Initiative for Climate Action Transparency

Climate Action Aggregation Tool for Non-State and Subnational Action

Methodology Note

NewClimate Institute

World Resources Institute

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Downloads

- **Latest version of the Excel-based tool:**
  climateactiontransparency.org/resources/caat-tool-2024-update
- **User Guide**
  climateactiontransparency.org/resources/caat-user-guide-2024-update
- **Data template**
  climateactiontransparency.org/resources/caat-tool-data-template-2024-update
- **ICAT Non-State and Subnational Guide:**
  https://climateactiontransparency.org/our-work/icat-toolbox/assessment-guides/non-state-and-subnational-action/

Abstract

Non-state and subnational action to reduce greenhouse gas (GHG) emissions is accelerating. There is a growing need for enhanced climate action, and a comprehensive understanding of the potential impacts of climate efforts by non-state and subnational actors can help country governments develop more comprehensive climate policy targets, and effective policy interventions to achieve these targets.

The Initiative for Climate Action Transparency (ICAT) Non-State and Subnational Action Guide was developed as part of a series of guides to help countries assess the impacts of policies and actions. The guide focuses on assessing the potential GHG emissions impact of non-state and subnational actions. It includes detailed methodology to enable users to identify, quantify and aggregate the impact of non-state and subnational actions. The results of the assessment can inform mitigation targets, projections and scenarios, which may support policy development, policy evaluation and target-setting.

The assessment process can be time-consuming and complex. To support users of the guide, the Climate Action Aggregation Tool aims to empower government experts, analysts from the public and private sectors and policymakers with the capacity to analyze and understand the full potential of non-state and subnational action to help inform target-setting and policymaking. This Methodology Note explains in detail the approach, methodology and data used in developing the Climate Action Aggregation Tool for Non-State and Subnational Action to help users better interpret the results of their assessments and understand the full strength and limitations of our data and methodology.

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1 Background

Non-state and subnational actors, including cities, states, companies and investors, among many others, play critical roles in mitigating greenhouse gas (GHG) emissions—and their numbers are growing. The collective efforts of these actors can directly impact national emissions trajectories and help meet or even exceed the ambition of national targets. At the same time, national governments may not fully consider the potential impact of these actors when determining national climate policies and implementing nationally determined contributions (NDCs) (ICAT 2020). Many countries may have uncertainty around the scope and scale of these efforts and their relationship, including potential overlap with national efforts.

In light of these issues, there was a growing need for a comprehensive methodology to evaluate these actors' contributions and potential GHG emission reductions in a consistent manner. The ICAT Non-State and Subnational Action Guide: Integrating the Impact of Non-State and Subnational Mitigation Actions into National Greenhouse Gas Projections, Targets and Planning (ICAT Guide) was developed to support assessment of the GHG emission reduction potential of non-state and subnational actions (NSAs). Understanding this potential can inform and improve the development of more ambitious future climate policies and targets, such as those in the NDCs, by boosting national governments' confidence that current targets can be met or identifying the emissions gaps that need to be bridged.

This type of assessment can be complex and requires users to make several assumptions depending on the objective of the assessment. To support application of the ICAT Guide, NewClimate Institute, with support from World Resources Institute, developed the Climate Action Aggregation Tool for Non-State and Subnational Action. This is a Microsoft Excel–based tool that closely follows the steps and methodology presented in the ICAT Guide and allows users to tailor the application of the tool to their objective and assessment boundary. Users should be able to undertake assessments toward any of the objectives presented in the guide and produce consistent results.

This Methodology Note explains in detail the framework, methodology and data used in developing the Climate Action Aggregation Tool. Section 2 provides an overview of the methodology, including specific calculations, steps involved and limitations of the tool, and Section 3 gives an overview of the data embedded in the tool. In addition to the Climate Action Aggregation Tool and this Methodology Note, an introductory User Guide has been developed to introduce users to the tool application process. Users are expected to apply the Climate Action Aggregation Tool, User Guide and Methodology Note in combination with the full ICAT Non-State and Subnational Action Guide, which provides greater detail and explanatory text behind each step involved in the assessment.

2 Methods

The functionalities and methodologies of the sheets are discussed in this section. Relative to the User Guide, the following sections provide information on technical details (where appropriate) to fully enable users to follow the step-by-step process of the tool. This Methodology Note is provided for additional interest for users who wish to understand the technical aspects of the Climate Action Aggregation Tool (hereafter referred to as the "tool") and is not required to be read to conduct an analysis.

2.1 Basic overview

The tool contains 13 sheets, which are color-coded to indicate different steps in the tool's utilization. The first user input is required in the Assessment_input sheet. Here, users define the assessment boundary and objective of their assessment (see Section 2.2). The assessment boundary determines which actions are considered in the quantitative analyses. Users can still input any non-state and subnational action into the ActionsList_overview sheet, regardless of the chosen assessment boundary. In the NationalPathways_input sheet, users insert historical emissions and an emissions reference scenario, and, depending on their chosen assessment objective, one or more emissions scenarios to compare additional results.

In the _calc sheets, the potential emission reductions of actions that are within the assessment boundary are aggregated and the results are corrected for any overlaps.[1] First, the tool aggregates the actions' targeted emission levels. Subsequently, the tool develops a reference scenario for the actors within the assessment boundary, based on the user-chosen growth rate. Then, the tool determines the potential impact by comparing the two developed emissions scenarios. Finally, this potential impact is corrected for overlap. In the _results sheets, the main results are presented in figures and data tables.

