chee Hean and assisted by the National Climate Change Secretariat, serves as the national coordinating agency for climate change issues under the Prime Minister's Office and Strategy Group
South Africa	Department of Environmental Affairs
Thailand	In 2017, Thailand established the National Committee on Climate Change Policy as the primary decision-making body for climate change management. The Subcommittee on Climate Change Policy and Planning Integration is responsible for providing recommendations and input on the integration and development of climate change policy, strategy, and plans, with a focus on both mitigation and adaptation for the Long-Term Strategy (LTS)
Tonga	Department of Climate Change under the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change, and Communications

Authors' creation based on QCA. Source: countries' LTS

France, Germany, the United Kingdom of Great Britain and Northern Ireland and the United States of America involved a range of ministries in implementing their LTS. Thus, vertical coordination measures have been included. Horizontal coordination aspects were not left out either. France provided a comprehensive inclusion of where, what and how coordination is needed to achieve their climate goals. Both the United Kingdom of Great Britain and Northern Ireland and France mentioned market-based coordination approaches to impose carbon taxes or tax reliefs and exemplified on how cooperation with the international community was in focus. The United Kingdom of Great Britain and Northern Ireland government is also planning to convene and lead a new international working group to drive down the cost and accelerate development of CCUS. The recognition of local leadership aspects as an essential tool for embedding low-carbon measures in strategic plans and its shared responsibility across the country, led the United Kingdom of Great Britain and Northern Ireland pursue horizontal coordination mechanisms. This demonstrated that, the formation of partnerships across different scales can unlock powerful integrated local energy solutions (United Kingdom of Great Britain and Northern Ireland, 2017, p. 102).

In Mexico, coordination among government levels and line ministries was managed through the National Climate Change System. The country follows a hierarchical coordination strategy including vertical and horizontal elements while connecting to already existing institutional arrangements. The LTS implementation was carried out by the leadership within the Ministry for Environment and Natural Resources with coordination and support from the National Institute for Ecology and Climate Change and Climate Change Interministerial Commission, a body consisting of 13 federal ministries to advise the government (Mexico, 2016). While Mexico relied on existing regulatory arrangements, Costa Rica developed their LTS without a formalized set of arrangements or coordinating body (Elliott et al., 2019). This consisted of a small team within the Ministry of Environment and Energy, the Office of Climate Change and the Ministry of Planning, the University and a few external consultants. Other measures to strengthen coordination were based on the establishment of working groups to boost implementation of key actions for defined time periods. This coordination efforts will be reinforced through multi-sectoral and dimensional coordination from the Presidential Environmental Council in close collaboration with other relevant actors (Costa Rica, 2019). Cambodia emphasized a similar strategy as it planned to complement their capacity needs through the creation of technical working groups tackling aspects of climate change (Kingdom of Cambodia, 2021). Other Non-Annex I parties such as Nepal included a precise framework for coordination in their LTS with focus on improving communication lines between different levels of governance as well as marginalized communities and individuals. Nepal also established a technical committee to provide oversight and technical guidance for the LTS process (Nepal, 2021, p. 25). Singapore created a long-term emissions and mitigation working group with responsibility to envision the country's post-2020 future in a carbon-constrained world. The working group conducted a rigorous modeling exercise to develop key mitigation strategies and low-emission pathways (Singapore, 2020, p. 33). Fiji established the National Climate Change Coordination Committee to align ministerial and departmental activities with relevant policies and frameworks, implement and monitor these policies, and assess progress towards climate-change integration. The National Committee is comprised of the permanent secretaries and nominated representatives from government ministries, departments, and agencies and functions on behalf of the Fijian Government (Fiji, 2019, p. 208). Colombia developed its LTS by gathering inputs from focal points of relevant ministries to define common goals for its 2050 vision. The country also has an Intersectoral Climate Change Commission, which is an interministerial body that takes high-level decisions for the environment[15]. In the Moroccan case, development, and the ownership of the LTS project were guided by a multi-stakeholder, multi-sector, and multi-scale governance approach. A participatory institutional governance structure was established, based on a Political Steering Committee, a joint high-level Technical Expertise Committee with public/private representation, and the seven Sectoral Decarbonization Groups (GSDs). The coordination entity assigned for the development of the LTS differed to the entity responsible for its implementation and update[16].

14 Information from interview with country focal point

15 Colombia interview

16 Information from written request provided by a Moroccan national focal point

Targeted collaboration turned out to be a tool for countries to include aspects of coordination across the public and private sectors. South Africa has a sub-chapter on how to enhance institutional capacities and arrangements towards achieving a carbon-neutral stadium. To translate this into reality, capabilities for the overall economy need to be strengthened and closer links to the research community, civil society and business community integrated (South Africa, 2020, pp. 44–45). Discussions have emerged regarding commitments to create and disclose Long-Term Strategies (LTS) in forums like the G7 and G20, aiming to generate additional momentum. It is suggested that G20 countries could pledge to utilize the G20 working group on energy as a platform for sharing insights on LTS development and commit to creating and publishing LTS within a specific timeframe. Another opportunity would involve increasing participation in reviews, such as the fossil fuel subsidy peer review within the G20 framework, as proposed by South Africa (South Africa, 2020, p. 41).

2.2 Coordination-related institutional capacities that are required for LTS implementation, but that countries often lack

This passage highlights significant gaps in the institutional capacities necessary to operate coordination mechanisms for Long-Term Strategy (LTS) implementation. Empirical findings indicate that most countries recognize the need to establish or utilize an existing coordinating entity. However, developing countries often face constraints due to insufficient funding or understaffing issues. These limitations impede the coordination entity's ability to fulfill its role, particularly when **high-level political support is scarce, institutions are fragmented, and the coordination entity's responsibilities extend beyond core duties.**

Limited high-level political support.

There are countries where coordination entities do not yet have the required high-level support from top government to be able to coordinate the LTS related work efficiently and engage all relevant agencies and stakeholders. In some cases, maintaining long-term high-level support for the coordination entity remains a challenge for a number of reasons, including change of political system or change in government.

Institutional fragmentation, financial and human capacity inadequacies:

Institutional fragmentation refers to the situation in which there is not enough coordination and alignment across sectoral priorities and therefore not much agreement on policy initiatives. Coordination entities often encounter two further challenges that arise from financial and human capacity inadequacies in developing countries' governments. First, some government agencies have staff with low qualifications, and more skilled or educated personnel often opt for better-paying job opportunities. Second, in some countries, sectoral government bodies lack the necessary institutional frameworks to participate in dialogues regarding the implementation of LTS. Consequently, they rarely prioritize this over other possible applications of their resources. Here, the intersectionality of various institutional arrangements is visible as uncertainty on the international financial support is a major barrier to produce more ambitious LTS.

The role of the coordination entity expands beyond core duties:

In some cases, the coordinating entity is expected to manage duties which require expanding the entity's role and responsibilities which is beyond its existing capacities. For example, although the establishment and maintenance of donor relations seems a relevant task for the coordination entity, it also adds new responsibilities. In other cases, alignment and establishing synergies between the NDC tracking process and reporting, as well as related tasks about the Sustainable Development Goals (SDGs), adds more burden.

Other countries identified coordination challenges in overcoming technological constraints. For example, Cambodia is in great need of external support and hence, intensified coordination action to achieve their climate targets, as the implementation of their strategy requires substantial public investment over a horizon of 30 years. Cambodia designed a public financing plan focused on the necessary national and international support (Kingdom of Cambodia, 2021). Before Cambodia's LTS was developed, support was pursued by various actors including the United Kingdom of Great Britain and Northern Ireland, World Bank, and other international bodies (Cambodia[17]). Equally, Thailand requested support from the international community for their coordination efforts in terms of capacity building and development of policy, research, technology and appropriate mechanisms and instruments (Thailand, 2021).Colombia mentioned being confronted with two major challenges: first on **how to maintain financial support by the international community and how to detach from being coal dependent**. The latter was further challenged as major industrial nations such as Germany increased their coal imports from Colombia due to an increasing fear of energy shortages caused by the Ukraine war[18].

2.3 Recommendations for bridging gaps in coordination capacity

This section provides broad recommendations for overcoming some of the mentioned capacities gaps as outlined in 2.2. The recommendation is based on the empirical analysis to support the implementation, development, and update of LTS under required institutional capacities for enhanced coordination efforts in especially developing countries. In addition, the content draws further on the authors' experience in working with developing country governments to prepare and implement LTS as well as with related planning and implementation processes.

In general, the assessment has emphasized countries' commitment to address respective aspects through strengthening institutional set-ups, working groups, increase responsibilities and different forms of coordination (vertical and horizontal). It was highlighted that a coordination entity can reap many benefits through its responsibility for leading the implementation process. The coordination entity tasked with developing the LTS may differ from the structures or entities responsible for its implementation and subsequent updates. The primary responsibility of the coordinating entity is to bring all relevant actors under a single governance structure together. This can, on the one hand, minimize transaction costs, and on the other, enhance synergies among actors. Consequently, this requires political will, coordination, and participatory processes across a broad range of stakeholders with specific analytical resources and expertise. High-level political support enables the coordinating entity to achieve these goals as increased coordination across government agencies effectively involves a change in the status quo. The acknowledgement of a link between coordination and human resources is one of the preconditions for more ambitious capacity-building initiatives, awareness-raising training sessions and workshops for staff and relevant actors. Based on our assessment and experience, we recommend that a coordination entity should have the following responsibilities (Bakhtiari et al., 2018):

- Secure high-level political support for the LTS development and implementation process.
- Building on existing arrangements, countries can benefit from the existing structure for gathering governmental and non-governmental partners together to prepare a national climate policy plan or, for example, update NDCs in alignment with LTS.
- Map the institutional climate change-related networks, to identify the key entities and their respective portfolios with various LTS priorities.
- Identify gaps in institutional capacity related to defining and implementing long-term scenarios and targets and draw up a plan for bridging them.
- Review and suggest improvements in connection with the regulatory needs for countries' long-term target implementation.
- Supervise and steer the contributions of the different committees, working groups and relevant actors involved in long-term implementation, to ensure that all parties deliver on their respective commitments. In some cases, formal working groups need to be set up before this can happen to reduce technical constraints.
- Facilitate collaboration with pertinent sub-national agencies and stakeholder groups, involving local businesses, ensuring alignment with their capacities and the needs of the implementation process.
- Act as a mediator in situations where disputes arise, such as disagreements over responsibilities or potential conflicts of interest between parties.
- The coordination entity should include gender focal points and representatives from women and marginalized communities to integrate gender perspectives into all stages of planning and implementation.
- In general, the increase of capacities in areas of climate change, climate-change impacts, risks, finance can address most of the coordination shortcomings.

To ensure successful implementation, it is crucial to involve sub-national governments and other relevant groups. However, meaningful engagement by sub-national actors typically requires support, such as funding and training. While the coordination entity may not have the authority to decide on such support availability, it can identify the needs of sub-national actors and bring them to the attention of relevant decision-makers.

Lastly, as a national lead entity responsible for main coordination tasks is usually not involved in technical functions, we propose that countries could establish a technical coordination entity which can work under the supervision of the coordinating entity. The technical entity can consist of national experts organized by thematic or key areas. For instance, the "technical coordination entity" could be a University/Faculty, or an office within a ministry, whereas the "coordination entity" may be the whole ministry.

17 *Cambodia Interview*

18 *Colombia interview*

Bangui Windmills in Ilocos Norte, Philippines
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03 Stakeholder Engagement

The integration of elements for stakeholder and public engagement into countries' LTS is of highest importance as it potentially increases public acceptance, ensures a fair transition to new climate options, and results in improvement in countries' long-term strategies. Relevant questions that have guided our assessment approach for this category were (Elliott et al., 2019; Rocha & Falduto, 2019):

- Who are the stakeholders to be included in the engagement process, such as civil society organizations, subnational authorities, scientific institutions and universities, the private sector, citizen groups, and vulnerable and indigenous populations?
- What will constitute effective means of engagement, such as through participation in the analysis, public consultation, in-person workshops, surveys, and/or an interactive website?
  - How will stakeholder feedback be taken into consideration and incorporated into the development process?
- At what point will the engagement process begin, and will it continue during implementation?
  - Do sufficient human capacity and adequate financial resources exist to manage and sustain the means of engagement?

A stakeholder is defined as any individual or group that can affect or is affected by, a public policy action while also being able to define such action (Bakhtiari et al., 2018). There are certain aspects that can be taken into account for countries to involve a broader range of stakeholder engagement such as through a consultative and participatory process (Rocha & Falduto, 2019). Stakeholder consultation encompasses three sets of activities: identifying stakeholders (a task that is often referred to as "stakeholder mapping"), eliciting input from stakeholders, and determining trade-offs (Bakhtiari et al., 2018). A wide stakeholder engagement has many benefits such as the sharing of leading, increasing transparency and supporting the acceptance of decisions taken (UNFCCC Secretariat, 2022). In most cases, a designated entity within the government will oversee coordinating LTS implementation (Chapter 2). This entity is likely to be well placed to organize the stakeholder consultation process that is deemed most relevant to support LTS implementation.

Scholars emphasized aspects for strong political commitment and engagement to facilitate the design of their LTS. In the case of Germany, their LTS was adopted following a whole-of-government approach including the Chancellor endorsing the final strategy. Germany and France organized workshops with key stakeholders including trade unions, business associations, civil society groups and subnational governments. In addition, France conducted a month-long online public consultation in the early phase of developing its LTS, whereas Germany initiated a public dialogue with citizens. For the public dialogue in Germany, citizens were randomly recruited by telephone to participate (Elliott et al., 2019; Jaber et al., 2020; Rocha & Falduto, 2019). Fiji and Republic of the Marshall Islands involved the Prime Minister and President to guide the development process of the country's LTS and conducted extensive stakeholder consultation (Abeysinghe, 2018). Fiji convened stakeholders in three workshops and Republic of the Marshall Islands emphasized the role of marginalized groups with focus on women. Mexico created advisory councils in all states and organized workshops with over 80 experts from NGOs, academia and the private sector (Rocha & Falduto, 2019). South Africa also included a wide range of various actors from businesses, industry, academia, local governments and agencies (Elliott et al., 2019; Ross, Elliott, et al., 2021).

3.1 Qualitative analysis of stakeholder engagement in countries submitted LTS

This section analyzes what measures and instruments different countries used for wide stakeholder engagement and consultation. The focus is on different aspects linked to stakeholder engagement such as stakeholder mapping, opinions, power imbalances, consultation and identification. Many diverse stakeholders have been engaged in the LTS and the importance of engaging different stakeholders is mentioned by all countries. Nonetheless, there are differences in the level of engagement, inclusion and consultation.

Table 4 shows countries that dedicated significant capacity to including a wide range of actors and describes different approaches.

