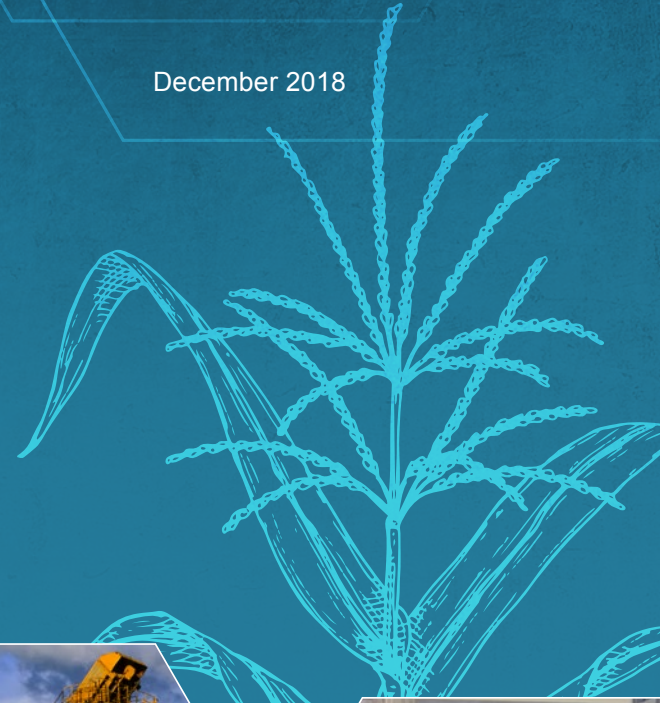


December 2018



RALI GHG MRV Harmonization Framework

A General Guide



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For more information

USAID

Amanda Valenta
Climate Change Specialist
avalenta@usaid.gov

ICF

Marian Van Pelt
RALI Project Manager
marian.vanpelt@icf.com

For more information on the Resources to Advance LEDS Implementation (RALI) project, please visit climatelinks.org/projects/rali.

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Acronyms

AFOLU	Agriculture, Forestry, and Other Land Use
BUR	Biennial Update Report
CDM	Clean Development Mechanism
CO₂	Carbon dioxide
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
kg	Kilogram
km	Kilometer
kWh	Kilowatt-hour
LEDS	Low Emission Development Strategies
MRV	Measurement, reporting, and verification
CH₄	Methane
NAMA	Nationally Appropriate Mitigation Actions
NDC	Nationally Determined Contribution
N	Nitrogen
N₂O	Nitrous oxide
RALI	Resources to Advance LEDES Implementation
TJ	Terajoule
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

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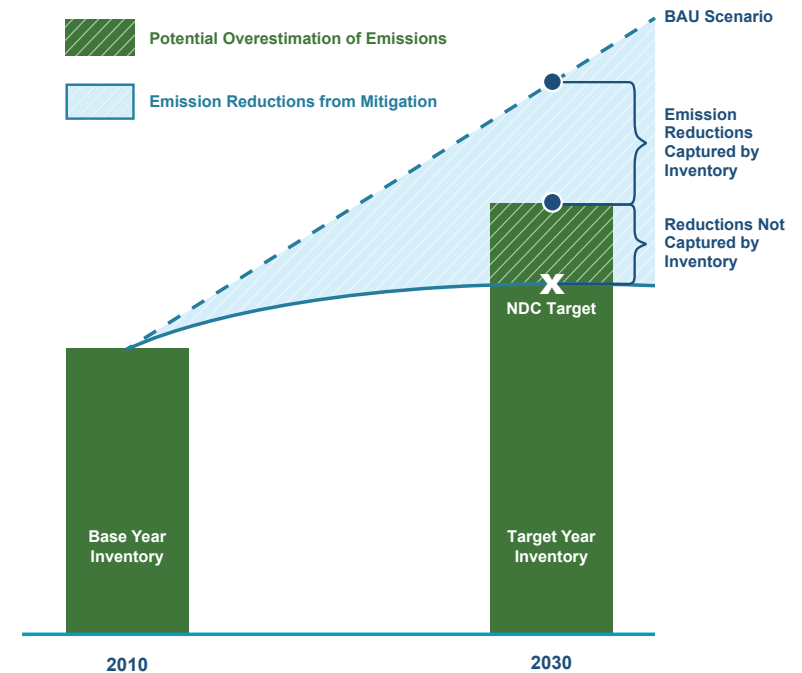
Countries around the world have set ambitious targets for reducing greenhouse gas (GHG) emissions as part of their nationally determined contributions (NDCs) under the Paris Climate Agreement. NDCs serve as a significant catalyst for mitigation actions across sectors and at all scales, from local projects to national policies. These developments enhance the need for transparent reporting on the impact of diverse mitigation actions.

The Challenge of Harmonization

As countries implement mitigation activities and develop methods to measure the impact of these activities, they need to also monitor progress toward their respective NDCs.

One way to do that is to ensure that mitigation activities are captured in national GHG inventories. However, measurement, reporting, and verification (MRV) methods for mitigation activities vary by project and are often distinct from MRV methods for national inventories, which are typically structured to comply with international reporting requirements. This may result in over- or under-estimated national emission levels. Underestimating emission reductions achieved could indicate that countries are not meeting their reduction targets and could affect investment in future activities if returns on climate investment are not demonstrated.

Figure 1: Incorporating Mitigation into National GHG Inventories



If national inventories do not reflect the full extent of mitigation activities, national emission trajectories may not demonstrate progress toward a country's NDC target.

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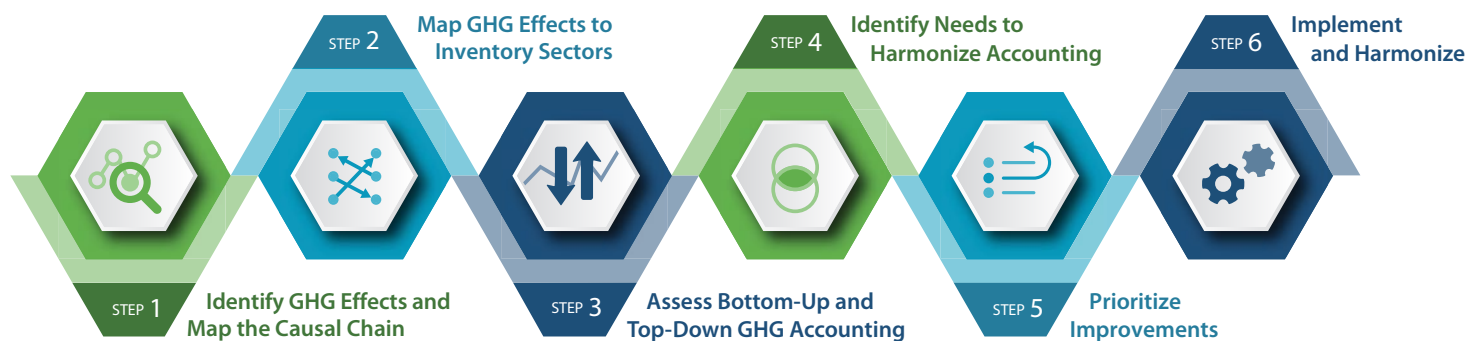
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The RALI GHG MRV Harmonization Framework

Recognizing the need for transparent and accurate reporting, the USAID Resources to Advance LEADS Implementation (RALI) project developed the RALI GHG MRV Harmonization Framework (“Harmonization Framework”). This is a six-step process designed to help national inventory compilers, mitigation activity implementers, and other climate change practitioners align MRV methods for GHG mitigation activities (i.e., “bottom-up” GHG accounting) with national GHG emission inventories (i.e., “top-down” GHG accounting).

Figure 2: RALI GHG MRV Harmonization Framework



Purpose of This Document

This document is a step-by-step guide for how to successfully apply the Harmonization Framework to a selected mitigation activity. Templates for implementing the framework are provided in the guide’s *Annex A: Harmonization Templates*. The guide’s intended audience includes national inventory compilers, mitigation activity implementers, and other climate change practitioners.

Tip: This guide is intended to support country-level harmonization between mitigation activities and national inventories. However, several steps in this document can be adapted to harmonization efforts at the subnational level.

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Advantages to Using the Harmonization Framework

The Harmonization Framework is designed to improve the accuracy and transparency of GHG emissions reporting and to enhance the ability of stakeholders to use this reporting for tracking GHG mitigation actions. Using the Harmonization Framework can provide these advantages:

- Position countries to demonstrate climate progress toward their NDC target and meet their reporting obligations under the Paris Agreement.
- Improve the accuracy of GHG emissions reporting.
- Support increased access to financing for mitigation activities.
- Enable decision-makers to prioritize mitigation investment and prioritize resources for MRV improvements.

As a result, climate change practitioners can establish and continuously improve MRV methods to provide transparent reporting and demonstrate progress under the Paris Climate Agreement.

Introduction to the Harmonization Framework

The Harmonization Framework is a step-by-step approach to identify areas where greenhouse gas mitigation impacts are not reflected in a country's GHG inventory, to analyze options, and to develop solutions. The framework can also be used to develop MRV methods that align with national GHG inventory needs.

Methods for measuring the GHG impact of mitigation activities can vary significantly from national inventories. MRV methods vary by type of mitigation project, location, and activity-specific circumstances, and may use different reporting standards depending on the implementer. National GHG inventories are typically structured to comply with international reporting requirements, which means that data, methodologies, and processes may not be granular enough to capture the GHG impacts of mitigation activities. This can occur for many reasons, including:

- The use of different methods, data sources, and assumptions between mitigation MRV and the national inventory,
- Differences in accounting boundaries between inventory and mitigation reporting,
- The scale at which mitigation activities occur versus national GHG accounting,
- Diverse stakeholders involved in implementing mitigation activities,
- A lack of institutional arrangements or coordination between inventory teams and activity implementers, or
- A lack of a central reporting system of all mitigation actions planned or underway across sectors.