2.1.1 Buttons and their use cases

- **Tool reset:** Clears all data, parameters and scenarios previously inserted in the tool.
- **Data check/update:** Checks users' data inputs in the active sheet and delivers prompts if there are inconsistencies with entries.
- **Reset:** Clears data, parameters and scenarios only for the active sheet.
- **Insert data:** Unique to ActionsList_input—it checks users' data inputs and inserts them into the last row entry of ActionsList_overview.
- **Update:** Performs calculations in limited sections of the tool and is quicker to execute.
- **Calculate:** Performs calculations across the tool and generally takes longer to execute.
- **Insert scenario:** Unique to the NationalPathways_input sheet, this button inserts the named scenario (including tables, named ranges and formulas) at the bottom of the sheet.
- **Delete scenario:** Unique to the NationalPathways_input sheet, this button deletes the named scenario (including tables, named ranges and formulas).
- **Update scenario:** Unique to the NationalPathways_input sheet, this button updates the name of the chosen scenario (including tables and named ranges).
- **Reporting update:** This button populates the Reporting_results sheet with inputs and results from the tool assessment.
- **Save file/sheet:** Unique to the Reporting_results sheet, this button allows users to save the sheet in different formats for printing.

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[1] Overlaps between two or more actions occur when the actions aim to reduce the same emissions, indirectly or directly. When overlaps are not accounted for in an aggregation, they can lead to double counting of GHG emission reductions and therefore an overestimation of the aggregated potential impact. See Section 2.6.3 for more information.

2.2 Assessment boundary

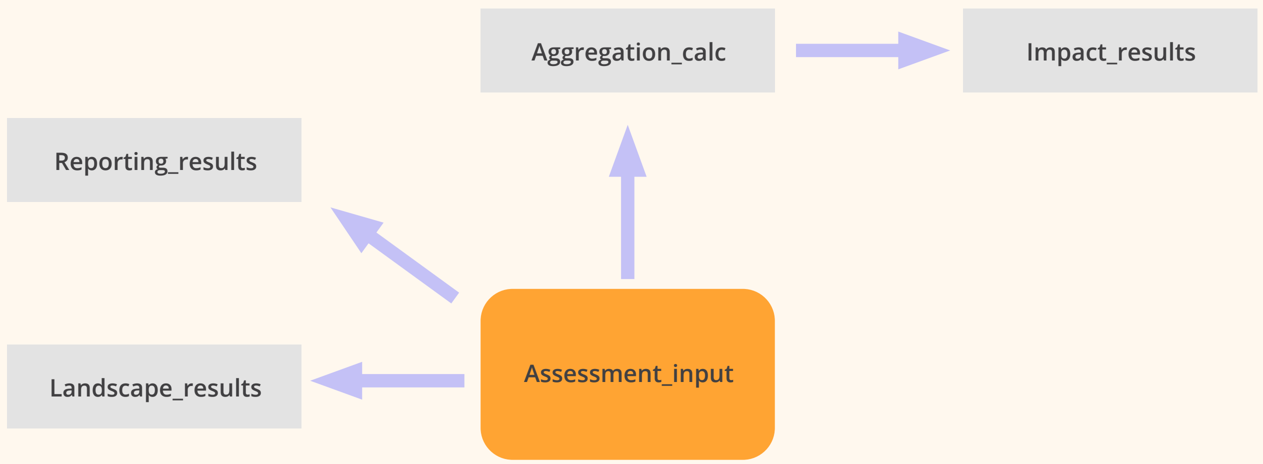
The assessment boundary is a critical section of the tool—it defines the overall scope of the analysis along with the required data inputs and default calculations required for that scope. In other words, it defines key filters, such as types of actors or sectors covered, to determine which NSAs will be included in the aggregation and landscape analysis. The Assessment_input sheet is where users must specify the assessment boundary. In the first part of the sheet, users must select the criteria. In the second part, a summary of the scope is provided.

The Assessment_input sheet feeds directly into the Aggregation_calc sheet (aggregation calculations) (and hence indirectly into the Impact_results sheet), Reporting_results sheet (final reporting sheet) and Landscape_results sheet (landscape analysis) as seen in Figure 1.

The criteria to be defined in the assessment boundary include the following:

- **Assessment objective:** Assists users in selecting the direction and aim of the assessment. The selected objective affects the data input requirements and the _results sheets. For example, if Objective 1 (landscape analysis) is chosen, no national pathways have to be inserted, the calculations in the Aggregation_calc and Overlaps_calc sheets are not executed and only landscape results will be calculated by the tool. If Objective 2 (NSA potential impact assessment) or Objective 3 (NSA potential impact on climate change targets) are selected, elements of the national pathways have to be populated by users, calculations are run in every sheet of the tool and the Impact_results sheet yields numerical results.