TABLE 4 Stakeholder engagement strategies for LTS implementation by various countries

STAKEHOLDER ENGAGEMENT STRATEGIES AND PROCESSES BY COUNTRY FOR PROPOSED LTS PREPARATION, IMPLEMENTATION, AND CONSISTENCY	
COUNTRY	**STAKEHOLDER ENGAGEMENT**
France	In France, workshops were organized with a broad range of stakeholders (trade unions, businesses, civil society and environmental organizations, local authorities and more) for consultations on specific targets that should be included in the country's LTS. In addition, France had public consultations, created an interactive website and allowed for an open comment period. Another interesting aspect worth mentioning is the institutionalization by law for the preparation of the 2015 Transition Law which created an ad hoc Council for the Energy Transitions (CNTE). The law mandates that the LTS needs to be regularly reviewed and revised every five years in a consultation process with the CNTE, which convened a wide range of different actors. France was also emphasizing on marginalized groups that are most affected by climate change and how a whole-of-societal perspective is enhancing the circumstances (France, 2016).
Germany	Germany developed their LTS by following previously established institutional arrangements and allowing representatives of the federal states, local authorities, associations (trade unions, businesses) to propose potential measures, which were revised with an impact assessment by the Institute for Applied Ecology. Beyond this, Germany pursued a bottom-up approach, in which 500 citizens were randomly selected to discuss the Climate Action Plan, creating an open dialogue for everyone. Five thematic working groups made a division of mandates possible, while creating a space for input provision and discussion exchange (Germany, 2016).
United States of America	The United States of America pursued a different approach due to a compressed timeline, relying on structured discussion with the private and non-profit sector in just a few meetings to implement the LTS (United States of America, 2021).
Colombia	Due to the Covid-19 pandemic, Colombia had to change to an online format of convening with relevant stakeholders. Previous concerns turned out to be beneficial as the virtual format was cost-efficient and allowed the country to conduct more workshops than initially planned to include a broad range of stakeholder: region and local governments (9-10 workshops conducted), indigenous people (5), marginalized communities (3), young and youth people (2-3), scientists (5-6), NGOs (many). An online public consultation process was also made accessible for the private sector and companies, where around 10,000 comments were collected and used for the LTS design[19].
Costa Rica	Costa Rica's stakeholder consultation process included bilateral meetings, workshops, and input collection, for developing the LTS with non-governmental actors. Input was collected by various stakeholders including NGOs, private sector, representatives from municipalities and academia (Costa Rica, 2019).
Fiji	Fiji's Climate Change and International Cooperation Division (CCICD) primarily led the preparation process of their LTS by engaging members of the Steering Committee as well as numerous national and international experts and various stakeholders through a participatory process. The participatory process convened three National Stakeholder Workshops to gather input and feedback and provide a range of different stakeholders with information about the LTS process and its progress. The LTS provided a clear description of how the stakeholder consultation process was done with focus on outcomes, remarks, results, changes, concerns including institutional barriers, and the overall engagement. The second stakeholder consultation workshop involved face-to-face meetings with government ministries (Fiji, 2019).
Gambia	In Gambia, the formulation of the LTS involved a wide consultative and participatory process with various stakeholders to elicit their input for the design of the strategy. Gambia ensured that the LTS review process would be all-inclusive, involving both governmental and non-governmental stakeholders (Gambia, 2022).
Mexico	Mexico's elaboration process of the LTS was supported by technical and scientific inputs primarily by the INECC (in English: National Institute for Ecology and Climate Change). For the consultative process, inputs were received from the Core Advisory Councils on Sustainable Development, a workshop with experts from civil society, private sector and academia and from a nation-wide online consultation process (Mexico, 2016).
Nepal	In Nepal, the Ministry of Forest and Environment developed the LTS through a participatory and consultative process with assistance from UNDP, NDC Partnership and the Policy and Institutions Facility. Additionally, a technical committee was formed to provide technical guidance. As part of the LTS implementation process, the government of Nepal started with a stakeholder mapping to identify all relevant stakeholders. Further attention was put on aspects of legal and institutional measures to implement the LTS through federal and local government in collaboration with other relevant actors. Nepal clearly elaborated on its LTS preparation and approval process including the framework design, consultation and validation process with different actors, approval and endorsement by the Council of Ministers before submission to the UNFCCC (Nepal, 2021).
Singapore	For the LTS design, Singapore created a technical roadmap to ensure that more input could be gathered from various actors. This step pursued the creation of an online platform for stakeholders to disseminate information on climate change, collect public feedback and elicit their input. Additional input was collected through an extensive (online) public consultation process, an engagement session for a wide range of stakeholders to facilitate in-depth and focus group discussions (Singapore, 2020).
Republic of Korea	The Republic of Korea held an open public forum to include perspectives from experts of civil society, academia, and industry while emphasizing that transformative change can only be achieved if consensus among stakeholders is considered. In a follow-up, a consultative body composed of representatives from 15 ministries conducted online surveys, public discussion and expert consultations allowing diverse opinions from industry, civil society, and the youth (Republic of Korea, 2020).
Tonga	Tonga's LTS provides a precise picture of how stakeholder consultation and mapping was performed. Tonga guided three workshops including instruments for strategic dialogues among various actors and technical experts. Sectoral pathways were guided by seven principles that were defined by diverse stakeholders. Relevant synergies between mitigation and adaptation were identified through stakeholder consultation processes, addressing topics such as improving productivity and diversity of agroforestry, enhancing home gardening or the expansion of marine protected areas and special management areas. Tonga is a good example of how effective stakeholder consultation worked as an inclusion method to identify improvement areas, synergies and further key components to include in the LTS to make it effective (Tonga, 2021).

Source: author's assessment of QCA

19 (Colombia's interview result performed by the authors 2022).

We could not find any information showing whether the Annex I countries included options or opened room to elicit inputs from youth. In contrast, the Republic of the Marshall Islands, Nepal and Singapore actively opened a window of opportunity through accepting input dialogue and opinion by youth and younger citizen generation. Singapore organized a Youth4ClimateFest2019[20] to provide a platform for youths to express their passion for the environment while encouraging dialogues to find innovative solutions for climate change (Nepal, 2021; Singapore, 2020). Republic of the Marshall Islands emphasized differentiated gender perspectives with steps to increased gender-disaggregated data collection to identify gaps, needs and opportunities for marginalized groups including women, children and youths. One strategy included the active involvement of women, men and youths as valuable stakeholders in addressing the climate-change concerns of their communities and sharing knowledge for responses to ensure their strengthened resilience as well as making a gender analysis mandatory (The Republic of the Marshall Islands, 2018). The engagement of youth in climate-change dialogue is perceived as an opportunity to incorporate their voice and allow for a more board-based inclusion of various actors.

Summing up, the strategy of how different actors have been involved in the preparation and implementation process of the LTS is mentioned and clearly described in most of the assessed national LTS. This was done through different approaches such as (online)-meetings, workshops, surveys, open comment periods, interactive websites or public consultation processes. Countries engaged different actors to secure expert feedback and greater buy-in and/or support from sector ministries, local authorities, and civil society and on how to build up a shared vision. Capacity building attempts turned out to be another key element identified that can support an open and inclusive dialogue on how to involve various stakeholders. Lastly, the assessment supported stakeholder engagement being used to maintain political support as it is often built upon convergence of interest at global, national, and local levels.

3.2 Stakeholder engagement-related institutional capacities that are required for LTS implementation, but that countries often lack

This section highlights significant gaps in the institutional capacities to involve stakeholders in supporting the implementation of Long-Term Strategies (LTS). Stakeholders who already have interest in climate change are often more eager to participate in consultation in comparison to stakeholders with lower interest but high influence on causing changes (Bakhtiari et al., 2018). Therefore, it might be challenging to identify and engage the "right" stakeholders. For example, there are challenges such as:

- Lack of interest from some stakeholders such as civil society who are not directly working with the climate-change area particularly LTS or NDC concepts to participate in consultations
- Lack of proper institutional arrangements to involve stakeholders at subnational /local level where there are limitations related to the level of knowledge and the number of stakeholders and therefore their availability. When it comes to engaging private sectors for example financial institutions, the consultation topics are not directly relevant to the companies' direct commercial focus and interest. Therefore, given the challenge of finding relevant stakeholders and the risk of misleading outcomes from wrong stakeholders, the coordinating entity may choose to limit the consultations which itself has a negative effect on the quality of inputs received

The assessment illustrated that developing countries faced several constraints regarding available capacities for rich stakeholder engagement pursuance. Some developing countries mentioned being confronted with challenges on **how to react to different levels of awareness, knowledge and capacities in terms of experience and availability across different stakeholders**:

- Lack of required knowledge by stakeholders which makes the quality of outcomes challenging irrespective of how the governments are experienced in revealing inputs from stakeholders

Other constraints were mentioned in areas of **technical capacity**, if it is accessible to include various stakeholders or if a solution to wider stakeholder engagement is through dedicating a special task force to lead the process. This was linked to a **lack of specific mandates** and limited expertise in **convening stakeholders and eliciting input**. Countries also emphasized **constraints in the form of political buy-in** from stakeholders and on how to assure high political and public acceptance in the long term.

3.3 Recommendations for bridging gaps in stakeholder engagement capacity

The following section serves as guidance for countries on how to overcome some of the mentioned constraints and how to strengthen the overall stakeholder engagement process. The suggestions are derived from results of the empirical assessment to prepare and implement long-term climate strategies.

The findings led us to conclude that the pursuance of a whole-of-society inclusion at all stages in the policy process (Lasswell, 1951; Ronit & Porter, 2015) to design, develop and update LTS is unavoidable for successful climate governance. It supported that inclusive and broad stakeholder consultation entails many benefits: it increases consensus and enhances the credibility of the chosen approach and gathers information that is required to define the LTS implementation process. Solutions for how to increase buy-in such as involving civil society to make the process less political and strengthen its ambition were under focus. Consequently, political mandate and leadership are key to reaching consensus for climate visions.

20 The Youth4Climate fest 2019 is organized by City Development Limited, in partnership with the National Environment Agency, National Parks Board and ActiveSG. It is an event to provide youth a platform to express their passion for the environment and learn about the importance of preserving it (Singapore, LTS).

The pursuance of a mixed-method approach of the following suggestions might be the most efficient recommendations to include a whole-of-stakeholder engagement process:

- **Steering committee for stakeholder engagement**

  Countries can dedicate working groups to engage with a variety of stakeholders in the process of developing pathways and implementing plans for the long term. For instance, Cambodia emphasized the importance to engage all relevant stakeholders under the leadership of one single authority unit, the National Council for Sustainable Development (Kingdom of Cambodia, 2021). Another option is to establish an inter-ministerial committee with the participation of secretaries of deputy ministers that can strengthen climate-change policies and stakeholder consultation in the countries.

- **Climate partnership with private sector organizations**

  Several countries, including Mexico, collected inputs from private stakeholders in workshops. South Africa included a chapter on the role of sub-national government and the private sector in their LTS (Mexico, 2016; South Africa, 2020).

- **Climate platform to provide a forum for dialogue on climate-change issues**

  As in the case of the Republic of Korea (Table 4) and in South Africa, where intergovernmental forums will be required to serve as Provincial Forums on Climate Change to coordinate climate-change response actions (South Africa, 2020).

- **Facilitating sector-specific climate dialogues and partnerships with key stakeholders**

  Germany facilitated an online dialogue, open for everyone to collect ideas for long-term climate targets and organized a meeting for stakeholders to discuss actions in five thematic working areas (Germany, 2016). Additionally, Morocco relied on a targeted awareness-raising and communication strategy to support stakeholder engagement in the LTS implementation by ensuring visibility and widespread ownership of the LTS objectives, fostering support across society[21].

- **Citizen climate assemblies to discuss, for example, implementation plan for LTS targets and recommend specific climate policies**

  Countries can also establish citizen climate assemblies to discuss and recommend specific climate policies, such as in the United Kingdom of Great Britain and Northern Ireland and France (France, 2016; United Kingdom of Great Britain and Northern Ireland, 2017).

- **Engaging with sub-national authorities to support implementation of national long-term strategy commitments**

  The collaboration with sub-national authorities to make long-term strategies more effective, is a relevant strategy that has been included by many countries in their LTS.

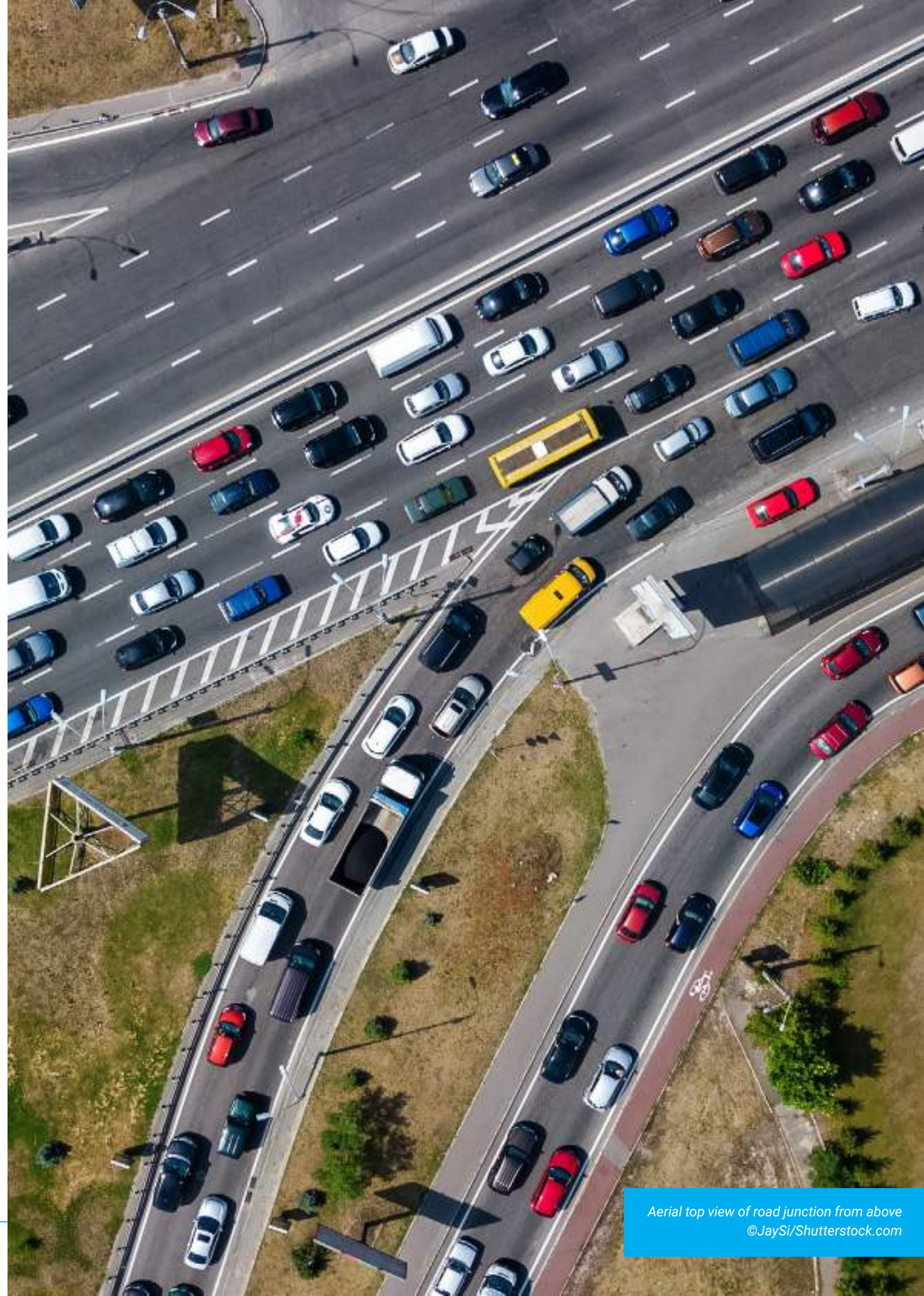
- **Engaging with marginalized groups: youths, women, indigenous people**

  For example, the engagement of youth in climate-change dialogue is perceived as opportunity to incorporate their voice and allow for a more board-based inclusion of various actors (Nepal, 2021; Singapore, 2020; The Republic of the Marshall Islands, 2018). Identifying and providing support to groups and different actors with limited resources is vital.

- **Gender focus and engagement of women**

  Specific strategies to involve women and gender-focused organizations is recommended. This includes reaching out to them directly, creating consultation processes that address gender-specific needs, and making sure women have a seat at the table in decision-making bodies.

21 Information acquired by Moroccan focal point in charge for LTS



Aerial top view of road junction from above
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04 Sectoral Integration

The integration of low-carbon emission strategies into sectoral policies refers to the process of revising sectoral policy plans and strategies to strike a balance between sectoral development goals and climate change priorities. Therefore, it is highly important to incorporate sector-specific targets as they contribute to achieving the defined goals in Long-Term Strategies (LTS). (Bakhtiari et al., 2018).

The definition for the coding category of sectoral integration is based on the guiding questions (Elliott et al., 2019; Rocha & Falduto, 2019):

- Has the country carried out an analysis of the sectors that will be mostly and potentially negatively affected by the transition to reach long-term climate targets?
  - Which sectors will be mostly affected by the transition?
  - What measures and actions are planned or have been put in place to ensure that livelihoods from certain sectors will be compensated by negative impacts of the transition?

In an optimal scenario, countries' LTS should encompass all sectors of the economy as specified in the IPCC reporting framework: energy, industrial processes, solvent and other product use (IPPU), agriculture, land-use change and forestry, waste. Additionally, international aviation and maritime shipping, known as international bunker fuels, should be considered (IPCC AR6, WG3, 2022). However, LTS pathways vary by country meaning that they can be economy-wide or sector-specific with cross-sectoral inclusion.