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The Harmonization Framework can guide national GHG inventory developers, mitigation activity implementers, and other stakeholders to align MRV methods for GHG mitigation activities with national inventories. Resources on the basics of national inventory and MRV accounting principles and processes, such as the *2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* and the GHG Protocol [Policy and Action Standard](#), can be found in *Annex B: Helpful Resources*.¹

What the Framework Offers

The Harmonization Framework offers several advantages for decision-makers and climate change practitioners. These advantages are described below.

- **Position countries to demonstrate climate progress toward their NDC target and meet their reporting obligations under the Paris Agreement.** The Enhanced Transparency Framework, which defines obligations for parties to evaluate and communicate their mitigation efforts, will be implemented as the Paris Agreement comes into effect in 2020. Although specific requirements are still being developed, countries that establish strong, harmonized MRV methods that capture GHG emission reductions within the national inventory will be well-positioned to meet the current United Nations Framework Convention on Climate Change (UNFCCC) requirements (e.g., National Communications, Biennial Update Reports) as well as the Enhanced Transparency Framework requirements under the Paris Agreement.
- **Improve the accuracy of GHG emissions reporting.** This framework enhances the ability of inventory teams to report GHG emissions that reflect actual country circumstances, including the impact of ongoing mitigation actions, and to provide an accurate snapshot of GHG emissions at the national level.
- **Support increased access to financing for mitigation activities.** By improving the accuracy and transparency of GHG accounting, this framework can enhance investor and/or market confidence in country-level mitigation activities. This can help improve the ability of countries and project developers to leverage financing for GHG mitigation actions from international partners.
- **Enable decision-makers to prioritize mitigation investment and prioritize resources for MRV improvements.** By supporting the alignment of mitigation activity results with national inventories, this framework can enhance the ability of decision-makers to track progress toward national mitigation targets, including those set in their respective NDCs. This can help determine the effectiveness of different mitigation activities and identify where to leverage resources to maximize GHG emission reductions. A harmonized MRV system will also enable decision-makers to prioritize investments in MRV improvements for both mitigation actions and the national inventory.

¹ A basic understanding of national inventory principles and processes as well as MRV accounting is important to effective implementation of the RALI GHG MRV Harmonization Framework.

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Getting Started with the Harmonization Framework

Before applying the Harmonization Framework, select a priority mitigation activity and determine whom to engage at each step of the framework, following the guidance below.

1. Select a priority mitigation activity to harmonize.

Many countries have prioritized mitigation activities to pursue to meet NDC commitments. To select mitigation activities for applying this framework, consider factors such as:

- Availability of information about the activity
- Availability of established MRV methods to estimate emission reductions
- Existing MRV and stakeholder activity underway
- Mitigation potential and relative contribution to NDC goal (if applicable)
- Impact to key categories or priority sectors within the national GHG inventory
- Overlap with national or subnational climate change policy and initiatives

It may be helpful to choose an activity that has a significant impact on the accuracy of GHG emission estimates in national inventories. The Energy and Agriculture, Forestry, and Other Land Use sectors tend to be significant sources of GHG emissions in most countries. Because of these sectors' significance, mitigation activities in these sectors are good candidates for the Harmonization Framework.



Examples of mitigation activities include installing biogas facilities to convert methane from waste to energy (left), or installing small-scale solar panels to generate electricity (right).

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2. Determine whom to engage at each step of the framework.

As will be outlined in the next section, the Harmonization Framework has six steps. Steps 1 through 4 are more analytical and may be appropriate for an inventory developer or mitigation activity implementer to apply, provided they have access to both mitigation MRV and national inventory information. Steps 5 and 6, however, include decisions to be made by the mitigation MRV and national inventory teams, along with governing ministries and other relevant stakeholders involved in decision-making. These steps will require engaging broader stakeholder groups for implementation. Given the differences between steps, identify the appropriate stakeholders to involve throughout the process.

3. Apply the framework.

Now it is time to begin using the Harmonization Framework. Follow the six steps shown in *Figure 3*, and repeat the steps for each selected priority mitigation activity. Refer to templates to implement the approach in *Annex A: Harmonization Templates*, along with resources in *Annex B: Helpful Resources*.

6 Steps of the Harmonization Framework

The six steps for applying the Harmonization Framework to a selected mitigation activity are outlined in *Figure 3*, and explained in more detail on the next pages.



Applying the RALI Harmonization Framework to an Example Transportation Activity

This guide illustrates each step of the RALI GHG MRV Harmonization Framework using an example *Transportation Activity*, which is designed to reduce emissions from the transportation sector. Follow the blue-shaded text boxes to walk through an example of the Harmonization Framework steps.

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Many countries have identified transportation mitigation actions, such as introducing compressed natural gas buses, to achieve their NDC commitments.

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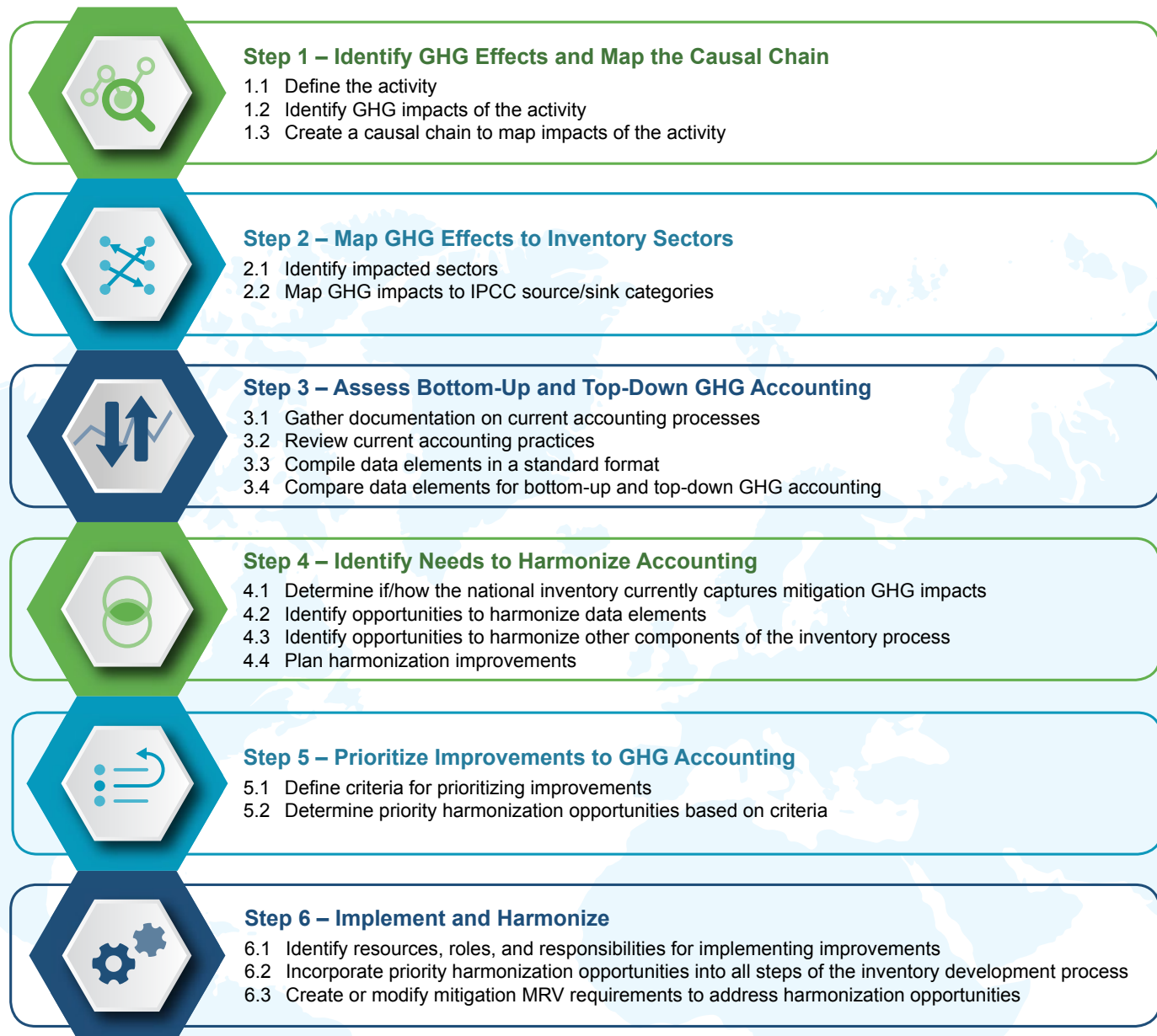
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Figure 3: 6 Steps of the Harmonization Framework



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Step 1: Identify GHG Effects and Map the Causal Chain

The first step of the Harmonization Framework is to set the boundaries of the mitigation activity. This includes defining the activity, describing its outcomes, and identifying its impacts on GHG emissions. This step is informed by the GHG Protocol *Policy and Action Standard*.²

1.1 Define the activity. Once the mitigation activity has been selected, define the boundaries of the activity for the purpose of applying the framework. Specifically:

- What does the activity include in terms of specific policy measures, actions, or strategies?
- Where does the activity occur (i.e., what are the activity's geographic boundaries)? Is the activity occurring at the local, regional, or national level?
- When will the activity occur (i.e., what is the temporal boundary)? Is the activity planned, ongoing, or implemented?
- Are there ongoing projects within the geographic boundary that are related to the activity?
- What are the discrete impacts of the activity (for example, reducing fuel use or improving access to energy)? How does the activity relate to other mitigation actions?