FIGURE 1: RELATIONSHIPS BETWEEN ASSESSMENT_INPUT AND OTHER SHEETS



- **Sectors:** Allows users to select the sectors to be included in the assessment. The sector selection directly affects the aggregation calculations because the aggregated emissions are summed based on the sectors of assessment. The sectors here are based on the Intergovernmental Panel on Climate Change (IPCC) sectors, with minor adjustments to match common cases for NSAs, and include the following:
  - Electricity and heating (energy supply)
  - Transport (energy)
  - Buildings (energy)
  - Industry (energy and processes)
  - Agriculture
  - Waste
  - Land use, land-use change and forestry (LULUCF)
  - Other, which refers to the same categorization as the IPCC's "Other" sector category; the full list may be found in the Admin sheet.
  - Sector cross-cutting, which refers to a scope that includes multiple sectors across the economy, or when sectors are undefined or unknown, such as cities with city-wide emission reduction targets or a private financial actor that commits to green financing .

- **Actor types:** Allows users to define the type of actors to be included in the assessment. The actor type directly affects the aggregation calculations because the aggregated emissions are also summed based on actor type. The possible actor types include companies; energy utilities; investors, civil society organisations, and others; cities; states, provinces and regions.

- **Action types:** Allows users to define the types of actions that will be included in the assessment, including individual actions and international initiatives.

- **Target types:** Allows users to define the types of targets for actions that will be included in the assessment. The emission inputs depend on the target types (GHG target or electricity-related target), which are then summed in the Aggregation_calc sheet.

- **Emissions scope:** Allows users to select the emissions scopes (1 and/or 2) to be included in the assessment. The aggregation of emissions is calculated by summing each scope and the results of the aggregation show how emission reductions are affected in either scope. For definitions of emissions scopes, users can reference the Glossary.

- **Period of assessment:** Allows users to specify the years for the assessment. The period of assessment will also be reflected in the Impact_results and Landscape_results sheets. The default is set to the maximum range, 2020–2050.

- **Electricity emission factor:** Allows users to specify base year and end year emission factors for the calculation of electricity-related targets, for a chosen time frame (default is 2015–2050). These factors are used to convert the electricity-related targets into GHG emissions values to be used in the Aggregation_calc sheet.

After setting the assessment boundary using these criteria, users can check their assessment boundary inputs by clicking on the "Save and proceed" button or delete them by clicking on the "Reset" button.

Limitations

- Scope 3 emissions are not an option under the selection of emissions scope, as the aggregation tool does not include methods to correctly allocate Scope 3 emissions. In part, this is because including Scope 3 emissions might lead to difficulties quantifying actions and overlaps, and ultimately skew results.

- The electricity emission factors are not automatically included in the tool since global/regional future trends are not curated in publicly available datasets; users may want to make their assumptions by inputting their specific factors.

2.3 Actions list overview

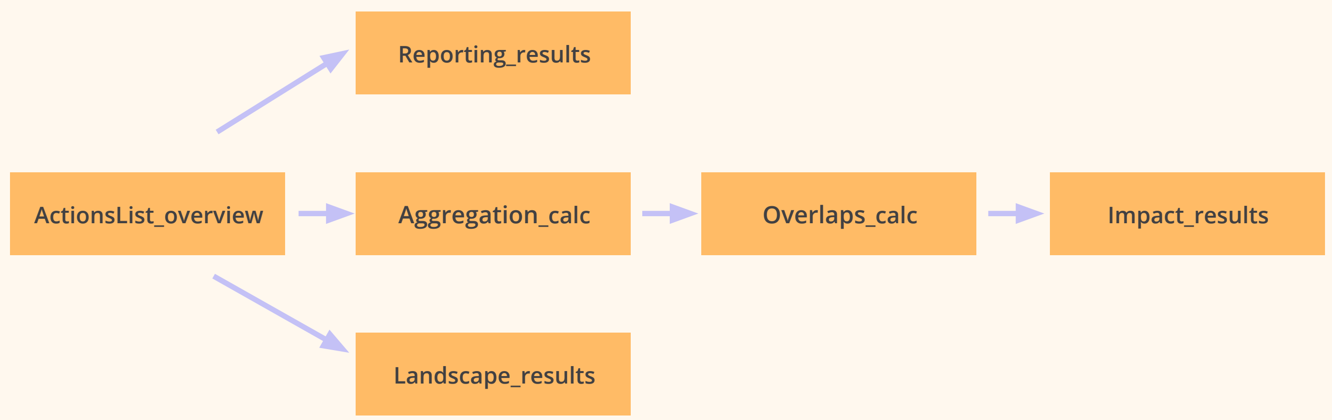
In the sheet ActionsList_overview, users can insert multiple NSAs at a time, or copy and paste them from an external source so long as the data align with the table format and cell values align with the set drop-down values in the cell (for example, if they have done the assessment before or used the data template for collecting data and run the consistency check). It is critical that when copying and pasting, users use the “Paste Special” option and paste only the values in the tables; this ensures that any formatting and data validation applications embedded in the tool are not lost. It is recommended that only advanced users with great familiarity with the data inputs and large datasets use this method of entering NSAs.

The ActionsList_overview feeds into the Aggregation_calc, Landscape_results and Reporting_results (see Figure 2). In addition, ActionsList_overview provides users with an overview of the inserted actions (from ActionsList_input) and allows users to adjust the data.

The first part of both ActionsList_input and ActionsList_overview contains various drop-down lists and input fields. Most of the fields correspond with those in the assessment boundary and some are additional for bookkeeping purposes. All entries are saved under named ranges, which feed into the aggregation and/or landscape results. They include the following:

- **Actor name:** These entries are used in the Aggregation_calc sheet for bookkeeping purposes and are a required input.
- **Action description:** These entries are used in the Aggregation_calc sheet for bookkeeping purposes.
- **Actor type:** Actor type helps define the assessment boundary and the entries are used for the aggregation of emissions. Actor type is a required entry for the aggregation analysis and landscape results.