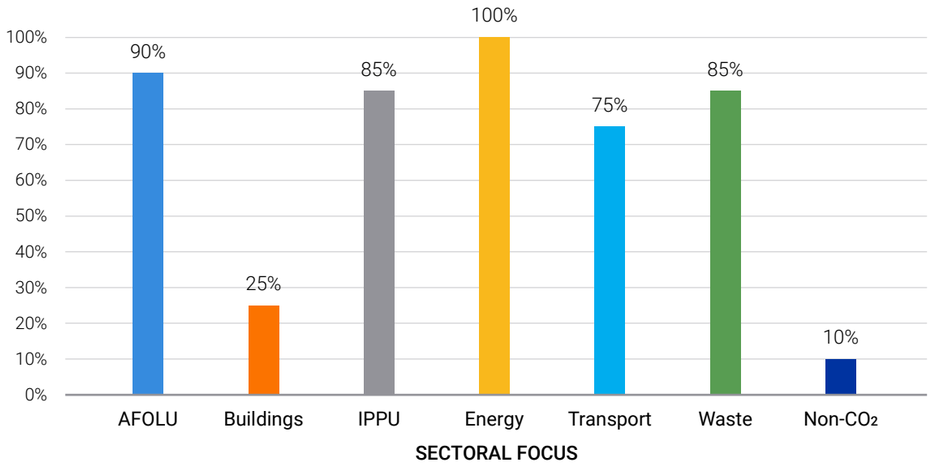
2028 for France, 2030 for Germany and 2032 for the United Kingdom of Great Britain and Northern Ireland are the indicated sector-specific future emission targets provided for the medium term, despite the fact that all have a national target for 2050 defined. France included 23 cross-cutting policy recommendations on climate change such as the management of land sustainability through enhancing urban planning. In addition, France included a sectoral breakdown of the budget as central tool used for monitoring progress across sectors and provided early warnings of the risk of not meeting the national carbon budget. All three case studies included measures for either carbon pricing or taxation. Germany set out a roadmap for each sector with linkages to already existing sectoral plans such as the National Cycle Paths Plan and the United Kingdom of Great Britain and Northern Ireland provides a package of measures, policies and proposals for each sector (Jaber et al., 2020). Fiji also set clear sectoral plan, such as its commitment to achieve 100 per cent renewable energy-based electricity by 2030. The United Kingdom of Great Britain and Northern Ireland divided its sectoral actions into national and local attempts: while power remained as authority of national governments, most agricultural policies were enacted at subnational levels (Jaber et al., 2020). Also, Singapore committed to phase out all internal combustion engine vehicles by 2040 (Ross, Elliott, et al., 2021; Ross, Schumer, et al., 2021).

4.1 Qualitative analysis of sectoral integration in countries submitted LTS

This section presents key findings of the QCA and highlights on selected countries and their approach for sectoral integration. The empirical evaluation assessed that all parties, Non-Annex I and Annex-I, included a multi-sectoral approach to decarbonization in their strategies and emission reduction targets for at least the energy (and/or electricity) sector (Figure 4). Variation in the coverage of different sectors can be explained by countries' geographical differences. Therefore, countries may have decided to concentrate on specific key sectors due to the occurring emission level or explained in existing knowledge shortages depending on national circumstances. For example, Andorra primarily focused on its energy sector, as it is the sector with highest level of GHG emissions (Andorra et al., 2021). Republic of the Marshall Islands developed sectoral strategies for electricity, transportation (land and sea), waste and cooking & lighting (The Republic of the Marshall Islands, 2018). A few countries, Mexico and the United States of America, also included sectoral strategies for non-CO_2 emissions, including SLCPs[22] (Mexico, 2016; United States of America, 2021).

Countries' approach to including sectoral strategies into their LTS also differs. One approach was to develop first an all-encompassing LTS implementation plan, e.g., China (China, 2021). Another was to implement the strategy through a series of separate, sectoral plans like France, Germany and the majority of developing countries. The latter also emphasized that nearly all parties, except Tonga, included determined quantified economy-wide emission GHG reduction targets Table 1: Parties analyzed, creation: author, information from: (UNFCCC, 2023), followed by the application of sectoral models to break economy-wide targets into sectoral goals.

FIGURE 3 Primary sectors covered in LTS (Annex-I and Non-Annex I countries)



Source: authors' own creation

22 *More information in Annex B*

Some countries followed a bottom-up sectoral model approach including different scenario analyzes, mitigation and adaptation targets, assumptions about aggregate socio-economic variables and/or sector-specific variables to predict emission pathways. Another key feature in sectoral integration approaches was that emission-reduction targets and pathways were often underpinned by scientifically sound modeling to emphasize its feasibility and to create technical know-how for future scenarios of the LTS targets. This method was used to provide projections for different emission reduction scenarios, including mostly a Business-as-usual (BAU) and "with measures" scenarios.

Fiji's LTS is quite comprehensive in this regard as it emphasizes four possible low emission scenarios: conditional, unconditional, high ambitious and very high ambitious. All four scenarios were elaborated for each sector and then aggregated to build a whole-of-economy emission reduction pathway for each scenario. Fiji linked the projection scenarios to an extensive stakeholder consultation process to forecast under which scenario net zero is being achieved and by when. Their primary focus is on achieving net-zero carbon emissions by 2050 across all sectors of its economy. It was found that a transformation at the energy sector to one based on renewable energy generation will have the highest impact on mitigation of emission. To achieve the planned sectoral targets and very high ambitious scenario, Fiji underpinned each scenario with key policies and actions. For electricity and energy use, economy-wide energy efficiency measures were proposed and capacity building for renewable energy and smart grid, and increasing education suggested. Other actions in the sector were on introducing new solar, hydro, biomass, wind, waste-to-energy, biogas, geothermal, and energy storage installations (Fiji, 2019). Indonesia followed a horizontal and vertical integration approach, with dedicated sectoral plans and how these can be achieved with avoidance of less-environmentally friendly practices. Deforestation avoidance is mentioned through improving crop productivity and cropping intensity (Indonesia, 2021). Cambodia dedicated efforts to understanding interlinkages between different sectors by setting up meetings between different sectoral working groups and through calculating emissions between sectors without double counting. This alignment was assured through an online-based NDC tracking system, where LTS targets have been included (Kingdom of Cambodia, 2021).

Costa Rica's plan to reach carbon neutrality before 2050 is structured around ten decarbonization axes that are derived from the country's GHG emissions, and incorporate concrete visions for transformation, policies and cross-cutting measures. Focus areas are energy, IPPU and agriculture, Forestry and Other Land Use (AFOLU). For example, one major proposal for transformation in the public transport sector was to replace private automobiles. The country focused on cross-cutting sectoral issues through proposing a funding strategy for a green tax reform. Aspects of human rights and equality were also included to pursue a just and fair transition (Costa Rica, 2019).

The United States of America included twelve different scenarios for low-carbon trajectories with five key transformation routes to achieve net zero and elaborated on cross-cutting measures. For example, the country aims to ensure that zero-emission vehicles dominate new sales for most types of vehicles by the early 2030 (United States of America, 2021).

Germany introduced a new strategy, sector coupling. Sector coupling refers to the idea of thinking about different sectors and the interaction between them under an integrated perspective. An example for sector coupling is that electricity from renewable sources must be used efficiently for heat provision, transport and industry. Germany focused on how to couple the sectors in energy, transport, building and industry to achieve the overall climate targets and link them with cross-sectoral strategies. In this regard, energy efficiency and energy conservation are vital. Beyond this, sectoral integration is linked to implemented standards and laws that focus on how different task forces and working groups can be used to achieve sector-specific targets. For this, it is also essential to include Länder, local authorities and associations as well as the public in the climate-action strategy from the earliest possible start (Germany, 2016).

Stressing the importance of sectoral integration, it has been examined that by integrating multiple sectoral actions and including cross (sectoral) strategies, LTS are becoming more successful. The findings acknowledged that high-level support within governmental units is a precondition for effective sectoral integration.

4.2 Sectoral integration-related institutional capacities that are required for LTS implementation, but that countries often lack

In order to support nations' LTS implementation, this section highlights the major institutional capacity constraints that must be overcome in order to integrate climate change priorities into sectoral and cross-sectoral policies. The main basis for the article is the empirical assessment's appraisal of the experiences that various countries had with the implementation of their LTS. In addition, the authors' conducted interviews with country officials that are involved as technical staff for the LTS submissions to identify further challenges. Examples of countries' approaches to overcome barriers are also mentioned.

One challenge mentioned that hindered the integration of action, with and across sectors, was described as that not so much **internal agreement on a sectoral level** have been taken yet. This challenge was further explained as different line ministries applying various tools, rather than using one common methodology and vertical planning tool, that is openly accessible. This raises questions for example on how to find solutions on how to address emission reductions in the energy sector, to decarbonize the coal industry and to acquire the necessary human resources. In addition, one Non-Annex I country mentioned that it was challenged in coordinating between different ministries to define sectoral targets due to different baseline scenarios and circumstances. For example, the ministry responsible for energy affairs has high capacities in many regards including human staff, financial resources and technical availability. In contrast, the Ministry for Agriculture is more restricted and faced with scarcity in financial resources. Therefore, it was difficult to define targets for the long term in the agricultural sector. The country tried to overcome this challenge by consulting with the treasury of state[23].

Due to a shortage of funding, several developing nations reported having insufficient capacity to combine sectoral agendas. A review of the sectoral policies and plans as well as the potential adoption of alternative measures are required to integrate LTS aims. Usually, more funding will be needed to put such alternative approaches into action. For instance, switching from fossil fuels to renewable energy sources to produce electricity will probably cost more money. Government entities charged with climate change often lack the funds needed to finance these kinds of activities. This low availability of financial, human and technical resources is identified as one of the main reasons why developing countries outlined conditional and unconditional scenarios. For example, Nepal set out clear sectoral targets with concrete policies and actions but mentioned being confronted with constraints to implementation due to financial resources and accessibility. In the AFOLU sector, Nepal proposed the switch to better cultivation practices, rice intensification systems, soil organic matter enrichment and more. Due to financial limitations, two-scenarios were described: one with existing measures and the other one with additional measures (Nepal, 2021).

Sectoral policy screening. Sectoral policies are typically not evaluated against LTS or other climate change-related goals. This is primarily due to two factors. Initially, the majority of government climate change offices do not have an "integration mandate." Because of this, sectoral policymaking only considers long-term sustainability (LTS) when the initiative originates from the line ministries. Second, governments frequently lack the data needed to assess how different courses of action may affect climate change. In the context of mitigation, indirect effects are more difficult to analyze than direct consequences.

23 Name of country remains confidential

Technology identification and evaluation are important tools for implementing LTS. However, developing countries struggle with a **lack of data and information sharing among sectors**. For example, Cambodia recognized a general lack of solid data. Hence, the country suggested for the waste sector to establish a central database to conduct studies on the composition of municipal solid and industrial waste and leakages. But for the required transformative policy measures, a budget allocation for infrastructure and information technology is necessary involving the Ministry of Public Works and Transport, Ministry of Environment, Ministry of Industry, Science, Technology and Innovation and subnational administrator (vertical coordination) (Kingdom of Cambodia, 2021). Republic of the Marshall Islands faced technical constraints due to a lack of resources for estimating the level of GHG emissions associated with international transportation and consequently, implementing concrete action strategies into their LTS (The Republic of the Marshall Islands, 2018). **Lack of LTS related dialogue among ministerial staff** is another challenge toward sectoral integration: Staff in line ministries seldom understand the rationale behind the selection of LTS targets or the methods used to calculate specific targets. Furthermore, employees in climate-change ministries lack familiarity with the specifics of some industries or the policy-making procedures in line ministries, which typically have lengthy timelines and few strategy changes. The lack of a platform that allows all pertinent government departments to regularly communicate information is the root cause of this disparity.

Bureaucracy and regulatory barriers can also be deterrents to integration. For instance, take into consideration a vague land-tenure policy. If the main stakeholders feel that their land will be taken away, efforts to amend local land-use plans to better strike a balance between climate change-related concerns and agricultural development goals are unlikely to move forward.

Local-level capacities. There aren't many attempts to raise the level of expertise of subnational government agencies, mostly because of financial limitations and the belief that funds would be better spent on national government agencies. However, local governments can be crucial in spotting contradictions in the priorities of policy as well as possible concessions that could lessen or completely eliminate the disparities. In addition to its financial component, the problem has an institutional component as well because subnational governmental entities are frequently overlooked in budget planning procedures.

4.3 Recommendations for bridging gaps in sectoral integration capacity

The section presents recommendations for overcoming some of the capacity gaps and suggests central elements that countries need to consider when implementing their LTS. It is based on the empirical assessment and complemented by relevant research and the authors' own experience in working with developing countries.

The empirical assessment supported the idea that integrating LTS priorities into sectoral strategies is a pre-condition for successful LTS implementation. This is explained as sectoral strategies may include policy goals that strengthen LTS goals. For example, changes must be perceived in an integral way with inclusion of institutions at a decentralized level. This connects directly to considerations of how to increase consistency and ensure continuity. As a point of departure, the development of the LTS and defining of its vision, objectives and measures should consider first the local context including that of the country's NDC, national mitigation and adaptation strategies, development strategies and national and territorial sectoral strategies and plans. Hereby, the LTS is designed in a way to ensure synergies and alignment between sectoral strategies that have different medium and long-term objectives.

- **Request that line ministries take LTS targets into account**. It is advised that the government agencies in charge of setting the LTS targets and the LTS coordinating entity persuade their counterparts in other branches of government to include mitigation and adaptation goals in their planning procedures. This means that the right tools and human resources are available, in addition to senior staff in the line ministries being aware of it. It might be possible to institutionalize such a requirement in circumstances where obtaining high-level support for achieving LTS targets is feasible. For example, senior civil servants could ask line ministries to allot staff time to guarantee that policy proposals reinforce rather than weaken LTS target priorities.
- **Establish a tracking system**. Establishing a centralized tracking system is advised in order to coordinate and record each individual effort to incorporate LTS priorities into sectoral policy plans and strategies. By taking this step, a knowledge repository that can be utilized by various actors and sectors in the future is created.
- **LTS complementation by Sectoral Decarbonization Plans or Macroeconomic Analysis**. A sectoral decarbonization plan offers a comprehensive sector-specific roadmaps to guide stakeholders in achieving decarbonization goals within each sector. A macroeconomic analysis can illustrate the consequences of sectoral trajectories essential for meeting the LTS objectives. This analysis underscores the interplay between sectoral and macroeconomic factors, as well as their connection to financial dynamics.
- **Binding element**. Sectoral targets are often lacking a binding element and national circumstances demand different solutions for how to overcome lacks in technical, human or financial resources. A first step that countries could follow is to identify national core priorities important for long-term planning and to determine the origins of emissions. The latter is related to additional analysis through surveys or other methods to identify priority action areas and on how to make resources available for governance agencies to conduct in-depth thematic analyzes and scenario modeling.
- **Train selected government actors**. Another potential solution could be to enhance the credibility of modeling and scenarios by recruiting external experts in the field. For example, in Germany, the models were exclusively developed by external experts (Germany, 2016). Developing countries such as the Republic of Korea and Thailand also relied on the support of external actors to enhance their models and be more precise about future scenario forecasting (Republic of Korea, 2020; Thailand, 2021).
- Another potential solution rooted in lack of data and information between sectors, makes it critical to use the overall capacity of the public sector through **collective resource sharing, skills and knowledge diffusion** to reach long-term climate strategies. A wide sectoral focus is more relevant in countries where emissions are distributed. Countries such as Andorra supported the opposite, as the country's emissions are primarily distributed in the energy sector (Andorra et al., 2021). Nonetheless, all countries targeting the establishment or update of its LTS should consider creating a sectoral roadmap to reach their climate targets.

Solar panel photovoltaic in a rural area
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05 Regulatory framework

The implementation of Long-Term Strategies (LTS) necessitates an appropriate regulatory framework as national legislative and executive actions (laws, policies, strategies, plans etc.) are essential to translate long-term climate goals into action. This section refers to countries' capacity to streamline and complement existing laws and regulations, to strengthen related governmental processes and entities, and to conduct a regulatory framework revision. We define a regulatory framework as a system of regulations, standards and administrative procedures that are relevant for implementing LTS and the mechanisms used to enforce their application (Bakhtiari et al., 2018).

Guiding questions for this category were (Elliott et al., 2019; Rocha & Falduto, 2019):

- Are there legal frameworks (constitutional, statutory, or otherwise) that provide a legal basis or can be leveraged and built upon when designing the LTS?
  - Do they have specific cycles or timeframes that can be aligned with the LTS process?
- Which governance components may need to be addressed through law (i.e., new mandates for planning, information sharing and communication, public engagement, sector coverage of long-term strategies)?

A regulatory framework is important as countries can build on already existing climate strategies to enhance the overall credibility of the LTS, promote time consistency and ensure that the defined priorities are consistent with sector specific conditions (Jaber et al., 2020). Hereby it is beneficial to link new pathways and strategies to already existing targets, laws, and decrees to enhance coherence with other national priorities and measures. Protecting climate targets by law or integrating them into national policy making could facilitate required changes in near-and long-term decision-making and provide domestic support behind the target. This linkage supports countries to identify synergies and trade-offs between climate action and other policy priorities and opens room for optimising resources and ensuring buy-in of key stakeholders (Vener et al., 2019; WRI, 2020). In addition, to ensure its successful implementation, it is important to break down long-term goals into mid-term objectives, develop clear roadmaps for implementation, and create regular monitoring, reporting, review and assessment processes (Rocha & Falduto, 2019).