1.2 Identify the GHG impacts of the activity. Consider which outcomes of the activity may impact GHG emissions. Specifically:

- What changes are expected that impact sources of GHG emissions (e.g., decreased fuel use)?
- Which GHGs will the activity impact (e.g., carbon dioxide [CO₂], methane [CH₄])?
- What outcomes of the activity will increase or decrease GHG emissions?

Define the Example Transportation Activity

The example *Transportation Activity* is a planned national policy to adopt alternative fuel vehicles over the next 10 years. The policy will encourage replacing fossil fuel vehicles with alternative fuel vehicles.

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² See guidance on mapping the causal chain in Chapters 5, 6, and 7 of the GHG Protocol *Policy and Action Standard*.

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- What are the intended and unintended GHG reduction outcomes of the activity?
 - Intended outcomes could include reducing GHG emissions by reducing fossil fuel combustion through improved vehicle fuel efficiency.
 - Unintended outcomes, such as rebound effects, could include vehicle fuel efficiency standards that reduce driving costs, which encourages drivers to travel more.
- Are the GHG impacts expected to be significant (i.e., the primary goal) or minor?

1.3 Create a causal chain to map impacts of the activity. Develop a flow chart, or “causal chain,” to identify and map the activity’s specific actions, outcomes, and associated impacts on GHG emissions. Refer to the causal chain for the example *Transportation Activity* on *page 15* and the causal chain template in the *Annex A: Harmonization Templates*. Focus on primary emission impacts to ensure that the largest emission impacts are prioritized in the harmonization analysis in *Step 4*.

Tip: For more detailed instruction on identifying the GHG impacts of the activity and mapping the causal chain, refer to Chapter 6 of the GHG Protocol *Policy and Action Standard*.



The use of sugarcane for biofuels can reduce fossil fuel emissions but increase emissions from agriculture and land-use change.

GHG Impacts of the Example Transportation Activity

The intended outcome of the example *Transportation Activity* is to reduce GHG emissions from the transportation sector by replacing conventional fuel vehicles with alternative fuel vehicles. This will reduce petroleum consumption and GHG emissions per vehicle mile traveled.

Some unintended outcomes of the activity are:

- Increased emissions from agricultural production to supply alternative fuels
- Decreased emissions from oil production and transport due to decreased demand for oil

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Tip: Common types of mitigation activities include:

Nationally Appropriate Mitigation Actions (NAMAs): Policies, programs, and projects formally undertaken by developing countries to reduce global GHG emissions.

Subnational Actions: Policy measures or actions taken by subnational governments, such as provinces, states, or cities, to reduce GHG emissions.

Private Sector Initiatives: Projects and programs supported by private companies, such as building efficiency improvements or renewable energy deployment.

Climate Action Plans: Plans or strategies developed by national or subnational governments to reduce GHG emissions.

Energy Plans: Plans or strategies developed by national or subnational governments to support energy sector goals, such as increased energy access or additional renewable energy in the electricity grid mix.

Sector Development Plans: National plans to develop and/or improve the sustainability of specific sectors, such as agriculture, forestry, or energy.

Internationally Financed Projects: Projects sponsored by international development agencies, multilateral development banks, or climate finance funds, such as the Green Climate Fund.

Legislation/Executive Actions: Other policy measures or actions that may affect GHG emission at the national, regional, or local level, such as regulations, standards, or resource management plans.

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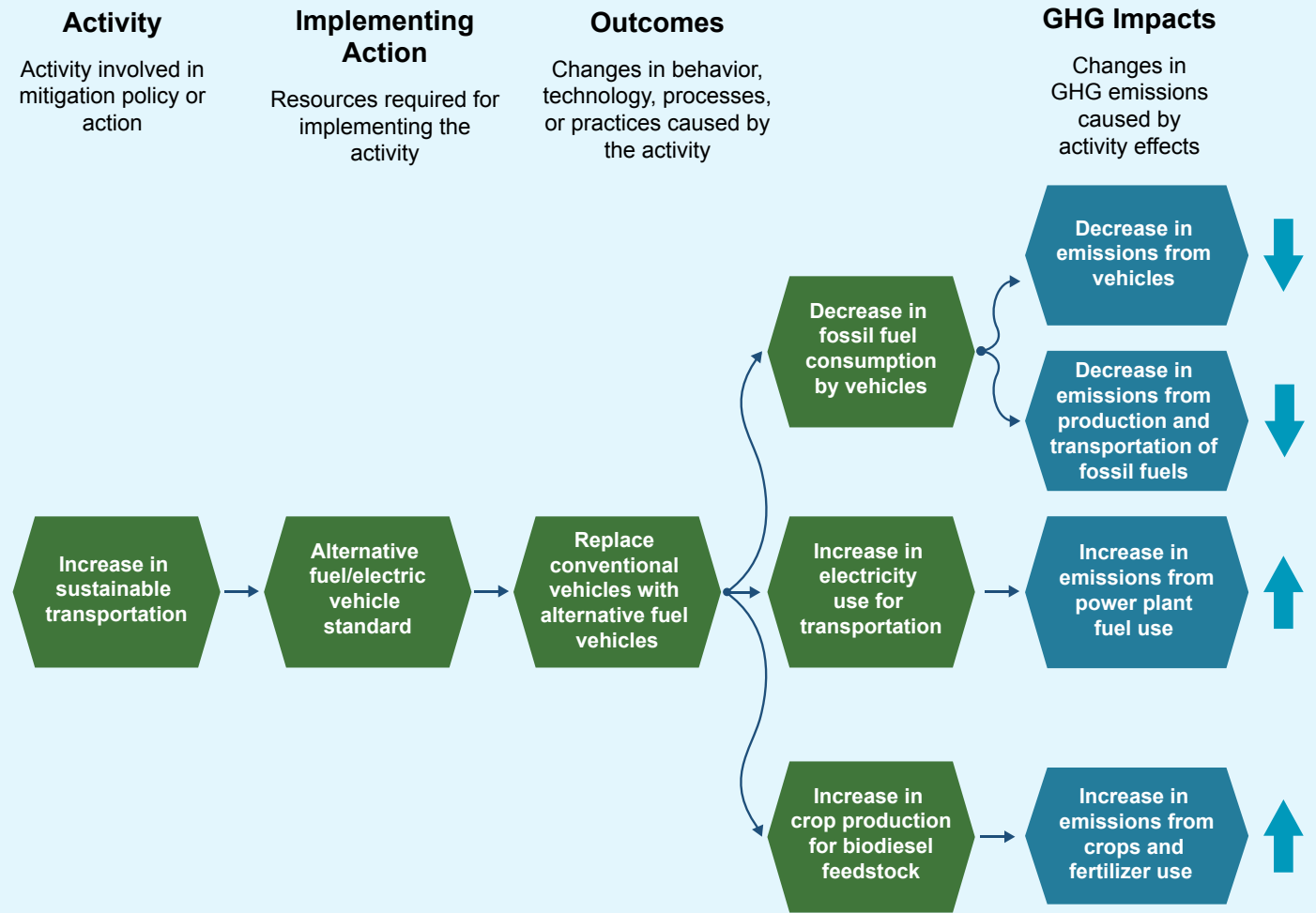
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Map the Causal Chain Using the GHG Protocol Policy and Action Standard Approach^a



^a This example represents a simplified causal chain for the *Transportation Activity* focused on major GHG impacts. Additional GHG impacts may be caused, for example, by land clearance for biodiesel crops, biodiesel combustion, and electric vehicle manufacturing. The actual activity and implementing action will also be more complex than what is provided in this example causal chain.

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Step 2: Map GHG Effects to Inventory Sectors

The next step is to map the GHG impacts identified in *Step 1* to GHG inventory sectors and source categories. For national inventories, these are defined by the *2006 IPCC Guidelines*. The *2006 IPCC Guidelines* are internationally accepted guidelines for how to account for activities in a national inventory and how to estimate national GHG emissions and removals (sinks). GHG emissions and sinks are grouped into sectors and source/sink categories based on the activity that emits (or absorbs) the gas.

This step will help identify which specific source/sink categories of the national inventory are impacted by the mitigation activity.

2.1 Identify impacted sectors. For each GHG effect, identify which IPCC sectors will be impacted by the mitigation activity. Descriptions of each IPCC sector are provided below.

Figure 4: IPCC Sectors for National Greenhouse Gas Inventories³

Energy

Includes emissions from the exploration and consumption of primary energy sources, conversion of primary energy sources, transmission and distribution of fuels, use of fuels in stationary and mobile applications, and other energy-related categories. Refer to Volume 2 of the *2006 IPCC Guidelines*.

Industrial Processes and Product Use

Includes emissions from industrial processes that transform chemicals, minerals, and metals, in addition to emissions of fluorinated gases and substitutes to ozone depleting substances. Refer to Volume 3 of the *2006 IPCC Guidelines*.

Agriculture, Forestry, and Other Land Use

Includes emissions from agricultural activities and emissions/removals on managed land (i.e., forest, cropland, grassland, wetlands, settlements, and other managed lands). Refer to Volume 4 of the *2006 IPCC Guidelines*.