FIGURE 2: RELATIONSHIPS OF ACTIONSLIST_OVERVIEW WITH OTHER SHEETS



- **Target type:** Target type helps define the assessment boundary and the entries are used for the aggregation of emissions. Target type is a required entry for the aggregation analysis and landscape results.

- **Action type**: Action type helps define the assessment boundary and the entries are used for the aggregation of emissions. Action type is a required entry for the aggregation analysis and landscape results.

- **Sector targeted and subsectors:** The main sector helps define the assessment boundary and the entries are used for the aggregation of emissions. In addition, the action's emissions growth rate (e.g., for determining the baseline emissions) is based on sectoral inputs in the NationalPathways_input sheet and the sector assigned to the action in the ActionsList. The main sector is a required entry for the aggregation analysis and landscape results. Subsectors (and sub-subsectors) are optional entries and can be used for bookkeeping purposes. The main sector determines which subsectors can be chosen, and the subsectors determine which sub-subsectors (subsector 2) can be chosen.

- **Does the action encompass other actions?** This question is asked for later guidance in the overlap calculations. For example, if users know that their dataset includes cities that lie within regions included in their ActionsList, they would answer "yes" to this question for those regions. If they know that there are cities that geographically overlap with company locations, they can insert "yes" for those cities, and so on. Users can leave the field blank (it is not a required entry) or insert "unknown", "no" or "yes". The yes values are fed into the Overlaps_calc sheet (see Section 2.6.3).

- **Geographic coverage:** Users can insert the geographic scope based on a drop-down menu. It is not a required entry and used only in the landscape analysis or for bookkeeping.

- **Action status:** Users can insert the action status based on a drop-down menu. It is not a required entry and used only in the landscape analysis or for bookkeeping purposes.

- **Qualitative impact assessment:** Users can insert the action status based on a drop-down menu. It is not a required entry and used only in the landscape analysis or for bookkeeping.

The second part of the ActionsList_input and ActionsList_overview sheets contains input fields for emission values and their corresponding years. The values input here are directly used for the aggregation calculations. This tool allows for GHG targets and electricity-related targets (which also include renewable energy targets) to be recorded (see Limitations below). There are two tables available for input emission values and they include the following:

A. **GHG emissions target information** is divided into four inputs: base year, latest inventory year, target year 1 and an optional target year 2. Each input requires users to insert the relevant years, Scope 1 and—if available—Scope 2 emissions of the non-state or subnational actor for the respective years. The units for the emissions values must be input as tonnes of carbon dioxide equivalent (tCO_2e). The named ranges for the years and corresponding emission levels are integrated into all parts of the Aggregation_calc sheet.

B. **Electricity-related target information** is also divided into four inputs: base year, latest inventory year, target year 1 and an optional target year 2. Each input requires users to insert the relevant years, the electricity demand and the share of renewables in the electricity demand of the non-state or subnational actor for the respective years. In addition, users are requested to make an assumption about the growth in electricity demand, given that this does not necessarily correspond to the growth in emissions. Users can either manually input a growth rate in percentage change annually, or directly input the estimated projected demand next to the target year. If the first option is chosen, users input the percentage change in the pop-up input box, and then can update the projected electricity demand in target years by clicking "calculate" (which pops up after the first option has been clicked). The units for the electricity demand values must be input in megawatt-hours (MWh). The named ranges for the years and corresponding emissions are integrated into all parts of the Aggregation_calc sheet.

The final columns of the ActionsList indicate whether the action will feed into the aggregation or not. If an action matches the criteria selected in the assessment boundary, enough data points are entered and users want the action to be considered in the aggregation, the action will be considered for the period of assessment. See Table 1 for an example of this logic.

Limitations

- Due to the extensive number of subsectors available for users to select, the tool limits the impact aggregation to the main sectors, leaving the subsectors for bookkeeping purposes (which are elaborated on the main IPCC sectors, as stated before). These subsectors are also not checked by the "Data check" button for the same reason.

- The target types are limited to GHG emissions targets and electricity-related targets, that is, the tool does not cover the full diversity of target types in various sectors (e.g., number of trees grown per acre, modal shift from passenger to public transport) as its main use is for aggregating actions. Users should therefore convert other types of targets to GHG emissions or electricity-related targets to aggregate them in the tool.

TABLE 1: EXAMPLE OF INCLUSION OR EXCLUSION OF ACTION INTO AGGREGATION

Emission scope	Target type	Sector	Actor type	Enough data points	Desire to include in aggregation?	Included in aggregation?
YES	YES	NO	YES	YES	NO	NO
YES	NO	YES	YES	YES	YES	NO
YES	YES	YES	YES	NO	YES	NO
YES	YES	YES	NO	YES	YES	NO
NO	YES	YES	YES	NO	NO	NO
YES	YES	YES	YES	NO	YES	NO
YES	YES	YES	YES	YES	YES	YES
YES	YES	YES	YES	YES	NO	NO

Users can click the "Data check" button to see if there are any pasted values that lead to errors, and the "Reset" button to start over.