France, Mexico, Germany, South Africa, United States of America and United Kingdom of Great Britain and Northern Ireland relied on existing institutional arrangements that had been developed during former cross-government initiatives to establish climate laws, strategies and policies. Other countries chose to establish new coordinating bodies or authorise new laws. In Mexico, the National Strategy on Climate Change and the General Law on Climate Change (GLCC), issued in 2012, provided the structure to establish the LTS. In France, a formal law for Energy Transition and Green Growth set a national goal to meet long-term quantitative targets in the strategy, bolstering its legal status. The law mandate established in 2015 covers all sectors and explores transition scenarios for the long term, 2050. In addition, the 2015 Act on Ecological Transition on Green Growth provided the mandate to develop the LTS (Rocha & Falduto, 2019; WRI, 2020). France further incorporated the Multiannual Energy Plan in its LTS. The United Kingdom of Great Britain and Northern Ireland issued a Climate Change Act (CC Act) in 2008, which made its LTS legally-binding and required the government to create an LTS. The use of long-term road maps, institutionalized by United Kingdom of Great Britain and Northern Ireland's CC Act, shapes politics and guides political dynamics for enhanced climate action (Mabey, 2018). The British government also decided to design its LTS linked to the 25 Year Environment Plan and create the LTS at the same time as the Industry Plan, to mutually reinforce each other. The government also developed an innovative, open-source and online energy model called the 2050 calculator to allow everyone, including policymakers, civil society and various stakeholders to engage in the discussion and explore options available to reduce emissions (Bakhtiari et al., 2018; 2050 Pathways Platform, 2017; Elliott et al., 2019; Jaber et al., 2020).

5.1 Qualitative analysis of regulatory framework in countries submitted LTS

This section presents the key findings of the empirical assessment. Two different approaches have been recognized on how countries integrated aspects of a regulatory framework system in their LTS. Some countries opted to create new governing structures and enact new laws to reach targets, while others have chosen to build on existing arrangements and regulations. Table 5 summarizes countries' capacity for LTS implementation to streamline and complement existing laws and regulations or build on new ones.

TABLE 5 Regulatory framework design

COUNTRY	SUMMARY OF COUNTRIES' LEGAL FRAMEWORK STRATEGY, I) ALIGNMENT TO EXISTING REGULATORY FRAMEWORKS, II) CREATION OF NEW ONE FOR IMPLEMENTING LTS
ANNEX-I	
France	**Existing:** (beginning of Ch. 5)
Germany	**Existing and new:** The LTS was developed based on previously established institutional frameworks. The government is also emphasizing on the creation of a new regulatory framework to support specific sectoral, cross-sectoral and national strategies and reach climate milestones by 2030. For example, by 2030 the energy performance of existing buildings must meet the virtually climate-neutral benchmark. Germany used the targets for the transformation of the energy sector as foundation for calculations of sectoral reduction targets (Germany, 2016)
United Kingdom of Great Britain and Northern Ireland	**Existing:** The United Kingdom of Great Britain and Northern Ireland enshrined a legally binding target by law, to reduce emission by 80 per cent relative to 1990 by 2050, while demanding the implementation of its LTS to be mandatory under its Climate Change Act issued in 2008. The Climate Change Act established an independent body of experts, the Climate Change Committee (United Kingdom of Great Britain and Northern Ireland, 2017)
United States of America	**Existing**: The United States of America relied on existing arrangements and implemented sector-specific regulations such as emission standards for power plants, for fuel-economy standards (United States of America, 2021)
NON-ANNEX I	
Andorra	**Existing**: LTS linked to Art. 10 of its Law 21/2018 on the promotion of energy transition and climate change and Law 21/2013 for the acquisition and installation of equipment for using renewable electricity sources (Andorra et al., 2021)
Cambodia	New: The design of the new regulatory framework is planned as soon as the necessary resources, country faces lacks in technological capacities, are in place (more in 5.2.) (Kingdom of Cambodia, 2021)
China	**Existing**: China referred to the overall improvement of the legal and institutional system. It clarified on the need to modify and screen current laws and regulations which are not yet compatible with carbon peaking and neutrality (China, 2021)
Colombia	**Existing:** In December 2021, a Climate Change law was enshrined, enforcing that every new policy needs to be in accordance with the goals as defined in Colombia's LTS and whomever has to abide by that law (Interview[24])
Costa Rica	**Existing** and New: Costa Rica built their LTS without a formalized set of procedures or coordinating organization in place. Even though Costa Rica introduced a new arrangement, the LTS also complements with its Strategic Plan 2050, National Adaptation Plan and an Interministerial Working Group on Climate Change Issues lead by the Ministry of Environment and Energy and Ministry of Economic Planning (Costa Rica, 2019)
Fiji	**Existing**: LTS aligned with Fiji's National Development Plan and other climate-change related strategies such as the National Adaptation Plan (Fiji, 2019)
Gambia	**Existing**: Governance structure of the National Climate Change Plan formed the basis for the governance structure implementing the LTS (Gambia, 2022)
Indonesia	**Existing**: Developed its LTS in line with the Constitution (Indonesia, 2021)
Mexico	**Existing**: GLCC and National Strategy on Climate Change (Mexico, 2016)
Nepal	**Existing:** A list of which policy plans are directing Nepal's low-carbon development pathway is included, e.g.: Environment Protection Act (2019), National Climate Change Policy (2019) and many more (Nepal, 2021)
Nigeria	**Existing:** LTS built on Nigeria Agenda 2050 and Deep Decarbonization Pathways Project funded by the French Development Agency and development process of LTS supported by the 2050 Pathways Platform (Nigeria et al., 2021)
Singapore	**(Existing):** Singapore's approach to implement their LTS ensured integrating action within the larger context in their national policy framework. The country is rather focusing on enhancing existing arrangements, than building new ones (Singapore, 2020)
South Africa	**Existing:** Three key policy documents provided the foundation on which South Africa developed its LTS: the National Development Plan, National Climate Change Response Policy and the Climate Change Bill. In addition, various other strategies, policies and sector plans have been developed for individual sectors of the economy aiming to reduce emissions (South Africa, 2020)
Republic of Korea	**Existing:** Green New Deal and Digital New Deal build foundation for the Korean New Deal (LTS). The LTS incorporated the country's 2050 Vision and established a Presidential 2050 Carbon Neutrality Committee (Republic of Korea, 2020)
Republic of Marshall Islands	**Existing**: References made to Republic of the Marshall Islands's forthcoming NDC Partnership Plan, 2nd National Climate Dialogue and Partnership Dialogue and National Adaptation Plan. LTS recognized as a living document, including feedback and key findings from other relevant ministerial documents and a range of different actors (The Republic of the Marshall Islands, 2018)
Thailand	**Existing:** Thailand's LTS was primarily guided by the Climate Change Master Plan (2015-2050) and complemented by the National Strategic Plan On Climate Change (2018-2013) (Thailand, 2021)
Tonga	**Existing:** The LTS aligned with the following key executive and legislative mandates, laws and policies: Tonga Strategic Development Framework 2015-2025, Tonga Climate Change Policy (TCCP, 2016), Joint National Action Plan 2 Climate Change and Disaster Risk Management 2018-2028, Third National Communication on Climate Change Report (TNC, 2019) and Tonga's Second NDC, 2020 (Tonga, 2021)

Authors' own creation based on QCA

24 Colombia interview

The following is an expansion of Table 5 and exemplifies in greater detail the outcomes and findings of the QCA, questionnaires and interviews with countries' approaches on boosting institutional arrangements for a regulatory framework design and integrated elements. Several countries have anchored climate targets expressed in their LTS to national laws, regulations and/ or policies. South Africa, for example, aligned their national climate targets with the targets as outlined under the Paris Agreement through planning and using technical teams, analytical and sectoral expertise and scenario forecasting (South Africa, 2020).

In Mexico, the GLCC defines clear roles for the federal and subnational government including regulatory instruments such as emission limit standards or the design of a legal framework with focus on fuel oil and marine diesel which are not regulated yet. At the federal level, the Interministerial Commission on Climate Change and the National Institute for Ecology and Climate Change are responsible to oversee climate policy. Mexico contemplated how regulatory frameworks and laws such as the GCCL, National Strategy on Climate Change; 10-20-40 Vision and a Special Program on Climate Chance 2014-2018 enhanced the development process and increase action for national climate-change policies, regulations and instruments (Mexico, 2016).

Fiji combined top-down and bottom-up elements into their economy-wide plan for decarbonization, starting with identifying a high-ambition net-zero vision for 2050 as established under the National Adaptation Plan, followed by adopting a pragmatic approach for developing sector-to-sector pathways and the provision of baseline scenarios for each sector. The archipelagic state introduced numerous sector-specific regulations and policies which are linked to each sector and its strategies to reduce emissions. For example, measures for low-emission development in the waste sector, in specific for coastal wetlands are linked to its Environmental Management Act 2005 and scenarios where new technologies such as hydropower and biomass will be added consistent with the NDC Implementation Roadmap (Fiji, 2019).

Another interesting case is Indonesia. The country developed its LTS in line with its constitution (UUD 1945, Article 28 H), emphasizing the obligation to guarantee decent life and healthy environment for all citizens and Law No.32/2009 regarding Environmental Protection and Management. The Indonesian government has put into force a regulation, No. 46/2017 in economic instruments for the environment, followed by the establishment of the Environmental Fund Management Agency (BPDLH) through Presidential Regulation No. 77/2018 on Environmental Fund Management. Another regulation No.46/2016 served as strong legal basis for integrated and spatially explicit land-use planning at the national and sub-national level, by adopting a landscape-based approach for food, water and energy securities (Indonesia, 2021).

Additionally, Indonesia as well as Tonga included a list of laws, policies, and regulations, which serve as a basis for the implementation and design process of the LTS. Indonesia has a comprehensive section in which national policy and regulatory frameworks are supporting climate-change mitigation and adaptation. The countries ensured that their NDCs and LTS are aligned and have high capacities in place for the integration of regulatory framework components (Indonesia, 2021; Tonga, 2021).

In the Korean LTS, long-term mitigation policies are aligned to several laws and institutional arrangements such as the Framework Act on low-carbon green growth. This builds the foundation for shifting to a low-carbon society. The Act prescribed the implementation of basic plans on green growth and climate relevant aspects on a five-year basis, which are required to be developed to meet the national GHG reduction target. The state enforced a national reduction target in its Enforcement Decree of the Framework Act. Carbon pricing and an implemented emission trading system (ETS) are setting emission caps with respect to reduction targets as well as allowing companies to freely trade their surplus allowances. To put this into practice, Republic of Korea set a legal basis and enacted the Act on the Allocation and Trading of GHG Emission Permits in 2012. The Republic of Korea is the first country in Southeast Asia to adopt a nation-wide ETS while providing support for others who want to follow by integrating elements of international cooperation and leading the path to reach carbon neutrality by 2050 (Republic of Korea, 2020).

Thailand incorporated climate elements to limit global warming since 2007 into national economic and social plans, policies and to its overall development strategy across various sectors. This reflected the countries' high ability to have conducted a comprehensive assessment of existing policies, laws and institutional frameworks for implementing their LTS. This was supported as the National Appropriate Mitigation Action and the NDCs shaped key policy instruments while using best practices for the LTS implementation as well as ensuring consistency with the timeframe of existing and subsequent NDCs (Thailand, 2021).

France and Germany aligned their LTS to European regulations and standards as both are Members of the European Union and influenced by European Union climate and energy policies. In the European Union, GHG emissions are managed equally by the European Emissions Trading Scheme and European Union Effort Sharing decision. In 2012, the European Union adopted the Directive 2012/27 on energy efficiency to meet the target of a 20 per cent improvement in energy efficiency. Consequently, France set itself a target of capping final energy consumption at 131.4 Mtoe by 2020, excluding international aviation, with a cap of 219.9 Mtoe for primary energy consumption, to transpose Article 3 of the European Union Directive (France, 2016, p. 108). Germany on the other hand strongly advocated in their Climate Action Plan 2050 to reinforce measures for the ETS including a subchapter in their strategy in disposition with the European Union's overall target of reducing GHG emissions by 80-95 per cent compared with 1990 by 2050 (Germany, 2016). France also set legally binding five-year carbon budgets until 2033 and managed to make the strategy legally binding for the public sector. Even though the United Kingdom of Great Britain and Northern Ireland is no longer a member of the European Union, its Clean Growth Strategy includes a long-term view to meet at least an 80 per cent reduction in 2050 emissions relative to 1990 levels and bolstered, the same as France did, the legal status of its strategy with support of the Climate Change Act, 2008 (France, 2016; United Kingdom of Great Britain and Northern Ireland, 2017).

5.2 Regulatory framework-related institutional capacities that are required for LTS implementation, but that countries often lack

This section illustrates common gaps' that countries, especially developing countries, were confronted with regarding institutional capacities required to establish and review the regulatory framework in support of LTS implementation and strategy alignment. The content is primarily based on the outcomes of the empirical findings. The assessment indicated that no matter how good a regulation is, the objective will not be achieved if the institutions responsible for implementing and enforcing it, lack the necessary capacities in human, financial or technical resources.

The findings pointed to two common institutional constraints that impede the determination of priorities when it comes to enhancing the regulatory framework: **inadequate coordination among various stakeholders** and **limited transparency in policy development**. In some countries, the responsible coordinating entity lacks the political support needed to steer the process related to review and design of necessary laws and regulations. These constraints are explained as effective coordination is necessary to ensure coherence and synergy among sectoral policy priorities and second, transparency is essential for reaching consensus on the scope of the existing regulatory framework. This is closely connected to the available capacity for countries to translate LTS goals into potential policy objectives. For example, Cambodia mentioned that it was confronted with technology and capacity constraints. This hindered the country to develop a profound regulatory framework for different sectors, energy and waste. In the waste sector there was limited public participation and awareness which delayed improvements in waste management (Kingdom of Cambodia, 2021).

Another constraint that countries need to consider is how to maintain the political mandate and leadership to reach consensus for long-term vision under circumstances such as changes in the political environment and government. A subcomponent of this is how to issue laws and legislations, rather than enforcing guidelines and decrees. Another is how to ensure that actions proposed in the LTS can remain apolitical.

5.3 Recommendations for bridging gaps in regulatory framework capacity

The empirical analysis emphasized that a central component to the success of LTS implementation is to embed it in the national policy process, conduct a regulatory framework revision, streamline, and complement existing laws and regulations while strengthening related governmental processes and entities. The recommendation of which action various countries followed for a regulatory framework pursuance, supported what other scholars (Elliott et al., 2019; Rocha & Falduto, 2019; Ross, Schumer, et al., 2021; Vener et al., 2019) have already emphasized: countries should take the opportunity to link economic and sectoral targets, as set in their LTS, on national laws, decrees and policies. These steps encourage states to take on legal action, be attached to budgets or be subjected to monitoring and evaluation and increase inter-ministerial or inter-agency coordination. The reliance on either already existing regulatory frameworks or the establishment of new ones is another important factor to be included for countries' LTS implementation. Having clear and robust institutional arrangements integrated in countries' LTS is unavoidable to avoid losing track of achieving the climate targets. Consequently, the importance of having a solid institutional governance framework for developing and implementing the LTS lies in its ability to ensure a cohesive and lasting integration supported by all relevant public and private stakeholders. This framework also ensures that sectoral policies are in line with the Net-Zero Objective of the LTS.

In addition to institutional, legislative, and regulatory measures, the LTS may be supported by a financing strategy for its implementation as it provides valuable insights into the levels of investment needed to fulfill the climate targets as set in the LTS.

Below are recommended measures and steps to overcome some of the mentioned challenges in setting-up relevant and required regulatory frameworks for developing LTS.

Step 1:

The first step is to conduct a comprehensive analysis and review of a range of intertwined elements, notably legislative provisions, and institutional structures and processes. To do so, there is no "one size fits all" approach, because the appropriateness of the method depends partly on the primary objective of the regulatory reform process.

The following **steps** can be recommended in the context of identifying and setting up relevant and required regulatory frameworks for LTS target implementation:

- **Ensuring that, even in sensitive or rapidly changing policy environments, the regulatory body remains adequate.** It is recommended that for the development process of new policies and climate actions, factors such as public participation and buy-in should be integrated in order to minimize any negative impacts of changes in countries' political systems. Another solution is to align goals to a specific climate-change law and ensure that every new introduced policy is in accordance with the LTS.
- **Updating legislation**, the main motivation behind many regulatory reform processes is to get rid of regulatory inefficiencies. These procedures, which are frequently motivated by concerns about competitiveness, result in a more straightforward and cohesive regulatory body. One well-known technique for getting this kind of result is the regulatory guillotine (Jacobs & Astrakhan, 2006). This approach essentially consists of three review processes that examine each pertinent piece of legislation separately, determining the degree to which it is deemed efficient, legal, and necessary. A common feature is the procedure of assessing regulations case by case and the analysis procedures which reveal enabling conditions and barriers for the regulatory reform.