Waste

Includes emissions from waste disposal, wastewater treatment, incineration of waste, and other waste handling activities. Refer to Volume 5 of the *2006 IPCC Guidelines*.

Other

Includes indirect emissions from nitrogen deposition from non-agriculture sources and other categories that are not included in the sectors described above.

³ IPCC. (2006). *2006 IPCC Guidelines*. Prepared by the National Greenhouse Gas Inventories Programme. [H.S. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe (eds.)].

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Countries may also define emission sources or mitigation activities in terms of economic sectors (e.g., transportation). Identifying the associated IPCC sector(s) impacted by the mitigation action(s) will facilitate the assessment of methods, data sources, and emission factors when comparing the action impacts and the national GHG inventory.

2.2 Map GHG impacts to IPCC source/sink categories. Once the sectors are identified, narrow down the GHG impacts further to individual source/sink categories and gases, based on the *2006 IPCC Guidelines*. Review the *2006 IPCC Guidelines* for the definitions of standard source/sink categories as well as the “Choice of Activity Data” sections to identify where the activity’s GHG impacts will be accounted for.⁴ For example, the *2006 IPCC Guidelines* include vehicle fuel consumption in the “Choice of Activity Data” section of the Road Transportation category. Therefore, mitigation activities that affect vehicle fuel consumption may fall within that category.

If an activity affects multiple categories, identify all relevant categories and determine if there are conflicting impacts that both increase and decrease emissions (e.g., a policy to adopt biodiesel vehicles may replace conventional fuel vehicles, thereby decreasing GHG emissions in the Energy sector, but may also increase emissions in the Agriculture, Forestry, and Other Land Use sector by increasing agricultural production to supply alternative fuels).

The inventory sectors and source categories identified in *Step 2* will form the assessment boundary of *Step 3*.



Electric vehicles can reduce transportation sector emissions, but they may also increase emissions if the associated increase in electricity demand is met by fossil fuel power plants.

⁴ Refer to the “Choice of Activity Data” sections in each volume of the *2006 IPCC Guidelines* and Volume 1, Chapter 8, Table 8.2, of the *2006 IPCC Guidelines*.

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Sample Mapping of Example Transportation Activity GHG Impacts to IPCC

GHG Impact	Corresponding Activity Data	IPCC Sector	IPCC Source Category and Description ^a	
Decrease in emissions from vehicles	Amount of fuel consumed	Energy	1A3: Fuel Combustion Activities—Transportation	Includes emissions from the combustion and evaporation of fuel for all transport activity (excluding military transport).
Limit emissions from production and transportation of fossil fuels	Total oil or gas production	Energy	1B2: Fuel Combustion Activities—Oil and Natural Gas	Includes fugitive emissions from oil and natural gas activities, including fugitive equipment leaks, evaporation losses, venting, flaring, and accidental releases.
Increase in emissions from on-site fuel use	Amount of fuel combusted	Energy	1A1: Fuel Combustion Activities—Energy Industries	Includes emissions from fuels combusted by the fuel extraction or energy-producing industries.
Increase in emissions from crops and fertilizer use	Amount of crop produced	Agriculture	3C4: Direct N ₂ O Emissions from Managed Soils	Includes the direct N ₂ O emissions from N fertilizer application, N in crop residues (above and below ground), and other agricultural sources of N ₂ O on managed soils.
	Amount of synthetic N fertilizers applied to soils	Agriculture	3C5: Indirect N ₂ O Emissions from Managed Soils	Includes the indirect N ₂ O emissions from the volatilization of N following N fertilizer application, and the leaching and runoff of N fertilizer additions, crop residues, and other N additions on managed soils.

^a IPCC source category descriptions can be found in Table 8.2 of Volume 1, Chapter 8, of the [2006 IPCC Guidelines](#).

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Step 3: Assess Bottom-Up and Top-Down GHG Accounting

In *Step 3*, review the components of the national inventory GHG accounting and mitigation activity MRV methods. For both bottom-up and top-down accounting, collect and document the data sources, emission factors, methodologies, and other components of GHG accounting processes to identify areas of overlap and to determine if/how mitigation activities are captured in the current inventory. This step will help establish an understanding of current accounting processes before exploring harmonization opportunities in *Step 4*.

3.1 Gather documentation on current accounting processes. Gather GHG accounting documentation for the sectors and source categories impacted by the mitigation activity from various stakeholders, such as national inventory compilers, NAMA developers, and mitigation MRV implementers. Examples of documentation for inventory and mitigation MRV accounting processes are listed in table below. This step will provide the relevant information needed to compare bottom-up and top-down accounting.

Table 1: Inventory and Mitigation Activity GHG Accounting Documentation

Bottom-Up Accounting: Mitigation Activity Documentation	Top-Down Accounting: Inventory Documentation
<ul style="list-style-type: none">Project evaluationsNAMA databaseSummary reportsTraining and capacity-building reportsSectoral action plansMitigation registry	<ul style="list-style-type: none">National Inventory ReportBiennial Update ReportNational Communications reportDocumentation of methods and data, including calculation spreadsheets or archiving systems where activity data and emission factors are storedKey category analysis resultsQuality assurance and quality control (QA/QC) proceduresNational inventory improvement plan

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If no mitigation activity MRV method exists, research internationally accepted guidelines on project-level GHG MRV methods from various standards and organizations for the type of mitigation activity being assessed. The methodologies in these guidelines, including those listed below, will provide an overview of potential MRV methods to inform the bottom-up assessment.

- Clean Development Mechanism
- GHG Protocol Project Standard
- Gold Standard
- The Climate Registry
- Verified Carbon Standard
- Climate Action Reserve
- American Carbon Registry

3.2 Review current accounting processes. After gathering documentation on components of the inventory and mitigation MRV for the sectors and source categories impacted by the mitigation activity, review the documents to identify the current processes, data, and calculations used to estimate GHG emissions. In addition, review the following aspects of inventory development:

- **Institutional arrangements and information flows**—Identify the institutional arrangements (i.e., which institutions are responsible for reporting relevant data) and information flows (i.e., how data are compiled for the development of the national inventory and mitigation activity MRV). These will vary by country and source/sink category.
- **Data elements**—Identify which data elements (i.e., variables) are used to calculate emissions in the national inventory and mitigation accounting. Data elements include activity data (e.g., fuel consumption) and emission factors (e.g., grams of CO₂ per gallon of fuel). Emission factors may vary in the degree of their complexity (e.g., IPCC Tier 1 default emission factors versus country-specific, IPCC Tier 2 or 3 factors).
- **Data attributes**—Identify the characteristics of the data elements including the data source, units, IPCC tier, frequency of collection, and associated uncertainty.
- **Methodological choice**—Identify the methods used to estimate emissions and emission reductions in terms of quantity of information required and the degree of analytical complexity (e.g., IPCC Tier 1 methodologies using default data and factors, versus higher tier methodologies that are more complex and use country-specific data and factors). If the inventory uses a lower tier methodology, also consider reviewing methodologies for higher tiers from the *2006 IPCC guidelines* in case higher tier methodologies align better with the mitigation MRV methods.
- **Reporting**—Identify how data are reported for both the national inventory and the mitigation activity (e.g., Biennial Update Reports and National Communications to the UNFCCC, progress reports to funders, project evaluations).
- **Planned improvements**—Identify whether the country has an inventory improvement plan for the inventory sector(s) affected by the mitigation activity.

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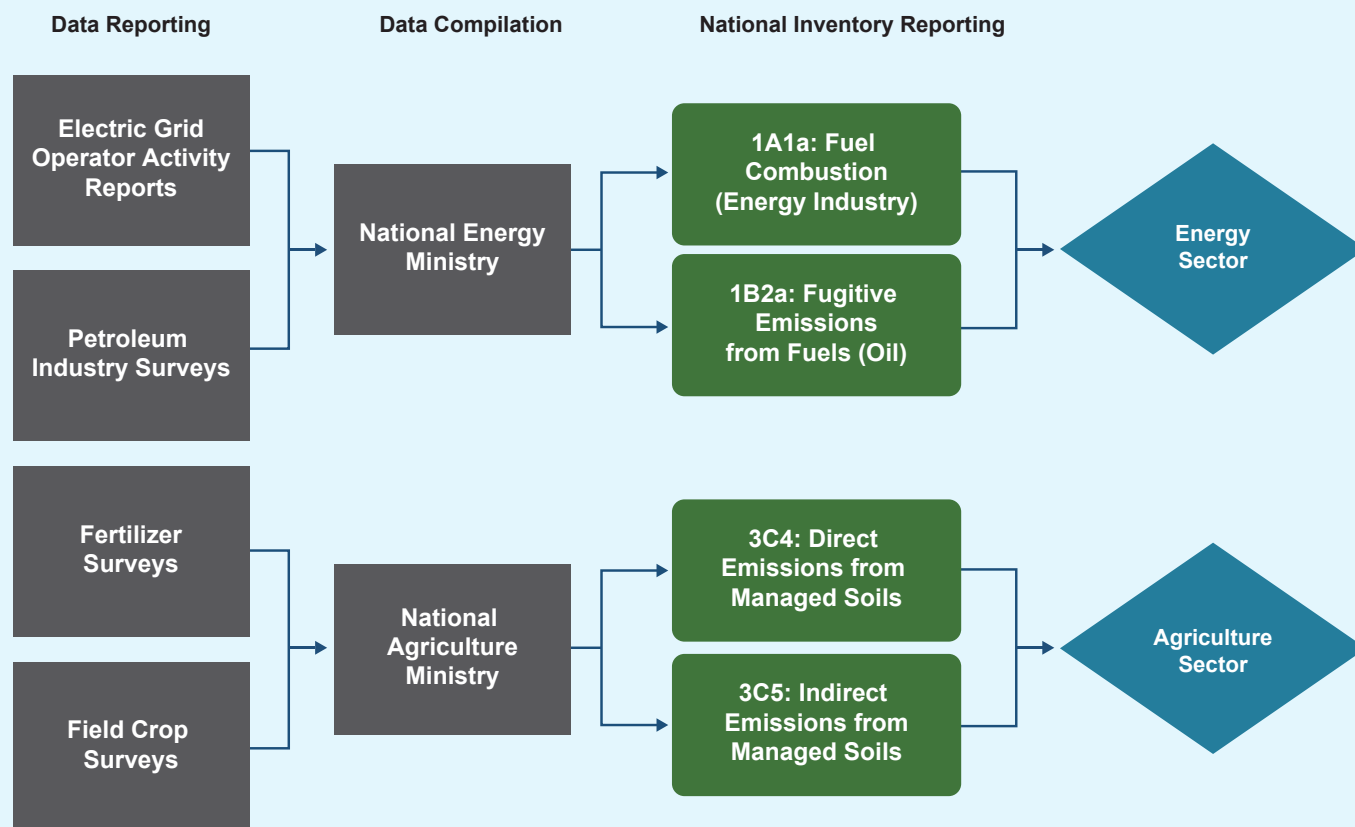
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Sample Information Flow for a National Inventory