2.4 National pathways

The NationalPathways_input sheet is vital because the information entered here helps assess the impact of NSAs. Specifically, this information determines the baseline against which the impact of NSAs are quantified. The sheet is made up of three main parts:

- A section where scenario names are inserted
- A section where the sectoral split of emissions needs to be inserted
- A section where users enter historical emissions data and projected emissions data for defined scenarios

Scenario assessment for projections: In this part, users decide which national scenarios should be used for NSA impact assessment. If users chose the second objective (bottom-up assessment) in the sheet Assessment_input, only the reference scenario is required. If users chose the third objective (top-down assessment) in the sheet Assessment_input, up to four additional scenarios can be inserted. The scenarios can be inserted into the tool by first defining a name and then clicking the "Insert" button. Scenarios can be removed by pressing the "Delete" button. The sector emission levels in the scenario tables are automatically populated using the sector split after clicking the "Update" button, as explained below.

- **Insert:** This button adds one blank scenario input table under the previous scenario table and populates the "growth rate" table with formulas. Users must input their emission projections in "Total emissions"[2] , update the sector split percentage estimations in Section 2 (more below) and then click the "Update" button beside the new scenario table.

- **Delete:** This button deletes the scenario in question and all associated information, including the scenario's sector split information and named ranges.

- **Update name**: This button allows users to update the names of the scenarios (including named ranges and tables) without deleting and re-inserting scenarios.

- **Save and proceed:** This button checks whether all information has been inserted to meet the chosen assessment objective, including whether scenario definitions, sector split percentages, and emissions data have been added appropriately.

- **Assessment_input check:** This button checks that the assessment boundary inputs have all been appropriately entered. It can be used as a pre-check before filling out the NationalPathways_input sheet and continuing the assessment.

Sectoral emissions split: Users need to input the sectoral emissions split (the share of total emissions that each sector comprises). Users must also input aggregate emissions totals (all sectors together) for relevant assessment years, and then sector-specific emissions totals are calculated automatically based on these values for user convenience. The user-defined sectoral emissions split values also determine the assumed growth rate for each sector in each scenario that is inserted. Importantly, the sectors that populate these tables are determined by user-defined inputs in the assessment boundary. The calculations for the growth rates are executed in the sheet Aggregation_calc and feed directly into this sheet when users click "Update". The "Update" button ensures calculations are updated for the entire NationalPathways_input sheet. When all sectors are chosen in the assessment boundary, the sum of the sectoral splits needs to equal 100 percent, which is checked when clicking "Save and Proceed". Otherwise, sector emissions split values do not need to add up to 100 percent.

[2] *If users use the tool for a regional assessment, the total emissions would equal the total emissions of that region. If users use the tool for a country-wide assessment, the total emissions would equal the total country-wide emissions. For example, if users want to assess the contributions of cities' transport-related targets to the national NDC, they need to insert total country-wide emissions under "Total emissions".*

Historical data: The historical emission values entered here can be based on official inventory data. For example, if using national emissions, the values should be based on submissions to the United Nations Framework Convention on Climate Change. Users can input the year in "Latest inventory year", which separates the time horizon for historical and other scenario tables. Data in the "Historical data" table will be used for all scenario results when comparing the impacts of NSAs, while emissions data for years after the latest inventory year are taken from the other scenario tables. If the latest inventory year is before 2015, the "Historical data" table is greyed out and no historical data should be inserted. In that case, all emission levels are based on projections.

2.5 Aggregation

In the sheet Aggregation_calc, the targeted emission levels of the actors are calculated and summed. Hence, the sheet includes two main sections: the calculation of support variables and emission levels per action over time (on the right side of the sheet) and the aggregation of the calculated emission levels per determined time period (on the left side of the sheet). Below, the methodology of the sheet's underlying calculations is explained in this order. The methods here are developed by the authors and follow the general approach from the ICAT Guide and Kuramochi et al. (2020). To allow for any assessment period between 2020 and 2050, the entire time frame is shown in this sheet. However, if the time period of the assessment is narrower (e.g., through 2030), this will be reflected in the _results sheets. Please note that overlaps are considered in a separate sheet (Overlaps_calc), discussed in Section 2.6.

2.5.1 Calculating emission levels

In the case of GHG emissions targets, the emission level of the base year and—if available—the latest inventory year are copied to this sheet directly from the ActionsList. The emission levels for each action's target year(s) are calculated based on the inserted target data in the ActionsList. The targeted emission level (ELx) for a target year x under a GHG emissions target is calculated as follows:

$$EL_x = EL_{by} * (1 - \%red_x)$$

Where:
EL_{by} = Emission level in the base year

$\%red_x$ = Percentage reduction of emissions in the target year (year x) compared with the base year, as defined in the ActionsList.

For electricity-related targets, targeted emission levels are calculated using user-defined electricity emission factors for the start and end years of the assessment (inserted in the Assessment_ input sheet). Between the start and end year of assessment, the electricity emission factor is determined based on linear interpolation. For this, an emission factor delta is calculated and applied to each annual step. If the emission factors are inserted for a shorter period than the desired assessment period (as determined in the Assessment_input sheet), the same delta is applied to the years outside the scope. The emission levels resulting from electricity-related targets are then calculated as follows:

$$EL_x = ElecD_x * (1 - SRE_x) * EF_x$$

Where:
EL_x = Emission level in the target year (year x)
$ElecD_x$ = Electricity demand in year x
SRE_x = Share of renewable electricity in year x
EF_x = Emission factor for year x