Step 2:

Translating or breaking down LTS targets into specific policy objectives or measures, as this makes it easier to determine the type of regulatory instruments that may be most suitable for implementing those objectives. It is important to set clear targets, define governance practices, allocate necessary funds, and link policy to existing social structures and practices. Therefore, mandating capacities on institutional arrangements for legally binding frameworks and mandates are preconditioned to assure resources and minimize resource constraints. These frameworks formalize new roles, responsibilities, resources, and relationships. In addition, some findings highlighted different examples such as linking LTS to climate laws, organizational mandates, decrees, and data sharing agreements. For developing countries, the establishment and implementation of a legal framework is a highly time-demanding process. As such, Memoranda of Understanding between different Ministries can serve as short-term solutions to address this lack of regulatory barriers. Countries that are still in the development phase of their LTS or in an update process, could learn from the United Kingdom of Great Britain and Northern Ireland as it was the first country in the world to introduce a legally binding emission reduction target under the Climate Change Act. The Climate Change Act not only improved public debate, but also ensured that the consensus on the need for more climate action remains steady and encourages to transform high emission sector (UNFCCC Secretariat, 2020; United Kingdom of Great Britain and Northern Ireland, 2017). Countries such as France, Denmark, Sweden and Mexico already followed their model by replicating aspects of it. In addition, creating gender-responsive policies to ensure that laws and regulations promote gender equality and protect women's rights, especially within low-emission development strategies is recommended.

Step 3:

Mapping the regulatory needs arising from the LTS against the elements of the existing regulatory framework in place. For example, Germany created a regulatory framework to balance generation and consumption flexibly based on its new Electricity Market Act (Germany, 2016). Therefore, determining which structure needs to be built or strengthened is the objective of this second step of the analysis.

Step 4:

Anticipating barriers to implementation and introducing regulations to overcome them. As a part of the review process of the regulatory framework, it is beneficial to include aspects of the above-mentioned challenges and possibly reflect this in the revised regulatory framework. For example, a carbon tax scheme could be used to discourage actors from further investment in fossil fuels.

Some countries mentioned being confronted with issues of limited transparency for policy development and insufficient coordination. Ensuring that the regulatory framework is transparent is a pre-condition for its effective use. Measures to overcome this include transparency focused on increased communication among various actors which can be facilitated through consultation, simplification of legislation, documentation of existing and planned regulation. Communication is key among both government and non-government stakeholders during and after the regulatory framework review process with the aim to reach consensus.

Step 5:

Ensure there are enough and timely communication channels. It is imperative to maintain open lines of communication with government and non-government stakeholders at all stages of the regulatory framework review process. Both establishing and carrying out a whole-of-government approach to the review process require dialogue. It is especially advised that the relevant government body assumes responsibility for efficiently informing all pertinent stakeholders of these changes following agreement on the regulatory framework. This could involve creating targeted communication campaigns and potentially providing training sessions to ensure that those who are most directly impacted by the regulatory changes are equipped to meet the associated requirements.

Mozambican fishers pulling a fishing net from the water
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06 Human capacities

The management of climate change necessitates several specialised skills. Hence, successful development and implementation of long-term strategies depends on a country's available human resource capacities for managing, collecting, and processing data and on structuring relevant information. The unit for human capacities was shaped by questions around (Elliott et al., 2019; Rocha & Falduto, 2019):

- What technical capacity is needed, and is there sufficient technical capacity at the domestic level to undertake the development and implementation of an LTS?
- What are the entities, including individuals that have the required capacity or will be involved in the process of capacity building?

Capacity is defined as the overall ability of an organization or system to create value for others (Paz Cigarán, 2018). Therefore, measures of efficient staffing, training, and capacity-building procedures should be put into focus and constantly reviewed. Building capacity should lead to strengthening permanent institutional arrangements (Ould-Dada, 2018; UNFCCC Secretariat, 2020). In general, human capacity refers to a classification into two categories. The first is the availability of an adequate number of staff, with the relevant skill sets, in the government agencies tasked with developing and implementing the LTS. The second category relates to the know-how and enabling framework (physical infrastructure, institutional arrangements and financial means needed to support the process) that is required to put the knowledge into practical use. The following chapter will focus on the second category, as the securing of staff falls outside the scope of this publication.

LTS development and implementation requires the addressing and integration of aspects in a range of areas:

- education and training as training programmes can transmit specialised skills and integrate disseminate generic knowledge on relevant aspects of climate change and secure it for the long term;
- capacity building initiatives, as it is often targeted at a lower number of recipients and to their specific needs and gaps in capacity or knowledge;
- dissemination of knowledge to the broader public through workshops, publications, conferences, newsletter or social media;
- and on how countries share experience, often in the form of issue- or region-specific workshops.

Existing research covered if countries integrated aspects of capacity-building in the form of education and training on a more generic level, rather than pointing out concrete country examples. Spotlight was also on the connection to stakeholder engagement and policy coordination. New incentives are under discussion for strengthening coordination and collaboration such as capacity-building initiatives, awareness-raising measures, training sessions and workshops for staff and relevant actors (Rocha & Falduto, 2019; Ross, Schumer, et al., 2021; UNFCCC Secretariat, 2022; Wise, 2022).

6.1 Qualitative analysis of human capacities in countries' submitted LTS

The empirical analysis supported the findings of how countries integrated relevant aspects of human capacities into their LTS and allowed us to collect data on different approaches. It was recognized that all countries included elements for capacity-building and most of the countries emphasized capacity building initiatives as essential to the LTS implementation. The findings demonstrated that many countries recognized education, knowledge, and training campaigns as indispensable tools for citizens in climate-relevant and linked decision-making processes. These elements are best-placed as being inclusive and accessible for everyone in the society. Thus, various parties reflected that the success of the LTS correlates with promoting capacities, capabilities, knowledge and expertise of professionals, companies, staff and other relevant actors. Therefore, many of the examined countries included training programs on sustainability and climate change for the private, public, and academic sectors. This was done primarily using science, technological innovation, and education to protect and enhance sustainable development. As human capacity was identified as an essential component of parties' institutional arrangements, we are exemplifying in more detail on countries' attempts and measures to include aspects of it in the subsequent section.

Costa Rica clarified different awareness-raising campaigns such as promoting public transport to raise awareness about pioneer bus companies with zero-emission technologies. Beyond this, Costa Rica included capacity-building initiatives across different sectors such as the integration of at least three capacity-building processes for municipalities in managing integral waste. Activities included the design of technical capacity-building programs in low-emissions waste management (Costa Rica, 2019, pp. 43, 53).

Fiji's extensive approach to include various stakeholders and link it to coordination mechanisms is also tightly linked to the provision of human capacities, education, and knowledge transmission. The country focused on requirements for capacity building and awareness-raising activities such as external human resources for the implementation of sustainable forest management including the improvement of plantation productivity, afforestation and reforestation activities and climate-smart agriculture. In addition, one chapter in their LTS was dedicated to enhancing training of relevant staff, secure jobs and employment for a green transition. Concrete measures and policies are integrated such as to foster green employment and how the government will support mechanisms for building skills and accessing information, markets, and finance. The government is also planning to work with employee associations and unions to survey its members and understand what is needed for enhancing capacities (Fiji, 2019, pp. 70, 98).

Singapore strives to build a knowledge-based society focused on research, innovation, and increasing investment in research and development to harness human capacities effectively. Additionally, the private sector was given the opportunity through a knowledge sharing platform to improve energy efficiency with measures of sharing good practices and success stories while learning from one another. Their LTS envisioned diffusing knowledge in various areas and parts of society through empowering youths to spur climate action and expanding education in schools (Singapore, 2020).

The Republic of Korea had a public outreach campaign for climate action and other incentive-based programs to encourage people to reduce their own carbon footprint including measures to generate less food waste and changes in dietary habits. The government also offered environmental education campaigns, including small and large-scale actions to reduce carbon emissions. The Korean government is pursuing to create new green job opportunities, especially for people working in industries depending on fossil fuels (Republic of Korea, 2020).

Actions for encouraging human capacities are also reiterated in Tonga's highly ambitious climate strategy. For each sector, the Polynesian kingdom pointed to capacity building aspects of how to increase education and training, ensure job provision in a low-carbon economy for the long term, increase climate awareness and diffuse knowledge. As a solution for how to minimize the shortage of technical expertise, Tonga proposed allocating external staff and gathering skills to upskill professionals (Tonga, 2021).

France focused on how to improve knowledge transfer by providing training for relevant staff creating spaces for stakeholders of different sectors and industries, linking research and education through clusters and competitiveness centres. This action included connecting to relevant national action plans for employment and careers in the Green Economy. Education and awareness-raising approaches were supported by collecting input from citizens used in the LTS. Actions to further support this was through the inclusion of environment and climate modules in school curriculum and the provision of further training courses in academia. Higher education should be considered as a priority area for energy transition while boosting the skill level of public and private sector employees (France, 2016, p. 43).

In Germany's LTS, training and education campaigns in the form of vocational training, professional development, extracurricular projects, or practical activities based on mutual learning were designed. As current information confirmed that greater sector coupling, which is a major component in Germany's LTS, will cause a higher electricity demand, continuous optimisation of knowledge is needed as base in combination with funding to increase scientific and technical knowledge and innovation. Duplication is avoided through coordination with federal educational and information campaigns in specific sectors (Germany, 2016, p. 66).

The government in the United Kingdom of Great Britain and Northern Ireland shall be used as enabler to invest, reform and reshape the educational system including technical reforms in education with the creation of new qualifications and high-quality work placements (United Kingdom of Great Britain and Northern Ireland, 2017, p. 37).

In comparison to the other three Annex-I countries, the United States of America has a less clear explanation of how to increase human capacities for institutional arrangements in their LTS document. Nonetheless, central aspects are included where the country positions itself as an incubator for innovation and firms with a well-trained workforce to build a strong economy (United States of America, 2021, p. 54).

6.2 Human capacity-related institutional capacities that are required for LTS implementation, but that countries often lack

The main deficiencies in the institutional capabilities needed to build human capacities in support of LTS implementation are highlighted in this section. The main sources of information for the content are a review of the literature, interviews, QCAs, surveys, and the experiences of the countries that were identified in the qualitative assessment in implementing their LTS.

Most of the Non-Annex I countries focused on aspects of support and needs in the areas of technical expertise, and knowledge gaps. Human resources are available within governmental agencies but on different levels. Indonesia faced challenges in how to acquire high-skilled workers and agree on mutual aspects. It identified a continuous need for the international community to support capacity building activities (Indonesia, 2021, p. 127). Nigeria followed a similar approach as Indonesia, focusing on the need to leverage opportunities for capacity building, efficient energy and innovations in technologies and digital transformations through enhanced international cooperation and collaboration (Nigeria et al., 2021). Thailand also requested external support (Thailand, 2021, p. 46). Other countries such as Cambodia emphasized a lack of available data due to limited human capacities (Kingdom of Cambodia, 2021) (Cambodia[25]).

The Republic of the Marshall Islands focused on capacity-building initiatives such as through training sessions and educational campaigns, including marginalized actors. However, implementation is limited due to a lack of availa ble resources (The Republic of the Marshall Islands, 2018). South Africa also mentioned that infrastructure and skills are needed to expand institutional capacities at the sub-national level as many of the sub-national government structures are dysfunctional and lack capacity to support the required actions to transition towards low carbon (South Africa, 2020, p. 45).

Certain countries possess the necessary human and financial resources for organizing know-how development programs. Know-how was identified as an essential component for modeling and evaluation. It is needed to define the technical aspects of improved data collection programmes and to raise funding for it. However, some lack the institutional capabilities required to establish such programs, mainly due to governance and other institutional deficiencies.

A central limitation is **the lack in appropriate mandates** and **financial constraints** which often hinder the creation and execution of know-how development programs. Nepal points to an increased need for capacity building, technology transfer and finance to meet its scenario targets while emphasizing its financial limitations. A strategy suggested, was to receive funding from the Green Climate Fund, Global Environment Facility and Adaptation or other multilateral organizations to bolster limited national resources and technical capacities for scaling up climate action (Nepal, 2021, p. 23).

Another example is Gambia, as it included measures on how to strengthen human resource capacities, with emphasis on gaps and suggested solutions. By 2030 the country highlighted on the need to acquire USD 50 million to mobilize for institutional strengthening and sensitisation initiatives. The funding is planned to be primarily allocated to academia to establish more educational programmes in climate change and train relevant staff. For example, the American International University West Africa is planning to develop a Bachelor programme in Climate Change and Environmental Science. As financial and human capacities for systematic support of climate awareness raising in the country is limiting the outreach of experts, the government targeted to include awareness-raising as horizontal priority in all policies and measures to promote higher climate action. Measures included the development of a national programme for climate awareness raising, the allocation of resources for climate-change awareness raising activities such as sustainable food production, vegan diet, and lifestyle and environmental and climate friendly consumer practices. Gambia recognized that climate action's success ultimately depends on the engagement of all stakeholders and the pursuance of a whole-of-society approach (Gambia, 2022, p. 61).

25 *Cambodia Interview*

6.3 Recommendations for bridging gaps in human capacities

This section provides some general information on how countries can overcome challenges. The content draws further on the authors' experience in working with developing country governments to prepare climate strategies as well as with related planning and implementation processes. Throughout the assessment, we could identify a pattern that especially developing countries included issues related to the delivery of education, training and public awareness programmes aimed at improving human capacities. For instance, Gender-specific training is recommended ensuring women have equal access to capacity building programs, as well as incorporating gender perspectives in training content.

Capacity building can be strengthened through various incentives such as avoiding a high staff turnover, inclusion of the needs of all actions or through centralizing learning activities in one single entity. A different attempt, realized by Colombia was through a staff turnover in responsible ministries for climate relevant topics as soon as their new president was inaugurated[26]. This can either result in creating new opportunities through new perspective and input or make the process for improvement in new climate innovations more rigid. It is case-by-case dependent.

Government officials working in climate change face challenges in effectively interacting with colleagues from other government sectors, despite the implementation of coordination and collaboration mandates. To address this issue, it is crucial to enhance know-how in two key areas: technical knowledge related to specific economic sectors and the ability to foster consensus and effective negotiation. Concurrently, incentives should be introduced to retain skilled personnel within the government, as they may otherwise be enticed by more appealing job opportunities elsewhere. Another solution might be, a LTS coordination entity (chapter 2). This entity could be well-placed to oversee the development of a plan for the integration of some of the aspects mentioned to increase human capacities for governmental units working inside and outside climate-change departments. In conclusion, aspects of enhanced bilateral, multilateral, and international cooperation are also highly essential under the institutional arrangement for human capacities to increase the climate efforts and support developing countries in implementing their LTS.

We identified that small-scale interventions for awareness-raising campaigns as in the case of Costa Rica could be easily emulated by other countries to increase climate awareness-raising campaigns as they do not require high capacities (Costa Rica, 2019). Another solution for minimizing some of the mentioned barriers for Non-Annex I countries was recognized by the United Kingdom of Great Britain and Northern Ireland and its role on how to become an exporter of knowledge for other countries to follow its approach on how to reach the defined climate targets (United Kingdom of Great Britain and Northern Ireland, 2017, p. 76).

Continuous updating of skills, knowledge, and expertise should be integrated as a vital component for the successful implementation of LTS. It requires know-how in a range of different areas:

- Technical knowledge and capacity on how to execute qualitative and quantitative assessments for modeling activities;
- Ability to connect the targets and goals as defined in the long-term strategy based on other important climate-relevant laws, frameworks, documents etc.;
- Strategic capacity for systemic policy design and implementation;
- Institutional capacity for governance, stakeholder engagement and coordination.

26 *Colombia interview*

Modern sustainable neighbourhood in Almere, The Netherlands
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07 Reporting

Reporting refers to the provision of information regarding progress in the implementation of a country's LTS. It is important to indicate who is responsible for reviewing the LTS development and implementation process including the methods applied and frequency. For example, if the review process is transparent and publicly-accessible; if the LTS reporting process is linked to the update of NDCs or other relevant domestic policies and laws; if it is planned to establish a monitoring plan or if one is already in place and how institutional roles are divided for collecting and compiling data relevant to the implementation of the LTS. Furthermore, a reporting process supports the provision of transparent and comparable information to both national and international stakeholders. The category of reporting was shaped by some of the following questions (Elliott et al., 2019; Rocha & Falduto, 2019; WRI, 2020):

- Will the LTS be revised and/or updated?
  - How often will the strategy be revised and/or updated?
  - Which group (ministry/independent body) is best placed to lead and conduct the review?
- Is there a Monitoring Reporting and Verification (MRV) or Monitoring and Evaluation (M&E) system already in place or planned to be established?
- How can the review process align with other domestic or international processes, like National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs)?
- How can the results of the review process inform current development plans, near-term sectoral and economy-wide policies, and infrastructure investment?