This flow chart shows the institutional arrangements and information flows for national inventory in the energy and agriculture sectors that may be impacted by replacing conventional fuel vehicles with biofuel vehicles in the example *Transportation Activity*.



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3.3 Compile data elements in a standard format.

Document key data elements and calculation methodologies of both the national inventory and mitigation MRV, and compile them into a standard format, such as a matrix. For each data element, document the following information:

- Source of the data
- Frequency of data collection or publication
- Unit of measurement
- Level of data granularity (e.g., project-level, regional, national)
- Level of uncertainty (qualitative and/or quantitative) associated with the data and/or methodologies (e.g., uncertainty ranges or distributions, possible sources of error, and which data elements have higher degrees of uncertainty)
- IPCC methodology tier (if applicable)
- Key assumptions
- Reporting status
- Data quality

Tip: See *Annex A: Harmonization Templates* for a template for documenting data elements and attributes in national inventory calculations.

Examples of Bottom-Up GHG Accounting

In the example *Transportation Activity*, bottom-up GHG accounting for the electric and hybrid vehicle components rely on the Clean Development Mechanism (CDM) methodology for “Emission reductions by electric and hybrid vehicles” (AMS-III.C.)^a

Components to identify for this MRV method include the following:

- Activity data, such as:
 - Number of electric and hybrid vehicles deployed under the activity
 - Distance traveled by electric and hybrid vehicles
 - Electricity consumed by the electric vehicles
 - Quantity of fossil fuel used by the hybrid vehicles
 - Quantity of fossil fuel used for the production of electricity for the electric and hybrid vehicles
- Electricity grid emission factors
- Geographic area covered (e.g., region, state, or city)

^a UNFCCC (2017). AMS-III.C.: Emission reductions by electric and hybrid vehicles. *CDM Methodology Booklet*, 9th edition.

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Sample Matrix of Data Elements and Attributes to Estimate Emissions from the Transportation Activity

Data Element	Type of Data	Units	Source of Data	IPCC Methodology Tier	Frequency of Collection	Associated Uncertainty
Top-Down GHG Accounting						
Amount of fuel sold by type	Activity data	TJ	National government statistics	Tier 1	Every 3 years	Low
IPCC default CO ₂ emission factor for fuels	Emission factor	kg CO ₂ /TJ	IPCC	Tier 1	NA ^a	Low
IPCC default CH ₄ emission factor for fuels	Emission factor	kg CH ₄ /TJ	IPCC	Tier 1	NA	High
IPCC default N ₂ O emission factor for fuels	Emission factor	kg N ₂ O/TJ	IPCC	Tier 1	NA	High
Bottom-Up GHG Accounting						
Average distance driven by fleet electric vehicles	Activity data	km/year	Capital City Fleet Manager	Tier 2	Annual	Medium
Electricity consumption by fleet electric vehicles	Activity data	kWh/year	Electric charging station operator	Tier 2	Annual	Medium
GHG emission factors of local electricity provider grid	Emission factor	kg GHG [CO ₂ , CH ₄ , and N ₂ O]/kWh	Local electricity provider	Tier 2	Annual	Low
Country-specific GHG emission factors for fuels	Emission factor	kg GHG [CO ₂ , CH ₄ , and N ₂ O]/TJ	Energy Ministry	Tier 2	One-time	Low

^a NA – Not applicable

Source: UNFCCC (2017). *CDM Methodology Booklet*, 9th edition. Methodology AMS-III.C.

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3.4 Compare data elements for bottom-up and top-down GHG accounting. Using the documentation from *Step 3.3*, compare the data elements of the national inventory and the mitigation MRV methods for all relevant GHG sources to understand how GHG emissions and emission reductions are estimated. Identify common data elements in both top-down and bottom-up GHG accounting, such as the same or similar activity data points or emission factors. If data points are common across top-down and bottom-up accounting, they may represent an opportunity for further analysis and harmonization in *Step 4*. If data points are similar they can be modified to ensure alignment.

Comparison of Sample Data Elements in Bottom-Up and Top-Down GHG Accounting for Transportation Activity

This table compares data elements from the assessment of bottom-up and top-down GHG accounting in *Step 3.3*.^a As shown in the table, the **emission factor for fuels** is a common data element for both top-down and bottom-up GHG accounting and therefore represents a potential harmonization opportunity to explore in *Step 4*.

	Amount of fuel sold	Emission factor for fuels	Distance driven by electric vehicles	Electricity consumption by electric vehicles	Emission factor for electricity grid
Bottom-Up	✓	✓			
Top-Down		✓	✓	✓	✓

^a The "✓" notation indicates data elements captured by either the top-down (inventory) calculations or the bottom-up (project MRV) calculations.

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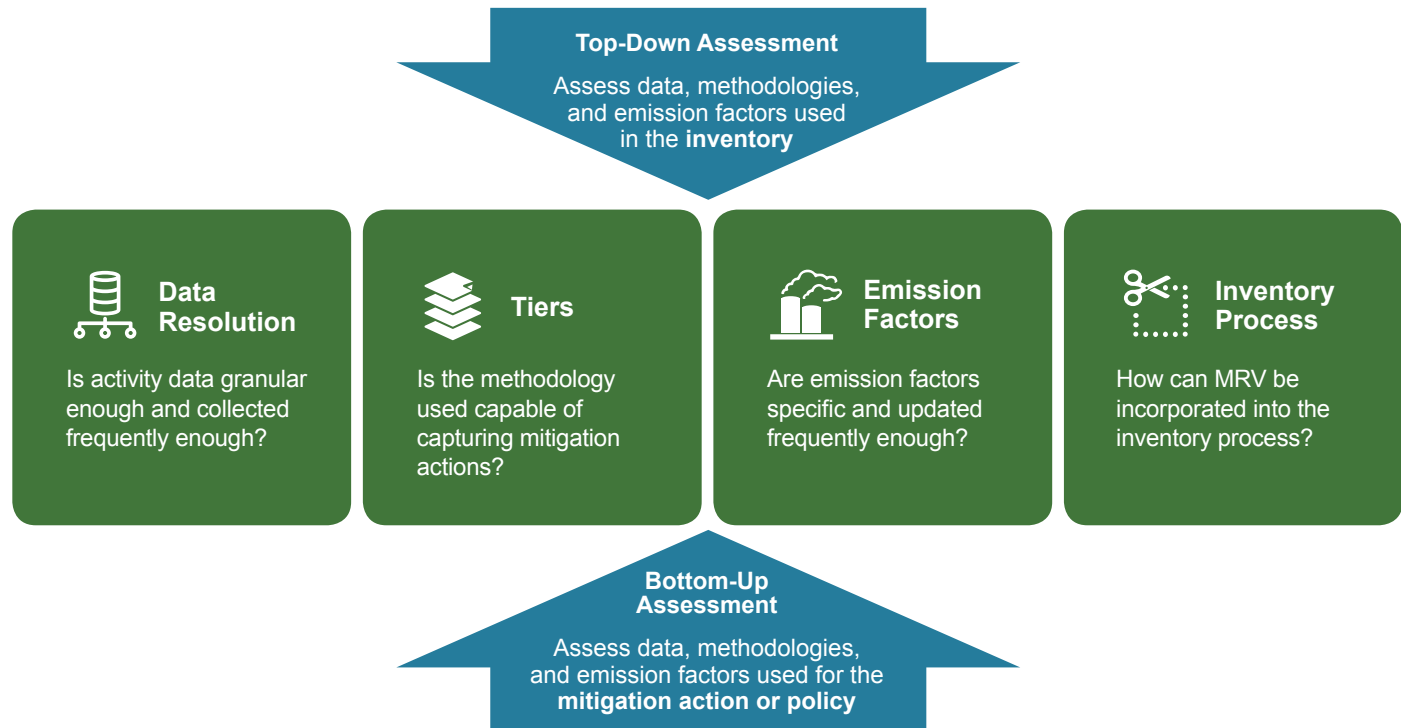
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Step 4: Identify Opportunities to Harmonize Accounting

Use the information from the assessment of current accounting practices in *Step 3* to identify opportunities for harmonizing data, variables, or other elements of top-down and bottom-up accounting. Opportunities to harmonize GHG accounting exist throughout the entire national inventory development process, from establishing institutional arrangements and selecting methodologies to reporting and inventory improvement planning. Similarly, MRV processes can be designed or updated to incorporate elements needed for national inventory reporting. To identify opportunities for harmonization, consider the components and questions described in Figure 5.