[3] *If an action of an energy utility entails a GHG emissions target, Scope 1 and Scope 2 emission levels are determined and allocated in the same way as any other GHG emissions target.*

This calculation assumes that renewable electricity is GHG-emissions free. In addition, the resulting targeted emission levels are split into Scope 1 and Scope 2 emissions. If the target is related to GHG emissions, users will have already defined emissions as Scope 1 and/or Scope 2, which feeds directly into the corresponding scopes in the aggregation. Emission levels resulting from electricity-related targets are included in Scope 2 emissions unless the actor type is an energy utility. In that case, the resulting emission levels feed into Scope 1 emissions.[3]

2.5.2 Calculating deltas

To determine the emission levels of non-state or subnational actions for years between given or calculated data points, the tool will calculate "deltas". A delta is the absolute annual change in emissions between given or calculated emission levels of known years (e.g., between the latest inventory year and the first target year). The deltas are based on the emission difference between two data points, divided by the number of years between them. Assuming linear interpolation, they are a measure of the annual emission change (increase or decrease) per year (see Figure 3). When calculating the impacts of climate actions, deltas are typically negative, indicating a decrease in emission levels as a result of the mitigation targets. Deltas are positive and therefore indicate an annual increase in emissions when, for example, the emissions in the inventory year are higher than those in the base year.

For each time period illustrated in Figure 3, the annual delta (Δ) changes since the absolute emission levels at the start of each corresponding time period are different. However, because linear interpolation is used, deltas are consistent within a given time period (e.g., between base year and target year). As users need to input at least base year emissions and specify one target year to include an action in the aggregation, the minimum number of unique deltas is one, indicated with the grey delta in Figure 3. In such a case, the delta would be calculated for the period between the base year and the first target year. On the other hand, there is a maximum of three deltas that could be calculated for one NSA, as shown in the figure with orange deltas. For example, for the calculation of the emissions delta between the first and second target years, the start year is the first target year, and the start year value is the calculated emission level of the first target year (as explained in Section 2.2). Therefore, the delta for the years between the first and second target years is calculated as follows:

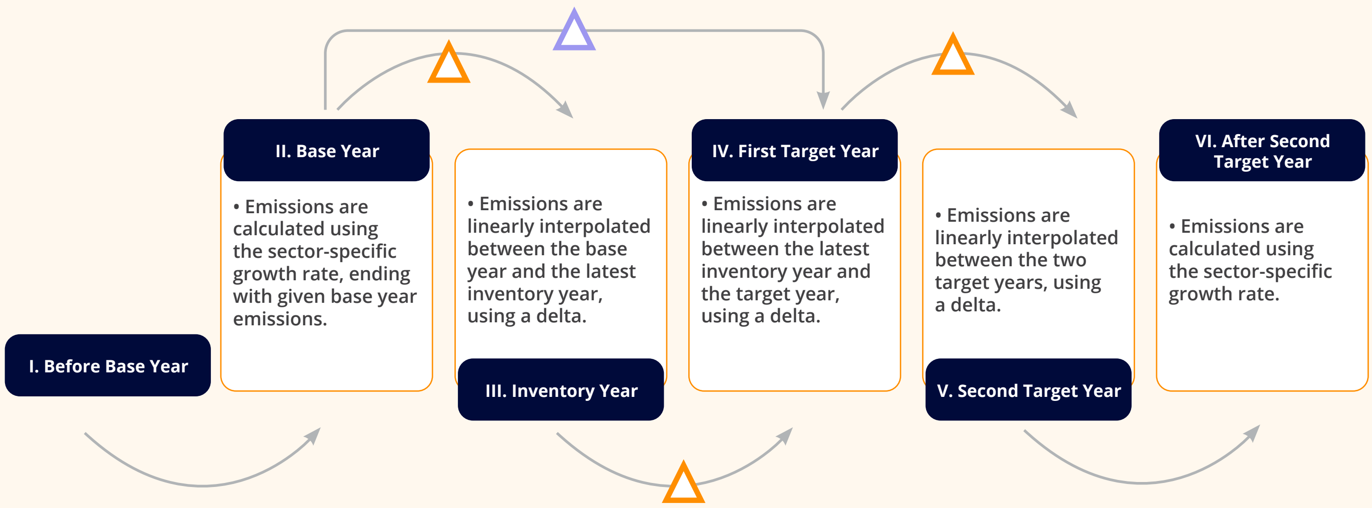
$$\Delta = (EL_y - EL_x) / (Y_y - Y_x)$$

Where:
EL_y = Calculated emission level in year y (e.g., 2040)
EL_x = Calculated emission level in year x (e.g., 2025)
Y_y = The second target year
Y_x = The first target year

If there are fewer time period data points for one action, the unique deltas used in the calculations are fewer. For example, if no inventory year is inserted for an action, or if the latest inventory year is equal to or smaller than the base year, a delta is calculated directly between the base year and first target year.

For actions without a second target year and a first target year before 2050, the growth rate from the chosen scenario is applied to the emissions after the first target year (see Section 2.5.3). All deltas are calculated on the sheet Delta_calc, on the left-hand side.

FIGURE 3: CALCULATING THE DELTA (Δ)—THE ANNUAL CHANGE IN EMISSIONS—BETWEEN TIME PERIODS



2.5.3 Emission levels outside the known range

In certain cases, an annual growth rate will be applied to determine the emission levels instead of a delta. The annual growth rates are obtained from the sheet NationalPathways_input, are sector-specific and are determined for the time frame 2020 to 2050. The calculations for emission levels outside the known range, which include applying growth rates, are executed in the far-right tables of the Delta_calc sheet.