Scholars have already assessed some of the countries. For example, France and the United Kingdom of Great Britain and Northern Ireland created an independent advisory body for monitoring the implementation of the LTS. Costa Rica, Fiji, France, Germany, the Republic of the Marshall Islands, Mexico, South Africa, United Kingdom of Great Britain and Northern Ireland and United States of America all stated that they would include monitoring and evaluation as well as review and revision plans to ensure the longevity of the strategies. Germany, France and the United Kingdom of Great Britain and Northern Ireland plan to review their LTS every five years in line with their NDC (Elliott et al., 2019; Ross, Schumer, et al., 2021). Countries can choose different approaches for the LTS reporting process. For example, setting up reporting and review mechanisms for their LTS targets linked to annual financial budget discussions, linking the review cycles to the process of updating midterm pledges (NDCs), and some review mechanism could be connected to the Global Stocktake process under the Paris Agreement.

7.1 Qualitative analysis of Reporting in countries submitted LTS

Table 6 summarizes whether countries integrated a planned cycle for reporting into their LTS and if it is planned to be in alignment with the reporting cycle for NDCs. Subsequently, we focus on individual country cases and identify how far actions were included in relation to the above-mentioned questions to enhance capacities in reporting.

TABLE 6 Reporting and review cycle for LTS

COUNTRY	CYCLE OF REVIEW FOR LTS	IS THE LTS REVIEW CYCLE ALIGNED WITH THE NDC REVIEW CYCLE?
France*	Every 5 years	Yes
Germany*	N/A	Yes
United Kingdom of Great Britain and Northern Ireland*	N/A	Yes
United States of America*	Every 5 years	N/A
Andorra	At least every 6 years	N/A[27]
Cambodia	Every 5 years	N/A
China	N/A	N/A
Colombia[28]	N/A	Yes
Costa Rica	N/A	N/A
Fiji	Every 4 years	Yes
Gambia	Every 5 years	N/A
Indonesia	N/A	N/A
Mexico	Mitigation action: at least every 10 and adaptation 6 years	N/A
Nepal	Every 5 years	Yes
Nigeria	N/A	N/A
Republic of Korea	N/A	Yes
Republic of the Marshall Islands	At least every 5 years	Yes
Singapore	N/A	N/A
South Africa	At least every 5 years	Yes
Thailand*[29]	Every 5 years	Yes
Tonga	Every 5 years	Yes

Source: authors' assessment based on the QCA and interviews

As shown in Table 6, some countries linked their review cycle to the mandatory review cycle for NDCs. For instance, the Republic of the Marshall Islands will review their strategy every five years, at least one year before it needs to submit the updated NDC: This was explained in the context of identifying new and relevant technologies and policy options. Feasibility studies and pilot projects are recommended in order to validate and verify that the targeted pathways are becoming feasible. The TTE Committee and another body is responsible for overseeing the monitoring process regarding its alignment with other relevant legislation, policies and measures. Beyond its linkage to the review cycle of the NDCs, Republic of the Marshall Islands further integrated elements of related transparency documents such as the Third National Communication and its BURs (The Republic of the Marshall Islands, 2018).

The analysis elaborated that the review of LTS is often done by dedicated committees. In Fiji, the strategy is reviewed every four years by the LEDS Steering Committee, which serves as an advisory group providing guidance, information, and recommendations. The Committee is encouraged to propose new actions included in the NDC, LTS and legislation to achieve the determined climate goals. The review is further reinforced by national legal arrangements and laws, and builds onto existing mitigation and adaptation actions that are being undertaken by the Fijian government. The strategy implemented economy-wide and sector-specific emission targets in five-year intervals between 2020 and 2050 in all scenarios (Fiji, 2019).

Gambia plans to establish a robust monitoring framework in line with its National Climate Change Policy to undertake regular monitoring and evaluation of the LTS. Feedback from the monitoring framework will indicate where the LTS is falling short and which readjustments should be made to address gaps for future circumstances. The review process, planned for every five years, shall be all-inclusive, engaging a wide range of actors and coordinated by the Climate Change Secretariat in collaboration with the Directorate of Development Planning at the Ministry of Financial and Economic Affairs (Gambia, 2022). The Republic of the Marshall Islands included options for a more coordinated and centralized approach on applying for, and monitoring, overseas aid and investment in relation to implementation of Republic of the Marshall Islands's NDC and 2050 Strategy (The Republic of the Marshall Islands, 2018).

South Africa links its 5-year reporting cycle directly to its Climate Change Bill providing the foundation for future review and national GHG emission trajectories. It also imposed mandatory requirements for monitoring and reporting to review elements such as fossil-fuel subsidies and a suggestion to join a fossil-fuel subsidy peer review within the G20 framework for experience sharing and mutual learning. Nevertheless, the establishment of a M&E system will only be automated during the final phase of implementation. Sectoral actions are also connected with reporting schemes as the development of standardized tools for voluntary reporting of energy savings from initiatives in the mining sector (South Africa, 2020, p. 30).

While Singapore did not include any specification of the timeframe for reviewing, it clarified the reporting requirements for companies. For example, companies must report the energy performance of key systems that account for at least 80 per cent of the new facilities' total energy consumption (Singapore, 2020, p. 16).

France integrated a demand that institutional investors are obliged to submit non-financial reports providing information on the actions taken to further strengthen the energy and ecological transition to change the path for investment practices (France, 2016, p. 44).

Germany mentioned a regular updating and reporting of its LTS as part of a constant learning and public dialogue process (Germany, 2016).

27 N/A: no answer

28 Information from interview with country focal point

*29 Countries with *: already submitted an revised version of their LTS, source: (UNFCCC, 2023)*

7.2 Reporting – related institutional capacities that are required for LTS implementation, but that countries often lack

Some commonly identified gaps on the institutional arrangement of reporting on the progress with LTS implementation are presented in this section, linked to the outcomes of the qualitative analysis.

At present, there is no commonly agreed international guidance for reporting on LTS implementation, for a proposed Review cycle or for a structure specifying how countries could align their LTS and NDC revision cycles, and potentially their Biennial Transparency Reports (BTRs) to reinforce the outlined objectives.

- Another structural issue that exacerbates these difficulties is the absence of a mandate, which leaves involved actors without defined roles. The term "mandate" refers to the responsibility to furnish information as well as the power to request it. This impacts not just the public sector but also the private sector, as the latter is particularly hesitant to divulge commercially sensitive data. Subnational governments occasionally may have different motivations than national governments, making them equally hesitant to participate in data collection initiatives. With regard to quality assurance procedures, there is a need for guidance that is detailed without being prescriptive (Bakhtiari et al. 2018).
- One of the most common challenges countries faced was lack of reliable information and quantitative data. This can have implications for the quality of the reporting practices itself, as well as for the data collection and analysis process. For example, collecting reliable information, particularly on topics such as climate finance, data is often singled out as problematic in the LTS reporting context. Limited understanding of the definitions of certain topics (e.g. climate finance) and inadequate reporting methodologies are among the main difficulties that countries face in this regard.
- Challenges were encountered in coordinating data-collection efforts. These difficulties were primarily caused by financial constraints, resulting from insufficient funding to establish all the required data-collection programs. Additionally, human capacity constraints played a significant role, as there was limited time for the staff to collect and analyze the necessary data.

7.3 Recommendations for bridging gaps in reporting

In the absence of an international framework for reporting on LTS implementation, we present some guidance that can enhance the process for strengthening required institutional capacities regarding key elements of reporting mechanisms. The content relates to the findings in the empirical section, literature reviews and on the authors' experience in working with developing country governments.

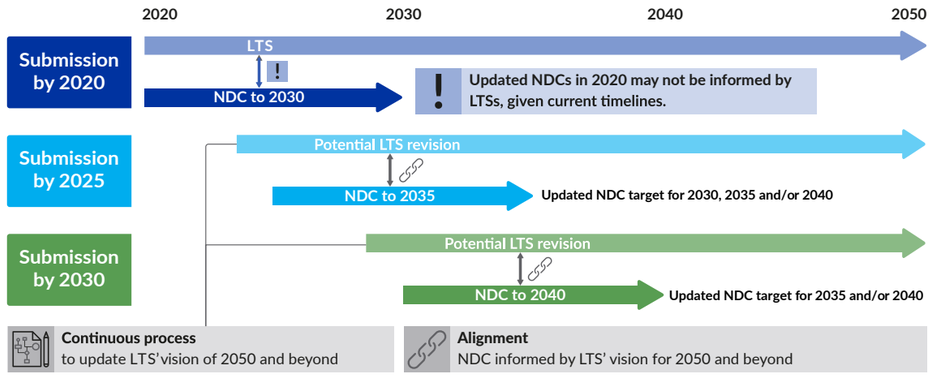
Summing up, LTS are perceived as key opportunities to inform, enhance and raise the ambition of future NDCs and national climate action. Some developing countries have emphasized the need for better data availability and monitoring progress to establish baselines for certain climate activities and sectors. However, research conducted in different countries has revealed that there is not a single, "one-size-fits-all" approach for institutional capacities to enhance reporting mechanisms. Each party needs to create its own reporting system, including national circumstances as an in-depth reporting system might be an indispensable tool to overcome some technological and financial constraints.

Thus, we identified some key elements to guarantee the long-term sustainability of the reporting process, a robust institutional setup and an "open space" for adjustments to meet various requirements.

- To begin, it is important to ensure that there is a consistent process for regularly updating data collection, analysis, and review. This process should involve input from a diverse group of stakeholders. This consistency is a prerequisite for conducting more detailed thematic analyzes, scenario modeling, political coordination, and engaging with stakeholders for consultation.
- It is also important that the reporting mechanisms include sex-disaggregated data to track progress on gender equality and ensure that both men and women benefit from low-emission development strategies.
- In addition, structured LTS revision processes can address potential shortcomings of an earlier submission considering the most recent societal, technological, and economic development that ensure the strategies are kept up-to-date (Elliott et al., 2019; Hans et al., 2020). Non-Annex I parties, especially, could use a regular update and review of their LTS as a means to communicate any support for financial, human and technical resources. This step can also include requests for direct support from the international community. As already mentioned, Costa Rica included seven cross-sectoral strategies in their LTS, of which two aim to mobilize and allocate funds aimed at achieving the decarbonization pathway. The Ministry of Finance led the strategies aiming to elaborate and implement a domestic "Green Tax Reform". The reform is focused on pricing negative externalities along certain steps to generate new income sources (Costa Rica, 2019; Hans et al., 2020).
- Based on our results, we recommend that countries integrate a fixed timeframe for the revision cycle, in most cases 5 years for the LTS, in alignment with the NDC update. Ideally, the update of the LTS should happen shortly before the NDCs are to be updated so that the long-term goals can inform the choice of NDC targets and sectoral action strategies.
- Outline **clear mandates** for the LTS process (e.g. data collection process) and ensure high-level government support. Particularly for the entities that provide data to such reporting systems may see few incentives for providing the data and therefore they need to be encouraged. For this reason, and especially in the context of centralized systems, clear mandates and high-level support are often needed. Hereby, linking roles and responsibilities to governance structures is key.
- Another overarching component integrated by some countries was the development of a Monitoring Reporting and Verification (MRV) system for the LTS. An MRV is important as it underpins national and sectoral GHG data quality and assists in identifying downstream national and sectoral priorities as it strengthens policy planning and prioritization towards a low-carbon future. Hence, the alignment with NDCs and other national plans is highly advisable as it is more efficient to improve existing systems rather than building new ones from scratch while at the same time increasing credibility and transparency. Also incorporating the reporting tasks into sectoral development plans as far as possible would reduce the financial constraints which are often cited as key barriers to strengthening MRV systems.

Figure 4 outlines the basic concept of how NDC revision cycles can be informed by the long-term vision over the course of the next ten years.

FIGURE 4 Proposal for ongoing LTS revision and alignment to NDC cycle



Source: inspired by (Hans et al., 2020) publication.

Chinese steelworks smoke pollution
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Woman cooks in front of the yurt entrance circa Harhorin, Mongolia
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08 International cooperation

In this chapter, we focus on aspects of **international cooperation**[30] as the implementation of LTS will be a new experience for many countries. International cooperation can provide a space for countries to share knowledge, identify areas for collaboration, discuss common challenges and options to overcome them, support and shift capacity to countries that need it most and reach their long-term targets. One example would be through international carbon markets (Elliott et al., 2019). Some countries have already started cooperating on their LTS. For instance, Mexico, Canada, and the United States of America collaborated closely during the creation of each LTS to share and compare experience (Goodlet & Monahan, 2018).

Key questions that influence the category of international cooperation were (Elliott et al., 2019; Rocha & Falduto, 2019):

- What issues would the country like to learn about or receive assistance on via international cooperation? What are the key objectives of the cooperation? Learned lessons and common challenges?

Market in Ghana
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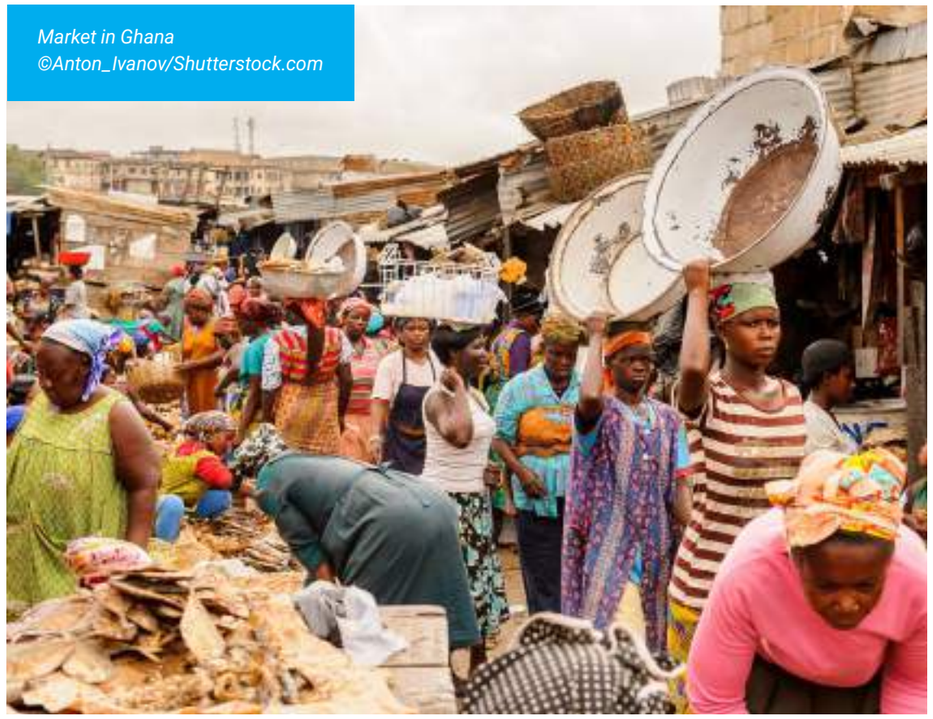

30 *The institutional arrangement for international cooperation was not initially planned to be directly examined as part of the QCA, but it turned out to be a relevant subcomponent in many LTS and is therefore included in this publication.*

8.1 Qualitative analysis of international cooperation in countries submitted LTS

This section presents key findings of the qualitative content analysis on countries' approach for international cooperation. We found that not solely increased emphasis for closer international cooperation mechanisms, but also concrete action plans on how it can be strengthened were included by many countries. While some focused on market-based approaches such as international carbon market efforts or carbon capture, utilization and storage (CCUS), others created working groups to increase regional cooperation, share practices and experience.

All four Annex-I countries covered aspects to increase international cooperation. For example, Germany included measures on how to reinforce international cooperation by conserving, restoring and sustainably managing forests (Germany, 2016, p. 58). The United Kingdom of Great Britain and Northern Ireland targeted convening and leading a new international working group to drive down the costs of enhanced climate action and accelerate the deployment of CCUS (United Kingdom of Great Britain and Northern Ireland, 2017, p. 55). The Republic of the Marshall Islands connected its regulatory framework setup to the United Kingdom of Great Britain and Northern Ireland Climate Change Act, 2008 and their Climate Change Committee. This decision was based on an offer by the United Kingdom of Great Britain and Northern Ireland to provide technical advice and insights into the functioning of its Climate Change Act (The Republic of the Marshall Islands, 2018; United Kingdom of Great Britain and Northern Ireland, 2017). Mexico collaborated with the Canadian and United States of America governments to align their strategies and develop an offset generation and validation system. Since 2016, Mexico, Canada and the United States of America have been working to develop their LTS. A connection to the GLCC, issued in 2012, and the role of different actors to comply with it, was under close focus during the development process. Hence, Mexico reemphasized their role as key actor among developing countries to combat climate change, taking responsibility to increase cooperation, especially in the region and for South-South cooperation (Elliott et al., 2019; Mexico, 2016; United States of America, 2021). Singapore is another country proposing to take on a leading role in regional and international cooperation action to combat the adverse impacts of climate change (Singapore, 2020). Similarly, Indonesia has a chapter for international partnership with focus on trade and investment, technology cooperation and research, finance flow and capacity development (Indonesia, 2021).

Other countries that included direct aspects and actions for increase international cooperation were: Andorra, China, Costa Rica, France, Nepal and Tonga (Andorra et al., 2021; China, 2021; Costa Rica, 2019; France, 2016; Nepal, 2021; Tonga, 2021).