Figure 5: Considerations for Harmonization



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4.1 Determine if/how the national inventory currently captures mitigation GHG impacts. Based on the assessment of top-down GHG accounting in *Step 3*, determine whether the national inventory does or does not currently capture the GHG impacts of the mitigation activity—for example, by incorporating activity data from mitigation projects or adjusting emission factors to incorporate the use of mitigation technologies. Understanding how the current inventory captures mitigation GHG impacts will help uncover areas where harmonization already exists or can be improved.

Analyze the information collected in *Step 3* to determine whether activity data or emission factors currently used in the inventory can capture changing trends due to mitigation activities. Questions to consider include:

- **Are mitigation project-level data used?**
 - Are project implementers included in the national inventory institutional arrangements?
 - Does the national inventory obtain activity data from project-level data sources?
 - Are emission factors developed using technology-specific or project-level data?
 - Are the geographic locations where the mitigation activity occurs included in inventory data and calculations?
- **Is the methodology able to capture changing trends?**
 - Is the methodology IPCC Tier 2 or Tier 3? Higher methodology tiers typically require country-specific or region-specific inputs that are more likely to capture changing trends.
- **Are data collected frequently enough to capture changing trends?**
 - Are inputs to emission factors collected frequently enough to capture changing trends?
 - Are activity data collected frequently enough to capture changing trends? For example, if a mitigation activity can be implemented quickly within a year, are activity data collected annually to reflect the activity's GHG impacts?

Tip: Methodology “tiers” refer to levels of complexity, according to the *2006 IPCC Guidelines*. Tier 1 is the least complex methodology, whereas Tiers 2 and 3 are more complex, and typically more accurate.

If the answer to any of the questions above is yes, it is likely that the national inventory captures some of the GHG impacts of the mitigation activity. For example, based on the assessment of institutional arrangements, if the inventory incorporates project-level data from voluntary GHG reduction programs or other bottom-up data sources, then the inventory likely captures some mitigation GHG impacts because the data incorporate mitigation projects. There may still be opportunities for harmonization between the inventory and mitigation actions.

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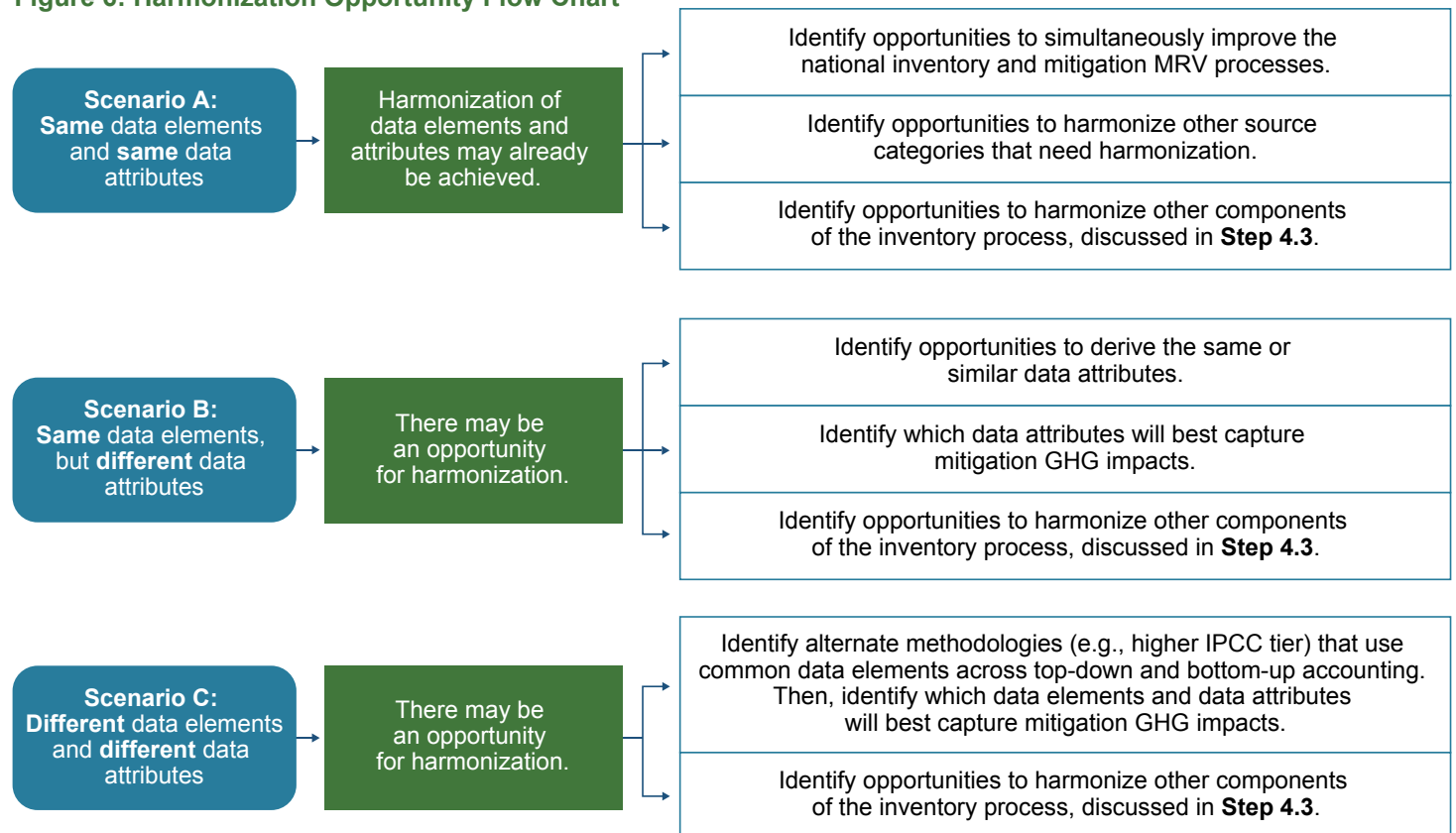
If the answer to any of the questions above is no, there may be potential for new harmonization. These new or improved harmonization opportunities are explored for data and other elements of the inventory process in the following steps.

4.2 Identify opportunities to harmonize data elements.

Review the common data elements across the top-down and bottom-up accounting for similarities and differences in their attributes (e.g., granularity, frequency of collection, and data source). The flow chart in Figure 6 gives three likely scenarios and how to identify opportunities to harmonize within each scenario.

Tip: See *Annex A: Harmonization Templates* for a template table for organizing alignment issues for data elements in the top-down and bottom-up methodologies.

Figure 6: Harmonization Opportunity Flow Chart



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After comparing the top-down and bottom-up accounting for similarities and differences, determine which data elements will best capture mitigation GHG impacts in the national inventory. Identify the data elements that incorporate mitigation project-level data, the methodology that is detailed or complex enough to capture changing trends, and/or the data that is collected frequently enough to capture changing trends. Questions to consider were provided in *Step 4.1*.

The activity data and emission factors that will best capture the GHG impacts of the mitigation activity represent harmonization opportunities. Subsequent steps provide guidance for how to implement these harmonization opportunities in the national inventory process.

Sample Transportation Activity Alignment Issue Between Top-Down and Bottom-Up GHG Accounting

This table compares the common data element identified in *Step 3.4*, **emission factor for fuels**. In the earlier *Transportation Activity* example, the national inventory used a default Tier 1 emission factor for fuels while the mitigation activity MRV method used a local, Tier 2 emission factor. In this example, harmonizing the methodologies by moving to a Tier 2 emission factor would enable the national inventory to reflect the impacts of the mitigation activity.

Data Element	Type of Alignment Issue	Top-Down Methodology	Bottom-Up Methodology
Emission factor for fuels	Data source and IPCC tier	IPCC default–Tier 1	Study from Energy Ministry–Tier 2

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4.3 Identify opportunities to harmonize other components of the inventory process. Opportunities for harmonization between top-down and bottom-up GHG accounting may involve other components of the inventory process aside from data elements, including institutional arrangements, data documentation and reporting, uncertainty analyses and discussion, and improvement planning.

- **Institutional arrangements**—Consider opportunities for new or improved arrangements between stakeholders and data owners (e.g., working with stakeholders to increase frequency of data collection), including academic institutions, the private sector, government entities, and international partners to measure and report project-level data.

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- **Data documentation and reporting**—Consider improvements that align data documentation (e.g., through data templates) so that data are comparable between entities. Also, consider improvements that align the timeframe of MRV data collection with the inventory development schedule so data can be used in inventory calculations.
- **Uncertainty analyses and discussion**—Identify opportunities to incorporate mitigation activity impacts into uncertainty analyses and discussions. There may be opportunities for harmonization associated with these data elements that can reduce overall uncertainty, or qualitative information from the mitigation activity that can inform additional uncertainty introduced by the mitigation activity.
- **Improvement planning**—Consider including harmonization activities in the Inventory Improvement Plan, especially for plans to improve key categories.