First, if a base year is later than 2020, the reference scenario growth rate obtained from the NationalPathways_input sheet is applied to determine the emission levels between 2020 and the base year. Here, the annual growth rate is used to extrapolate emission levels backwards—since the future values are known, the growth rate is applied to calculate unknown historical values as opposed to the more common method of extrapolating into the future.

Second, if an action does not have a second target year and the first target year is before 2050, the growth rate of the chosen scenario is applied to the calculated emission level in the first target year to determine the emission levels in the remaining years until 2050. If an action has a second target year before 2050, the growth rate of the chosen scenario is applied to the remaining years until 2050 as well. If users chose the second assessment objective, the reference scenario will always determine the growth rates for the years after target realization, as shown in the NationalPathways_input sheet. If users chose the third assessment objective, they are asked to choose which scenario they want to apply to the years after target realization ("default growth rate scenario" in the NationalPathways_input sheet), which can therefore be the reference scenario, or any other entered scenario.

In addition, the tool breaks down the scenario growth rate to the sector level, as users also estimate the expected percentage share of emissions for each sector in both the inventory year and 2050. The growth rate of total emissions is applied to actions that are cross-cutting, as they impact more than one sector.

2.5.4 Aggregation

On the sheet "Aggregation_calc", the calculated emission levels are summed to obtain the aggregated emissions of actors if they realize their targets. As explained in Section 2.3, actions are quantified and aggregated only if they are within the assessment boundary, if enough data points are entered and if users want to include them in the aggregation. Therefore, the aggregation methodology is based on a conditional sum of emissions from actions input on the ActionsList_overview sheet, with the final column in the ActionsList_overview sheet being the leading condition (see named range "Input_IncludeInAgg"). In addition, targeted emission levels are aggregated based on the actors' and actions' characteristics as defined in the ActionsList—emissions scope, target type, action type, sector type and actor type—and the specific time period. These time periods are shown in Column B of the Aggregation_calc sheet and ensure a chronological order in terms of time categories. This approach is taken to align the emissions of actions with differing base, inventory and target years. A function is used to match the timeframes and actions' characteristics into unified categories and multiply the emissions with the calculated delta (as explained in Section 2.5.2). The multiplications within the function ensure that when one of the elements that determine the assessment boundary or other crucial characteristics is not met by an action or actor, the action's contribution to the sum would automatically be zero.

Returning to the previous example, the emission level (EL), in year y, of an action that meets the characteristics in Columns B-F in the Aggregation_calc sheet for the period between the first and second target years is therefore calculated as follows:

$$EL_{AssY} = \Delta * (Analysis_y - TY1) + EL_{TY1}$$

Where:
Δ = The calculated delta between target year 1 and target year 2
$Analysis_y$ = Year of analysis (e.g., 2035)
TY1 = First target year (e.g., 2040)
EL_{TY1} = The calculated emission level in target year 1

Analysisy can be any year between 2020 and 2050 and is part of the condition that determines in which time period table the action's emission levels should be aggregated. Returning to the example above, if the action had a second target year of 2045, the emission levels for the period between 2045 and 2050 would be visible in the "after target year 2" table. The results would then be zero in the table "between target year 1 and target year 2" for the period between 2045 and 2050, as the table runs on the condition Analysisy < TY2.

In addition, there are a few more conditions:

- Period **between base year and inventory year:** The base year needs to be lower than the inventory year. Hence, if an inventory year has not been inserted, or is equal to or lower than the base year, the function still takes a delta, but it is based on the difference between the base year and the first target year.

- Period **between inventory year and target year:** If no inventory year has been inserted, or the inventory is equal to or lower than the base year, the emission level is determined in the period above. The result for the specific action in this periodical table would be zero.

- Period **between target year 1 and target year 2:** If an action reports a second target year that is before 2050, the function takes the calculated delta between the first and second target year. If there is only one target year, the function sums the year-specific values of the table where emission levels until 2050 are calculated (see Section 2.5.3).

- Period **after target year 2:** If an action has a second target before 2050, the function sums the year-specific values of the table where emission levels until 2050 are calculated (see Section 2.5.3).

The same steps and calculations are done for Scope 2 emissions.

Limitations

- A linear interpolation is assumed between the different points in time, such as between the given base year and inventory year, between the first and second target year, and between the latest reporting year and the first target year. Users cannot adjust this shape of the curve, although implementation of non-state and subnational actions might not occur in a linear pattern.

2.6 Calculating impact and addressing overlaps

In the Overlaps_calc sheet, the potential impacts of actions are calculated and aggregated while accounting for overlaps. The "raw impact"[4] of actions is calculated by comparing a counterfactual emissions scenario per actor to the targeted emission levels per actor. However, aggregating the individual raw impacts without accounting for potential overlaps between them could lead to an overestimation of the total impact. Below, the methods behind determining a counterfactual scenario, the calculation of raw impacts and the aggregation of impacts, while addressing overlaps, are explained.