The empirical assessment illustrated that enhanced international cooperation efforts can support developing countries to overcome some national barriers to implement their LTS. Evidence shows that some of the Non-Annex I countries were initially confronted with this dilemma and had to ask the international community for support to implement their LTS. In Nepal, the Ministry of Forests and Environment with assistance from United Nations Development Programme (UNDP), the NDC Partnership, and the Policy and Institutions Facility led the development process (Nepal, 2021). Gambia faced a similar baseline situation due to a lack of financial and human capacities, and requested closer international support and collaboration with United Nations agencies and other actors (Gambia, 2022). Thus, increased regional and international cooperation will also leverage opportunities for capacity-building, energy efficiency and innovations in new technologies as reemphasized by Nigeria (Nigeria et al., 2021).

8.2 Recommendations for effective use of international cooperation for LTS implementation

These recommendations are informed by the authors' practical experience in collaborating with developing country governments in the preparation and execution of climate strategies and the findings of the empirical analysis in this publication.

Throughout the analysis, it was found that despite the fact that many developing countries have successfully developed their LTS, they still lack financial and technical resources for implementation. Thus, international cooperation and dialogue can help to define and promote best practice LTS. Annex-I countries like United Kingdom of Great Britain and Northern Ireland, United States of America, Germany and France could take a lead in designing long-term low-emission development strategies and supporting developing countries. LTS should not be part of the post-Paris negotiations and should not be kept separate from discussions about NDCs. Government should aim to establish a set of shared best practices that can develop in a more ad hoc way norms about how LTS should be developed. Countries may choose to express their aspirations collectively to develop and implement their LTS as it will facilitate climate-policy discussion across stakeholders and the international community. A whole-of-society inclusion supports overcoming the remaining constraints in capacities and resources based on a combination of a mixed-method of a bottom-up and top-down approach. Morocco developed a LTS roadmap and investment plan to facilitate international collaboration and relied on international cooperation of Research Development & Demonstration (RD&D) in terms of implementation[31].

The analysis identified Mexico, Canada, and the United States of America to be highly concerned about how to increase international cooperation and collaboration efforts as they had designed their LTS in a collaborative process. However, there is more to enhance and improve international cooperation efforts than through collaboration between countries. For example, the 2050 Pathway Platform is an initiative that was launched at COP21 to support countries, states, regions, cities, and companies in the development of long-term, net-zero and sustainable pathways and designed as a space for collective problem-solving. The Platform aims to support national governments with financial and technical assistance in formulating their LTS tailored to country priorities while ensuring national ownership. Financial grants are provided by various donors including support for modeling, stakeholder consultation or personnel acquisition. Knowledge and advisory services are ensured through an annual meeting and capacity-building initiatives are included through training sessions and workshops with government officials and key stakeholders. As of February 2023, the initiative has 35 member countries, 12[32] of which has been covered in this technical report (2050 Pathways Platform, 2017, 2023). Nigeria's Federal Ministry of Environment at the Department of Climate Change relied on support from the 2050 Pathways Platform to implement their LTS (Nigeria et al., 2021). Similarly, the New Climate Institute designed the LTS Hub, which explores LTS to inform policymakers, researchers and other stakeholders interested in developing, supporting or assessing LTS. The focus of the Hub is to provide guidance, identify key elements that countries could incorporate when developing their LTS, benefits of revision cycles and good-practice cases (New Climate Institute, 2023).

If well-designed, LTS have the potential to facilitate policy planning within and between countries, promoting collaboration on specific issues by identifying pathways and investment requirements for each sector and providing a framework to deepen international discussion. Potential solutions for increased international cooperation and connected knowledge-sharing practices across own national borders can be to establish forums, regional and international, to enhance consensus among countries to tackle climate change and share lessons learned.

31 Information provided through written request by Moroccan focal point

32 Andorra, Costa Rica, Fiji, France, Gambia, Germany, Marshall Islands, Mexico, Nigeria, South Africa, United Kingdom of Great Britain and Northern Ireland, United States of America (Andorra was the last country that joined the 2050PP in November 2021)

Container vessel under cargo operations. Mombasa, Kenya
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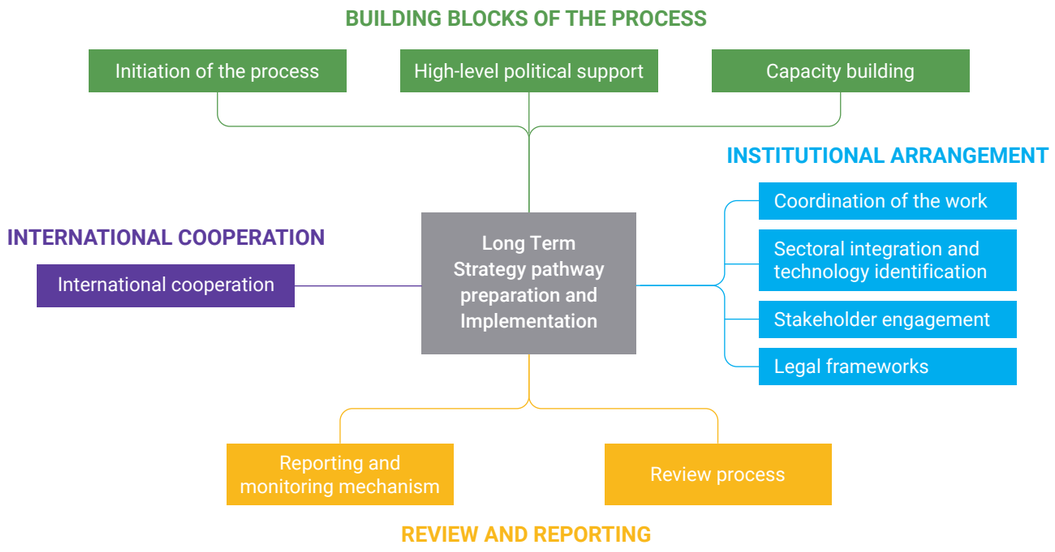
09 Concluding Remarks

The present publication consists of 8 chapters resulting from an assessment of the literature and the authors' experience, Chapter 1 introduced key elements of institutional capacities plus international cooperation that are central to implementing Long Term Strategies (LTS). For each of these elements, Chapters 2 to 8 have highlighted the findings of our qualitative content assessment as well as describing common capacity gaps and providing recommendations for bridging them. In addition, Annex B introduced a new emerging component for LTS: Short-Lived Climate Pollutants.

This analytical report emphasizes that effective governance mechanisms and institutional arrangements are essential components for shaping the success of designing countries' LTS pathways. Throughout the empirical analysis, we perceived that LTS are highly meaningful for guiding the direction and approaches of different countries in the development and implementation of reaching their long-term climate targets, in most cases net zero by 2050. The LTS can help bolster a country's climate ambition beyond short-term goals set in its NDC by providing a strong political signal and visibility regarding a country's medium and long-term strategic choices to both public and private investors and international financial institutions. Compared to other government strategies, LTS distinguish themselves by offering a long-term perspective on the national economy and covering an exceptionally wide range of policy domains. Thus, it is important to engage in the process towards implementation of Article 4.19 under the Paris Agreement, despite its non-mandatory nature.

For this report, the authors have created a building-block recommendation for the whole process of how countries can integrate institutional arrangements and ensure the longevity of their LTS development, implementation and updating strategy. The findings showed that certain institutional arrangements play a more essential role for different countries than for others given national circumstances.

FIGURE 5 Governance steps for LTS pathway development and implementation



(inspired from Elliott, C., Worker, J., Levin, K., & Ross, K., 2019. Good Governance for Long-Term Low-Emissions Development Strategies. World Resources Institute, Washington, DC

Building blocks of the process

Initiating the process by Identifying the key drivers, factors and conditions such as organizing events, meetings and awareness raising that help to start the process.

High-level political support: High-level political buy-in plays a vital role in the success of the implementation process because politics affects governmental action and measures which can reinforce the political alliances that support climate policy with regard to high-level political support, in most cases, a lead institution, usually the Ministry of Environment or the Ministry of Foreign Affairs or equivalent, and the respective Minister have been designated to coordinate the process.

Capacity building (e.g. technical and human capacity): Resources to train relevant government agency staff (and possibly non-government agency staff), with a view to increasing the technical (e.g. modeling, analysis) and managerial skills.

Institutional arrangement

Coordination of the work: Ability to launch and coordinate a whole-of-government process, incorporating contributions from all relevant government agencies and non-governmental parties as relevant.

Sectoral integration and technology identification: Capacity to integrate net-zero targets and strategies into sectoral and cross-sectoral programmes and projects and identification of relevant technologies

Stakeholder engagement: Ability to involve all pertinent parties in consultations meant to get their feedback so that it can be taken into account and increase stakeholder buy-in.

Legal frameworks: the ability to strengthen relevant governmental processes and entities, streamline and enhance current laws and regulations, and revise the regulatory framework.

International cooperation

International cooperation: it refers to all the international market mechanisms that the country adopts (as the main way or a complementary solution) to reach its long-term low-carbon mitigation commitments.

Monitoring, reporting and review

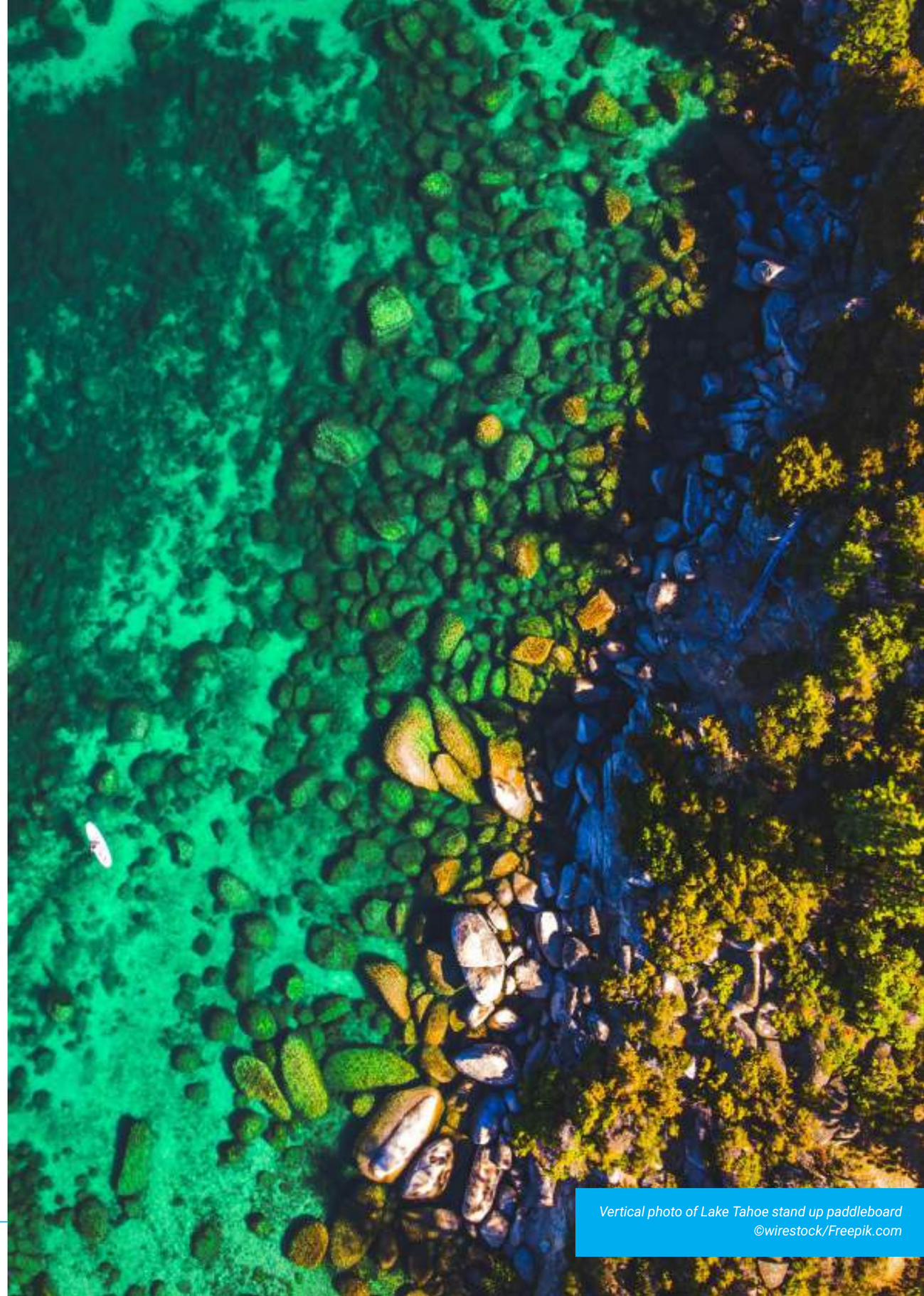
Monitoring and Reporting mechanism: Ability to report, communicate and monitor the progress of achieving the LTS pathway, making the best use of existing data collection mechanisms and strengthening related capabilities wherever needed.

Review process: Creating a review process for the LTS implementation process enables the country to reflect on the previous process, incorporate new data and methodologies to the existing plan, and adjust the course of action on implementation.

BOX 3 Pioneering Case: Tonga Interconnected Institutional Capacities

Tonga positioned itself as a "global leader in developing policies and plans that incorporate climate-change action and sustainable development measures (Tonga, 2021)." Tonga has developed its LTS with support from the New Zealand Ministry of Foreign Affairs and Trade and technical assistance provided by ClimateWorks Australia. The empirical research identified Tonga as an outstanding case for connecting different aspects of institutional arrangements and demonstrating, why a comprehensive understanding of it, is essential to implement successful climate targets. Tonga is a good example of how to link all the institutional arrangements with each other and ensure that they are "treated" in a coordinated manner.

As already mentioned under regulatory framework, the LTS was aligned to several key executive and legislative mandates with focus on short- and long-term climate action. The Joint National Action Plan (JNAP) mandated the creation of their LTS and alignment with the NDC targets. Beyond, the JNAP Secretariat has clear roles and responsibilities, guiding coordination attempts between different committees and ministries. For sectoral integration, the strategy includes sector visions on standards and regulations to impose, for example in the transport-sector regulations for higher energy efficiency. Besides, a new Energy Commission will be responsible for regulation of the energy sector. In the energy sector, there has been some transformation recently by the acceleration of new policies from the energy bill, enacted in 2022 by royal assent. The Bill provides a robust policy to establish coherent institutional and regulatory frameworks for coordination in the energy sector. Tonga's LTS is divided into different sectors: AFOLU, IPPU, energy, waste and transport. For each sector, Tonga demonstrated its outstanding ability to integrate aspects of institutional arrangements by connecting it to national and sectoral policies, responsible ministries and stakeholders, emissions and sector pathway actions over time. This was followed by its implementation, socio-economic and environmental considerations and gaps and potential solutions for mitigation and adaptation efforts. Tonga's second NDC is also in alignment while integrating components of stakeholder engagement: many of the stakeholders who participated in the 2015 NDC review and second NDC validation were also actively engaged in the workshop to gather inputs for the LTS design. Tonga's distinguished climate performance is further underpinned by the application of regulatory elements for its reporting and review process guided by the Department of Climate Change. The review process is conjointly supported through the NDC M&E Framework and JNAP2's M&E system guide. Thus, it uses already existing M&E and MRV system for the review cycle for the LTS and NDC (Tonga, 2021).



Vertical photo of Lake Tahoe stand up paddleboard
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Institutional Capacities for LTS Implementation

Annexes

Solar panels and wind power equipment
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Annex A

Codebook and Methodology expansion

The authors assessed and evaluated the meanings behind the coded segments in the countries' strategies on the respective capacities in place.

A codebook was created to detail the coding process, including the overall meaning, aligned sub-codes with acronyms and synonyms, assignment dates, examples, and challenges encountered during the process. As mentioned in the methodology section, an automatic coding tool was used initially, followed by manual revision to ensure appropriateness and completeness of the assigned units. Due to significant overlap among the institutional arrangements, complete disentanglement was not the aim of this publication, and was recognized from the outset.

Limitations of the study

After the empirical analysis was conducted, further LTS were submitted to the UNFCCC, including some updates of already submitted strategies. Additionally, the QCA is limited to countries who submitted their strategies in English. This directs towards some of the standard limitations when conducting qualitative research. The performance of extensive qualitative research is highly time-and resource-intensive. Therefore, the sample size is often limited and smaller in comparison to an application of quantitative research. Another important aspect in qualitative research, is that it relies on the researcher's interpretations of the data. Even though it was tried to leave out the authors'' subjectivity, personal biases and perspectives to the highest extent, objectivity can never be fully ensured. Lastly, qualitative research is often constrained by limited generalization. This report provides an in-depth insight into the analyzed sample size and their national circumstances on efforts for their implementation, development, and revision of LTS. Nevertheless, there is no guarantee for its replicability on different circumstances (Koks, 2015).