4.4 Plan harmonization improvements. Plan how to address harmonization improvements in the inventory process. To identify how to incorporate these improvements into the national inventory process, consider the following:

- **What inventory improvements are planned or currently underway?** Determine whether there are plans or activities already underway to improve the inventory process or MRV practices, such as a voluntary reporting program or efforts to update emission factors more regularly. It may be possible to use these plans or activities to address identified harmonization opportunities. For example, a planned facility-level reporting program could be used to facilitate greater harmonization between the national inventory process and a mitigation activity MRV method.
- **What component of the inventory development process needs to be updated?** Determine what parts of the inventory process need to be modified to incorporate the new or improved activity data, emission factors, and/or methodology. As part of this, consider how the improvement might affect existing processes or require new processes. For example, moving to a higher IPCC tier may require developing a more specific emission factor and establishing processes and data templates to gather emission factor inputs from the mitigation activity.
- **Who currently has the data required to implement the improvement?** Determine which stakeholders, if any, possess the data and how it can be accessed, if the data are not already available for use in the national inventory. For example, incorporating activity data from a new data source may require formation of a new institutional arrangement or establishment of a new reporting procedure.



It's important to review the existing data management systems and consider how new data elements can be incorporated.

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- **How will improvements be incorporated into existing data management systems?** National inventories rely on a variety of data management systems. Consider what steps will need to be taken to bring new or improved data elements into these systems. For example, new reporting procedures may be needed or data management systems may need to be connected.
- **What resources are required to incorporate the improvement?** If significant time or resources are required to implement the harmonization improvement, consider whether the improvement should be prioritized in the short-term or added to the Inventory Improvement Plan to be implemented in future years. Guidance on prioritizing harmonization improvements is provided in *Step 5*.
- **Do the activity data or emission factors have low uncertainty?** If not, consider how to improve data quality to reduce overall uncertainty.

Actions for how to implement harmonization actions vary, but these are some examples:

- **Define new data sources**
- **Create new data templates** for mitigation activity implementers
- **Align schedules** of inventory and MRV data collection
- **Increase the frequency** of data collection
- **Move to a higher IPCC tier** of inventory methodology
- **Develop more specific emission factors** (e.g., country-, region-, or project-specific)
- **Splice subnational data** to incorporate into national data
- **Form new institutional arrangements or strengthen current ones**
- **Update or create new reporting procedures**
- **Update the Inventory Improvement Plan** to include harmonization opportunities

Tip: If improvements are not feasible, consider IPCC “splicing” techniques, defined as a combination of different methods or datasets to compensate for incomplete or missing data.

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Step 5: Prioritize Improvements to GHG Accounting

Steps 1 through 4 require collecting and documenting data, comparing information, and analyzing results. These steps can be repeated for many mitigation activities at a time, and then assessed together in *Step 5* to determine which harmonization opportunities to prioritize. In *Step 5*, there may be a need to engage with different team members and/or stakeholders to comprehensively prioritize improvements.

Once *Step 4* is complete, the next step is to prioritize the identified improvements to national inventory GHG accounting and mitigation activity MRV methods. The following steps provide guidance on how to define criteria for prioritizing improvements and then how to determine priority harmonization opportunities based on the criteria.

5.1 Define criteria for prioritizing improvements. The following factors could be considered when defining the criteria to prioritize improvements:

- **Existing approach**—If top-down GHG accounting already successfully captures emission trends with a reasonable degree of accuracy, consider prioritizing other improvements.
- **Availability of resources**—Some improvements may require more resources to implement than others. Consider prioritizing improvements that are more feasible to implement based on the availability of financial resources, expertise, and/or time needed to make the improvement.
- **Existing data collection**—Consider prioritizing improvements that require the use of data that are already collected. If data are already collected, it may significantly reduce the level of effort required to improve alignment. If data are not already collected or are not usable for other reasons, the level of effort required to make improvements may be significantly higher.



By prioritizing improvements that use data that is already collected, the level of burden to make improvements can be drastically lower.

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- **Institutional dynamics**—Some improvements may require substantial interactions between data providers or other institutions as well as relevant stakeholders. Consider the challenges of coordinating these interactions, particularly if, for example, there are large numbers of contributors to certain data points used in the GHG accounting process or if new activity data and institutional arrangements are required.
- **Existing improvement plans**—Consider whether relevant top-down or bottom-up GHG accounting improvements are already planned or underway. Already planned improvements may be leveraged to support harmonization activities.

Several methods can be used to understand the relative impacts of harmonization improvements to identify priority improvements. These methods may include:

- **Estimate the relative impact on emission estimates**—Consider prioritizing improvements that affect the larger emission source categories in the inventory, such as key categories, categories where there are significant trends, or categories where there are greater uncertainties in existing calculations.
- **Sensitivity analysis of data elements**—Activity data, emission factors, and calculations may be more or less sensitive to certain assumptions, changes, or methodological approaches. If a specific improvement would significantly impact one of these elements, consider prioritizing that action over one that has a less significant impact.

5.2 Determine priority harmonization opportunities based on criteria. Prioritizing harmonization opportunities will ultimately depend on the relative importance assigned to each criterion by team members and/or stakeholders. Based on the identified criteria and their assigned importance, identify which improvements meet those criteria. For example, if availability of time and funding is limited, select the harmonization opportunities that require relatively few resources to implement but that may have a relatively large impact on emission estimates.

Prioritizing Improvements

In the example *Transportation Activity*, the largest emission impacts result from changes to stationary and mobile fuel combustion emissions. In addition, there are strong institutional arrangements, various experts, and a large amount of existing data collected for the source categories of stationary and mobile fuel combustion. As a result, implementers chose to prioritize harmonization improvements related to these two source categories.

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Step 6: Implement and Harmonize

Implementation of harmonization opportunities may take many forms, and may require other stakeholders than were engaged in Steps 1 through 5. Some actions are low- to no-cost, such as noting in inventory documentation that the results are over- or under-estimated because mitigation is not accounted for. Other harmonization opportunities, such as moving to a higher methodological tier or creating new institutional arrangements, may be expensive and take years to implement.

- 6.1 Identify resources, roles, and responsibilities for implementing improvements.** Determine which team members and/or stakeholders will be responsible for implementing harmonization improvements and consider what roles they will play and what resources are available to make these improvements. Implementing harmonization opportunities may require significant resource commitments and require disruptions to existing organizational procedures. Therefore, ensure that implementing team members and/or stakeholders, including any new partners, are able to collaborate and provide input throughout the implementation process.
- 6.2 Incorporate priority harmonization opportunities into all steps of the inventory development process.** Work with national inventory compilers, source category leads, and other inventory stakeholders throughout the inventory development process to incorporate the identified priority harmonization opportunities in a future national inventory cycle or in the Inventory Improvement Plan. This implementation may mean updating calculations, developing new emission estimates, updating methodology and uncertainty sections, and discussing the impact of harmonization improvements on emission results.
- 6.3 Create or modify mitigation MRV requirements to address harmonization opportunities.** In order to realize some harmonization opportunities, it may be necessary to create or modify existing mitigation activity MRV requirements to better align mitigation reporting with national inventories. For example, this may require mitigation activity leads to collect additional data that could be used in the national inventory or to modify existing data collection methods. Inventory teams could provide templates for data needed to inform the inventory or coordinate with MRV stakeholders to implement other improvements.

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The RALI GHG MRV Harmonization Framework will help stakeholders enhance the transparency of GHG accounting between national GHG inventories and mitigation accounting. Stakeholders can apply it to continually improve transparency, completeness, and accuracy of a national inventory; strengthen institutional arrangements with data providers; and establish institutional arrangements with MRV stakeholders to harmonize GHG accounting to demonstrate mitigation impacts through national inventory results.

After applying the Harmonization Framework, stakeholders will be better positioned to:

- Demonstrate climate progress toward a country's NDC target.
- Establish robust mitigation MRV that aligns with the national GHG inventory.
- Improve the accuracy of GHG emissions reporting.
- Support increased access to financing for mitigation activities.
- Enable decision-makers to prioritize mitigation investment and prioritize resources for MRV improvements.

It is important to engage multiple stakeholders at various stages of the Harmonization Framework to ensure that resulting improvements are successfully adopted and implemented. Steps 1 through 4, conducted by inventory developers or mitigation activity implementers, will provide concrete recommendations to improve alignment of mitigation and inventory accounting. Steps 5 and 6 will require engaging with broader stakeholder groups, including governing ministries and other stakeholders involved in the decision-making process to identify a path toward implementation.

As countries implement mitigation activities and measure their impact as part of their NDC commitments, the RALI Harmonization Framework will serve as an essential resource to ensure that mitigation activities are captured in national GHG inventories.

Implementing Harmonization Opportunities

To harmonize the national inventory GHG accounting with the MRV method of the *Transportation Activity*, inventory developers form a new institutional arrangement with MRV stakeholders. The inventory developers design a schedule to collect annual, country-specific emission factors, instead of the Tier 1 emission factors previously obtained from the *2006 IPCC Guidelines*. The inventory developers incorporate the local emission factors into calculations, documentation, and uncertainty estimates for the Mobile Combustion source category.

Due to this harmonization effort, the inventory developers observe that emission reductions from the *Transportation Activity* are captured in the results of the national inventory. The inventory developers summarize the transportation-related emission reductions and uncertainty considerations in the country's Third National Communication reported to the UNFCCC.

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Activity Data

Data measuring human activity that results in greenhouse gas (GHG) emissions or removals. Activity data could include fossil fuel combustion, waste generation, or land-use changes.

Bottom-Up GHG Accounting

Data, methodologies, and processes used for project-level measurement, reporting, and verification (MRV) for GHG mitigation activities.