TABLE 7 **Codebook for selection of Institutional Arrangements for the QCA**

CODEBOOK				
CODING UNITS WITH ACRONYMS AND SYNONYMS	**CODE DESCRIPTION (GENERAL)**	**SUB-CODES WITH ACRONYMS AND SYNONYMS**	**WHEN IT WAS APPLIED (BRIEF)**	**EXAMPLES**
Coordination Coordinate, coordinator	Overall, refers to all coordination efforts mentioned in countries LTS to include different actors, ministries, and institutions: elements on the launch and coordination of a whole-of-government process and international cooperation across countries.	Horizontal coordination, vertical coordination Working groups, institutional set-ups Roles, responsibilities Public authority Cooperation, collaboration: cooperate, cooperator, collaborate, collaborator International cooperation	Code was applied to any mention of policy coordination mechanisms and instruments including aspects of coordination through hierarchy, networks, or markets (Peters, 2006).	Action in AFOLU sector: "Strengthen public private partnership to drive requirements of organizations with the aim of sharing responsibility to promote best practices in agriculture and forestry." (Tonga, 2021, p. 58) France provided a comprehensive inclusion of where, what and how coordination is needed to achieve common climate goals (France, 2016).
Stakeholder Engagement Stakeholder consultation, actor, stakeholder	Refers on countries attempt, and strategies of how different actors were engaged for the development, implementation and continuation of the LTS process.	Stakeholder mapping, identification Opinion, inputs, positions, trade-offs Interested parties or groups, affected parties or groups Power imbalance, information asymmetry	Code was applied if countries clarified on strategies of how various stakeholders were engaged in the implementation processes for the LTS. Identified aspects of a broad inclusion, consultation, workshops etc.	"[...] this 2050 Strategy should serve as a useful tool in setting the context for, and influencing, relevant near, medium and long-term planning and decision-making at all levels of stakeholders. As such, the purpose of this 2050 Strategy is to enable relevant Republic of the Marshall Islands decision-makers to make well-informed decisions based on the full national context and not only on economic considerations." (The Republic of the Marshall Islands, 2018, p. 65). "We regularly engage the public under a variety of platforms to gather feedback on government policies, to crowdsource ideas and to co-create solutions." (Singapore, 2020, p. 124)
Sectoral Integration Integrating, mainstream, sectoral mainstreaming	Refers on countries' capacities referred to sectoral and cross-sectoral strategies integrated for the long term.	Budgetary allocations, high-level support: allocate, budget Trade-offs, consistency, inclusion, policy screening: screen, include, consistent	Code was applied if countries included different sectoral strategies on how to reduce emissions in their LTS. Also, if strategies were linked directly to policy measures.	Fiji introduced for every relevant sector, specific policies and clarified on cross-sectoral needs. For example: relevant policies for land transport including "promote non-motorized transport, biofuels and efficient imported vehicles." (Fiji, 2019, p. 77)
Regulatory Framework	Refers to the system of regulations, standards and administrative procedures that are relevant for the LTS.	Streamline Regulations, standards, administrative procedures Primary and/or secondary legislation Independent regulator, red tape, regulatory efficiency, rule of law	Code was applied if countries included certain strategies on how to link their LTS to either existing or new regulatory frameworks, laws, decrees, mandates etc. relevant for long-term climate goals.	Green New Deal and Digital New Deal build foundation for the Korean New Deal (LTS). The LTS incorporates the country's 2050 Vision and established a Presidential 2050 Carbon Neutrality Committee (Republic of Korea, 2020).
Human Capacities Human capabilities, human resource capacity	Refers to the ability of government to train relevant stakeholder to achieve climate targets, provide training sessions, education, enhance capacity building etc.	Understaffing, staffing, staff, turnover Know-how, expertise, knowledge Training, capacity building, learning, train, educate, education, workshop Awareness raising, awareness	Code was applied when aspects of the main and subcodes have been mentioned and strategies on how to increase especially capacity-building initiatives for the public were included. Focus on human and technical skills.	Education, training, and capacity building are fundamental to the transformation of Tonga's traditional fossil-fuel based electricity system to a new, renewable electricity system. Currently however, there is a shortage of skills and experience in the technical and regulatory areas needed to implement Tonga's ambition to achieve 70 per cent then 100 per cent renewable electricity by 2030 and 2035, respectively (Tonga, 2021, p. 36).
Reporting Report	Refers to the ability to monitor progress and report on it	Quality assurance, review, verification, transparency, transparent, verify, review, assure Sources/ types of information and/ or data Public information, communication, accountability, account, communicate Monitoring, monitor	Code was applied when countries clarified on aspects behind reporting and reviewing mechanism including a reporting cycle, monitoring and evaluation and revision of the LTS with linkage on transparency strategies	"The MRV framework for the LTS4CN will build on existing government systems, while strengthening capacity and data collection capability where possible. It will be integrated into the online NDC tracking system with reporting conducted in parallel." (Kingdom of Cambodia, 2021, p. 46) "Industrial sector: Develop standardized tools for voluntary reporting of energy savings from initiatives in the mining sector." (South Africa, 2020, p. 30)
International Cooperation Cooperation	Refers to all attempts' countries made to increase international cooperation approaches in their LTS.	This category was identified during the coding process as sub-component of coordination. Therefore, no sub-codes have been included.	Code was applied to any mentioned of international cooperation mechanisms and aspects for efforts on which ministries were involved in LTS process were taken into account.	"[...] emphasizing on necessity of international cooperation for combating climate change and how China will engage in it." (China, 2021, p. 27)
Short-Lived Climate Pollutants SLCPs, SLCP, climate pollutants, short-lived	Refers to all attempts a country links strategies, actions, measures, policies or simply recognizes its importance as first step to reduce emissions by SLCPs.	Methane: CH4 Hydrofluorocarbons, HFCs, HFC Black carbon: BC Tropospheric ozone, O3, tropospheric	Code was applied to any mention of any type of SLCPs including the subcategories of BC, CH4, HFC and O3 and related policies, measures as stated in countries LTS.	"An essential component of Mexico's climate policy is the reduction of short-lived climate pollutants. We also modeled explicitly the goals for black carbon." (Mexico, 2016, p. 75)

Authors' creation

Annex B

New Emerging Component for LTS

SLCPs

Short-Lived Climate Pollutants which also called 'near-term climate forces' refers to GHGs and other climate pollutants that have short lifetimes in the atmosphere compared to carbon dioxide.

Reducing SLCP emissions can provide immediate benefits by slowing down the rate of global warming and improving air quality. SLCP mitigation measures are generally cost-effective, and their implementation can lead to significant co-benefits, such as improved public health, increased crop yields, and enhanced food security. Including aspects to reduce SLCPs in national climate strategies can also contribute to achieving the goals of the Paris Agreement, which aims to limit global warming to well below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius (CCAC, n.d.; Levin et al., 2019; UNEP et al., n.d.).

Next to CO_2, the SLCPs: black carbon (BC), methane (CH_4), tropospheric ozone (O_3), and hydrofluorocarbons (HFCs) are the most important contributors to global greenhouse effects. Black carbon is a component of fine particulate matter air pollution and is a produce of incomplete combustion of fossil fuels, biofuels and biomass. Methane is emitted either by human activities such as livestock production, from natural gas systems or by natural sources such as wetlands. Hydrofluorocarbons are man-made GHGs utilized in refrigeration, air conditioning, aerosols, for extinguishing systems and solvents. Despite making up a relatively minor portion of current greenhouse gas emissions, HFCs have a huge potential to warm the atmosphere than the same mass of carbon dioxide. Tropospheric ozone is formed by interaction of sunlight with hydrocarbons and nitrogen oxides, emitted by vehicles, fossil fuel power plants, refineries, and other industries (CCAC, n.d.).

The short period of time in which SLCPs can be removed from the atmosphere, combined with measures to cut carbon dioxide present an opportunity for countries to achieve their climate targets. Including actions to reduce emissions caused by SLCPs together with GHGs would help increase NDCs ambition and inherently LTS (IPCC AR6, WG3, 2022). Some countries already have started to include actions for SLCPs emission reductions in their inventories. Mexico and the United States of America included sectoral strategies for non-CO_2 emissions emphasizing on SLCPs (Jaber et al., 2020). Consequently, it was decided to evaluate which countries included aspects of SLCPs in their LTS and in how far these have been addressed (CCAC, n.d.; Levin et al., 2019).

Qualitative analysis of SLCPs in countries submitted LTS

Many countries mentioned SLCPs, especially methane. However, most parties just pointed towards the need for action without proposing concrete measures on how to enhance it. A more in-depth assessment recognized that only few included concrete measures or subchapters on how to integrate action for reducing emission caused by SLCPs for the long term.

Mexico was identified as country with highest capacities for proposed action. The country included an extensive strategy on how to address and introduce measures for emission reductions of SLCPs including BC, CH_4 and O_3. For example, Mexico formulated a long-term vision goal on reducing emissions caused by SLCPs in different time frames via measures of cost-effective mitigation actions (Mexico LTS p.5, p.53, p.88). The United States of America also emphasized measures to reduce emissions by SLCPs, dividing them into BC, HFCs and CH_4, Table 9. Reasons for the extensive coverage of SLCPs in both countries are rooted in the fact that they developed their LTS in a collaborative process, including Canada.

Nonetheless, tropospheric ozone was only included in Mexico's LTS. The country proposed action in the agriculture and forestry sector by incentivising the control of volatile organic compound (VOC) emissions and O_3 precursors in organic waste aerobic treatment (Mexico LTS p.94).

The following tables, Table 7 and Table 8, display the findings around two of the four SLCPs and measures in mitigation and adaptation on how to reduce the effects. Most of the parties included measures on how to reduce methane emissions in the agriculture and waste sector. Countries where no measures have been proposed, are left out. Nepal envisioned on strategic actions in the agriculture and waste sector to reduce methane emissions but estimated the implementation level to be low due to limited resources. Thus, the country asked for external support (Nepal, 2021).

TABLE 8 Methane, SLCPs in case studies

SLCPs	
COUNTRY	**SLCPS: METHANE, PROPOSED MEASURE TO REDUCE EMISSIONS**
Cambodia	AFOLU: Decrease emissions in crop cultivation by using less methane-intensive rice cultivators (Kingdom of Cambodia, 2021, p. 5)
Costa Rica	AFOLU: Consolidating the management of sanitary landfills to encourage the capture of methane either through active or passive techniques (Costa Rica, 2019, p. 9)
Fiji	Waste: Recycling programmes: solid waste and water management, methane capture for waste-to-energy use (Fiji, 2019, p. 161)
France	Agriculture: nutritional breakdown of animal feed (France, 2016, p. 69)
Gambia	Agriculture: mitigation measure: switching to a system of rice intensification, which discourages flooding of rice fields; promotion of upland rice production Waste: waste separation and collection, recycling and banning biodegradable waste from landfill, organic waste recovery […] (Gambia, 2022, pp. 30, 43)
Indonesia	Waste: utilization of aerobic treatment for the management of solid waste disposal sites; concrete action plan on how to reduce methane emissions, also in agriculture sector (Indonesia, 2021, p. 62)
Mexico	Comprehensive and concrete action plan: e.g., through encouraging electricity generation from biogas projects in landfill and wastewater treatment plans (Mexico, 2016, p. 90)
Nepal	Strategic action for methane reduction in agriculture and waste sector, but limited due to lack in resources (Nepal, 2021, p. 6)
Nigeria	Policies in specific sectors e.g., AFOLU low-methane fodders for livestock (Nigeria et al., 2021, p. 19)
Republic of the Marshall Islands	Waste: If landfilling is pursued, methods such as a "Fukuoka" style landfill, which reduces methane emissions by 50 per cent compared to standard landfills, should be considered (The Republic of the Marshall Islands, 2018, p. 13)
Republic of Korea	Agriculture: framing practices (Republic of Korea, 2020, p. 74) Waste: methane gas recovery: hygienic landfills, biological treatment facility (2020, p. 68)
South Africa	Waste: implementation of separation at source programmes in metropolitan municipalities and through the establishment of material recovery facilities (South Africa, 2020, p. 38)
Thailand	Agriculture: low methane rice farming, CH_4 reduction technologies such as enteric fermentation (Thailand, 2021, pp. 25, 44) Wastewater Management: Increasing biogas production from industrial wastewater through re-utilization of methane (Thailand, 2021, p. 23)
United States of America	Comprehensive: low-cost options to reduce non-CO_2 sources, such as implementing methane leak detection and repair for oil and gas systems and shifting from HFCs to climate-friendly working fluids in cooling equipment; included methane abatement potential by source (United States of America, 2021, pp. 9, 29)

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TABLE 9 HFCs, SLCPs in case studies

SLCP: HFCs	
COUNTRY	**HFCs, PROPOSED MEASURES TO REDUCE EMISSIONS**
Andorra	Improve air condition and cooling appliances, target in industry and use of products by 203: reduce 85 per cent of HFC consumption baseline (Andorra et al., 2021, pp. 16, 31)
Mexico	Subchapter on action for SLCPs: To accelerate the penetration of low global warming potential refrigerants in different sectors including: air conditioning, refrigeration, and foaming agents. This will be accompanied by the reduction of leaks, HFCs management and adequate disposal (Mexico, 2016, p. 89)
Singapore	HFC mitigation measures for refrigeration and air-conditioning including a voluntary label for climate-friendly refrigerants (Singapore, 2020, p. 34)
Republic of Korea	Connection to Kigali Amendment, target: 80 per cent reduction in HFCs by 2045; replacement of F-gases (Republic of Korea, 2020, p. 49)
United Kingdom of Great Britain and Northern Ireland	Target: 85 per cent phase down by 2036; F-gas regulations to achieve the target and encourage other countries to follow (United Kingdom of Great Britain and Northern Ireland, 2017, pp. 11, 96)
United States of America	Subchapter on fluorinated gases: HFCs emissions are reduced by a three-pronged approach: phase down production and import of HFCs, address existing stock of refrigerators and air conditioners, deploy next generation of low-GWP alternatives to HFCs (United States of America, 2021, p. 33)

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Recommendations for effective integration of aspects of SLCPs for LTS implementation

Summing up, parties who included measures and actions on reducing emissions caused by SLCPs can be taken as a role model for others to enhance more action in that area. In addition, a proposed control measure package by United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in collaboration with the Climate & Clean Air Coalition (CCAC) could further support countries to include relevant action measures and serve as guidance. The package of control measures targets to reduce emissions under SLCPs for methane, black carbon and hydrofluorocarbon.

An ambitious, successful, and sustainable NDC that supports these multiple benefits is constructed from four foundational building blocks:

A. Economy-wide targets that include CO_2 and non-CO_2 pollutants across all sectors;

B. Integrated air quality planning and climate strategies;

C. Harnessing related global, regional, and national strategies; and

D. Comprehensive reporting of non-CO_2 pollutants.

These building blocks ensure that mitigation efforts are broad, synergistic, and transparent, maximising co-benefits for climate, health, and development while leveraging resources and institutional support for implementation."

[UNEP-Convened Climate and Clean Air Coalition, 2024, p. 10]

A list of activities targeting individual pollutants in key emitting sectors was developed. Activities to reduce methane emissions in the agriculture sector include the improvement of manure management and animal feed quality, the promoting of farm-scale anaerobic digestion to control methane emissions from livestock, the application of intermittent aeration of continuously flooded rice paddies and more. For example, Gambia included activities for waste management practices to separate, collect and recycle waste as proposed in the control packages by UNEP and WMO (Gambia, 2022; UNEP et al., n.d.).

With focus on HFCs reduction measures, all parties covered ratified and complied with the control measures of the Kigali Amendments under the Montreal Protocol, which is identified as vital step to reduce HFCs emission (UNFCCC, 2016, p. 201). The replacement of high-global warming potential HFCs with low-or zero-global warming potential alternatives for cooling and refrigeration was also covered as measures by some parties, Table 10 (UNEP et al., n.d.).

As mentioned, measures to reduce emissions from black carbon were only covered by the United States of America and Mexico. The United States of America proposed to expand diesel vehicles (p.33) while Mexico focused on encouraging technologies and fuels such as particle filters and ultra-low sulphur diesel (p.89). Both countries acknowledged measures which are also proposed in the control package such as using diesel filters, eliminating high-emitting diesel vehicles and making technologies in the brick industry more energy efficient (UNEP et al., n.d.).

The assessment on parties' inclusion of aspects of SLCPs, undermined that concrete action for a reduction in emissions in this area is still lacking, despite the fact that it can avoid being locked in with high-carbon technologies and losses associated with stranded assets. Therefore, scaled-up efforts in all sectors and for everyone is required for integrated potential synergies and trade-offs in this new emerging component to implement LTS.

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