Causal Chain

A flow chart of a specific mitigation activity that identifies and maps the activity's specific actions, outcomes, and associated GHG impacts.

Emission Factor

The average emission rate of a GHG relative to a unit of activity. Together with activity data, emission factors are key components used to estimate emissions.

Key Category

A category of GHG emissions or removals that is prioritized due to its influence on the total absolute level of emissions, emission trends, or uncertainty associated with the emissions.

Tiers

A three-tiered classification system developed by the Intergovernmental Panel on Climate Change (IPCC) to distinguish different levels of methodological approaches to estimate GHG emissions. Tiers are based on data availability and the level of analytical complexity in approaches used to estimate GHG emissions. Tiers include IPCC default (Tier 1) and country-specific (Tier 2 and Tier 3) methods, which are typically more accurate.

Top-Down GHG Accounting

Data, methodologies, and processes used to measure GHG emissions as part of a country's national inventory process.

Splicing

A combination of different methods or datasets used to compensate for incomplete or missing data in the national inventory.

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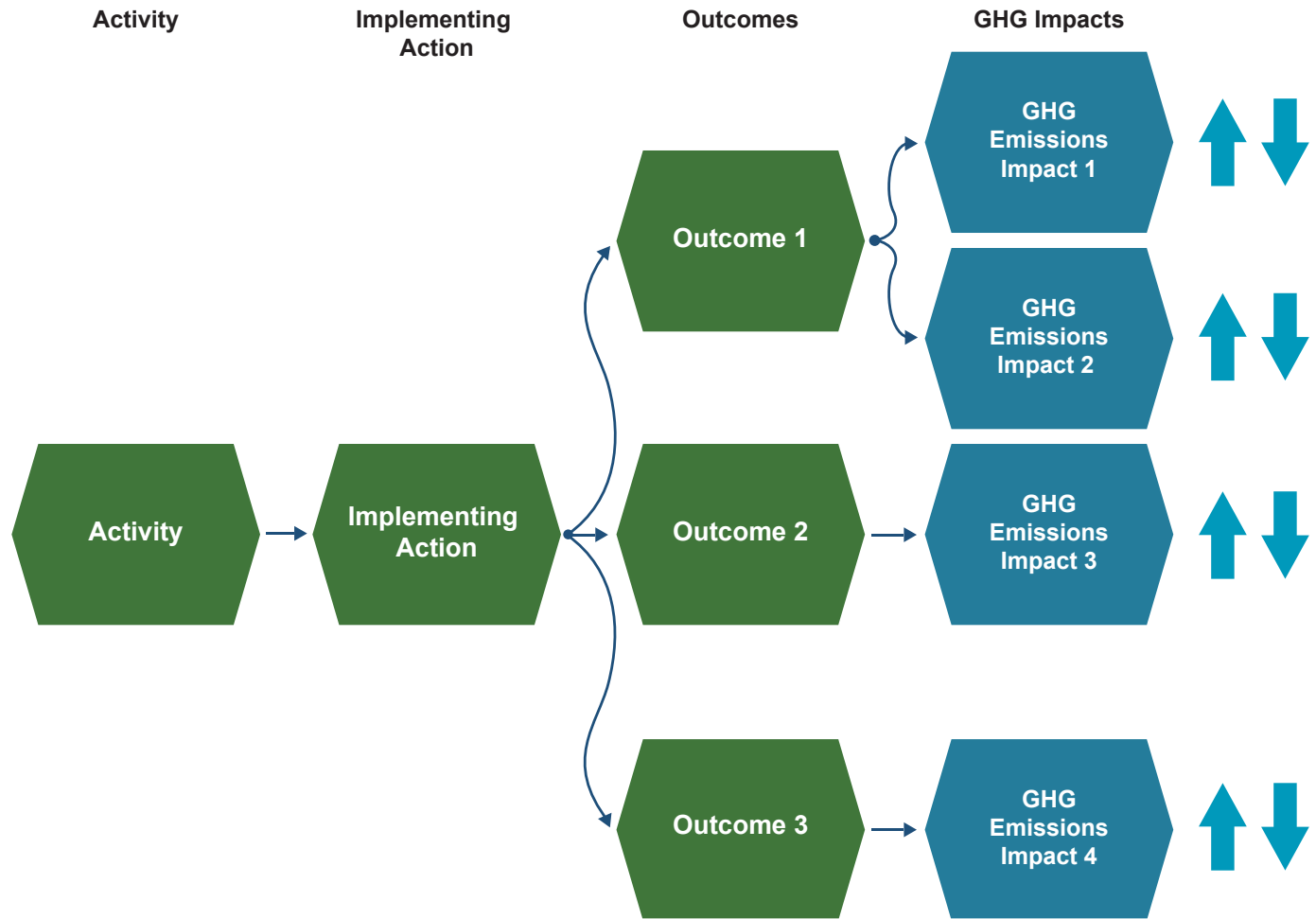
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Causal Chain (Step 1)

A causal chain is a flow chart used to trace the process by which the mitigation activity leads to GHG impacts through a series of cause-and-effect relationships. For *Step 1*, use the GHG Protocol *Policy and Action Standard* to map the causal chain to trace and visualize the activity's impacts on GHG emissions. Focus on primary emission impacts to ensure that the largest emission impacts are prioritized in the harmonization analysis. Below is an example of a simplified causal chain.



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Map GHG Effects to Inventory Sectors (Step 2)

Use this template to document the mapping of the GHG impacts identified in *Step 1* to the standard sectors and source categories as defined by the *2006 IPCC Guidelines*. For each GHG impact, identify which IPCC sectors and source categories will be impacted by the mitigation activity.

Table A-1: Map Mitigation Activity GHG Impacts to IPCC Sectors/Source Categories

GHG Impact	IPCC Sector	IPCC Source Category and Description ^a	
[GHG Impact]	[Energy, IPPU, AFOLU, Waste, or Other]	[IPCC Source Category Number and Name]	[Description]

^a IPCC source category descriptions can be found in Table 8.2 of Volume 1, Chapter 8, of the [2006 IPCC Guidelines](#).

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Summary of Data Elements in Bottom-Up and Top-Down GHG Accounting (Step 4)

Use this template to compare the data elements from the top-down and bottom-up GHG assessments, using the data elements identified in Table A-3. The notation [✓] indicates that the data element is used in the bottom-up and/or top-down methodology.

Table A-3: Primary Data Elements in Top-Down and Bottom-Up GHG Accounting

	Data Element 1	Data Element 2	Data Element 3	Data Element 4	Data Element 5	Data Element 6	Data Element 7
Top-Down	[✓]						
Bottom-Up							

Alignment Issues (Step 4)

Use this template to identify data alignment issues by documenting similarities and differences in the data elements and attributes (e.g., granularity, frequency of collection, and data source) across top-down and bottom-up accounting.

Table A-4: Alignment Issues for Data Elements

Data Element	Type of Alignment Issue	Top-Down Methodology	Bottom-Up Methodology
[Data Element 1]	[Data source/Granularity/Frequency of collection/Data elements]	[Description]	[Description]

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Annex B: Helpful Resources

GHG Inventory Resources

2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. National Greenhouse Gas Inventories Programme. [Edited by H.S. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe]. 2006. <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>.

Biennial Update Report Template. Partnership on Transparency in the Paris Agreement. GIZ. 2017. <https://www.transparency-partnership.net/documents-tools/biennial-update-report-template>.

Developing a national greenhouse gas inventory system. Low Emission Development Strategies (LEDS) Global Partnership and U.S. Environmental Protection Agency (EPA). June 2017. http://ledsgp.org/resource/greenhouse-gas-inventory-system/?loclang=en_gb.

National Greenhouse Gas Inventory Toolkit. LEDS Global Partnership and U.S. EPA. June 2017. <http://www.ledsgp.org/resource/greenhouse-gas-inventory-system#ghg-toolkit>.

Tools and Training Materials for Non-Annex I Reporting. UNFCCC. <https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-convention/support-for-developing-countries/training-opportunities#eq-4>.

Mitigation MRV Resources

American Carbon Registry Standards and Approved Methodologies. American Carbon Registry. <https://americancarbonregistry.org/carbon-accounting/standards-methodologies>.

Clean Development Mechanism (CDM) Methodologies. CDM. <https://cdm.unfccc.int/methodologies/index.html>.

Climate Action Reserve Protocols. Climate Action Reserve. <http://www.climateactionreserve.org/how/protocols>.

The Climate Registry Protocols. The Climate Registry. <https://www.theclimateregistry.org/tools-resources/reporting-protocols/general-reporting-protocol>.

Gold Standard: Agriculture Methodologies. Gold Standard. <https://www.goldstandard.org/content/methodologies>.

Gold Standard: Energy Methodologies. Gold Standard. <https://www.goldstandard.org/content/energy-methodologies-0>.

Gold Standard: Forest Methodologies. Gold Standard. <https://www.goldstandard.org/content/ar-methodologies>.

Greenhouse Gas Protocol Policy and Action Standard. Greenhouse Gas Protocol. <https://ghgprotocol.org/policy-and-action-standard>.

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Handbook on Measurement, Reporting and Verification for Developing Country Parties. UNFCCC. 2014. https://unfccc.int/sites/default/files/non-annex_i_mrv_handbook.pdf.

MRV 101: Understanding Measurement, Reporting, and Verification of Climate Change Mitigation. World Resources Institute. August 2016. http://www.wri.org/sites/default/files/MRV_101.pdf.

Verified Carbon Standard (VCS) Methodologies. Verra. <https://verra.org/methodologies>.



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