2.6.1 Calculating a counterfactual emissions scenario

First, the counterfactual projected emission levels (without NSA target realization) for the collective set of NSAs for each actor type within a given sector are determined.[5] This is done by multiplying the calculated emission levels from 2020 with the sector-specific growth rates from the reference scenario. The 2020 emission levels are obtained from the Aggregation_calc sheet and the sector-specific growth rates are pulled from the NationalPathways_input sheet, under the reference scenario. As a result, a series of GHG emission levels for 2020–2050 is determined for the collective set of NSAs for each actor type in each possible combination of characteristics (see footnote 4). This series is used as the counterfactual (reference) scenario to calculate the raw impact. If users want to determine the impact of NSA target realization under other (e.g., more ambitious) emissions scenarios, they should insert the desired scenario as the reference scenario. The tool always uses the growth rate of the reference scenario to calculate a counterfactual emissions series.

2.6.2 Calculating raw impact

To calculate the potential impact without accounting for overlaps (i.e., the raw impact) in aggregate for the collective set of NSAs for each actor type (e.g., cities or regions) and sector, the counterfactual emission series is compared with the aggregated emission levels under NSA target realization. The aggregated emission levels under NSA target realization are obtained from the Aggregation_calc sheet, where the emission levels are categorized by emissions scope, actor type, action type, target type and sector. Subsequently, the projected emission levels with NSA target realization are subtracted from the counterfactual emission levels. Hence, only the share of emissions that is lower than the emissions determined under the reference scenario is assumed to be the potential impact of an NSA. Therefore, overlaps between NSAs and national policies are implicitly accounted for if the reference scenario includes national climate policies, such as a scenario based on the implementation of a country's NDC (see Limitations below).

[4] *Here, "raw impact" means aggregated impact that has not yet accounted for overlaps between actions.*
[5] *This includes calculating counterfactual projected emission levels for each possible combination of action characteristics (i.e., actor type, target type, action type, sector and emissions scope).*

2.6.3 Addressing overlaps

Identifying overlaps

Overlaps between two or more actions occur when the actions aim to reduce the same emissions, indirectly or directly. When overlaps are not accounted for in an aggregation, they can lead to double counting of GHG emission reductions and therefore an overestimation of the aggregated potential impact. To avoid this, the tool features a section dedicated to overlap calculations—Overlaps_calc—following the methods described by Lui et al. (2020).

For this tool and its underlying methodology, overlap is calculated hierarchically, based on geographic scope. As shown in Table 2, regions are considered to be the most encompassing actor type, and therefore the NSA impact from regions is corrected for overlap with all actions at a lower level (e.g., cities, energy utilities, companies).

Further up in Table 2, the impact from energy utilities is only corrected for overlap with companies, since this is the only actor type defined as having a smaller geographic scope. See Table 2 for an overview of all potential overlaps.

Furthermore, overlap is assumed to occur within a sector, as actions targeting different sectors would not overlap (with a few exceptions, see Limitations below). In addition, overlap is assumed to occur regardless of action type and target type but within an emissions scope. Overlap between energy utilities and companies is assumed to occur only between energy utilities' Scope 1 emissions and companies' Scope 2 emissions.

TABLE 2: POSSIBLE OVERLAPS AMONG ACTOR TYPES

Actor type under analysis ↓	Other actor types under analysis with potential overlaps			
Companies can overlap with				
Energy utilities can overlap with	Companies			
Investors, civil society organisations, and others can overlap with	Companies	Energy utilities		
Cities can overlap with	Companies	Energy utilities	Investors, civil society organisations, and others	
States, provinces, and regions can overlap with	Companies	Energy utilities	Investors, civil society organisations, and others	Cities

Quantifying overlap

To quantify the overlap between actions and correct the potential impacts for overlap, the Overlaps_calc sheet and its underlying logic entail several steps. The emissions coverage for the collective set of NSAs of each actor type within a given sector is calculated. This is done by dividing their aggregated sectoral emissions from the counterfactual scenario described above by the reference total[6] sectoral emissions as inserted in the NationalPathways_input sheet. The resulting emissions coverage values for each actor type and sector are used as proxies for overlap, as they represent the share of action x's impact that is also covered by action y[7]. For sector cross-cutting actions, emissions coverage is calculated based on the total emissions inserted in the NationalPathways_input sheet (as no sector-specific information is available). An underlying assumption of this approach to quantifying overlap is that the aggregated actions and their impacts have a geographically unbiased dispersion across a country, region or sector, and that therefore emissions coverage is equivalent to the share of overlapping impact (see Section 2.6.4 for the tool's features on how to adjust this and the Limitations section below for associated caveats).

Next, the emissions coverage—which, as described above, is a proxy for the share of overlap in this analysis—is used to calculate "quantified overlap" in kilotons of carbon dioxide equivalent ($ktCO_2e$). In general, quantified overlap for each actor level is calculated by multiplying the actors' emissions coverages with impacts at all lower levels. So, for example, calculating the quantified overlap at the regional level would involve multiplying emissions coverage for regions with projected impacts from cities and companies. Calculating the quantified overlap at the city level would then involve multiplying emissions coverage for cities with projected impacts from companies, and so on. However, assuming companies overlap with cities, and those cities overlap with regions, applying this method would lead to overcounting of the quantified overlap. In a case with regional-, city- and company-level actions in the assessment boundary, the quantified overlap at the regional level is therefore corrected to account for the overlap that is also accounted for when calculating the city-level quantified overlap. This is done by multiplying the assumed region-company overlap with the inverse of the emissions coverage of cities (i.e., 1 minus the cities' emissions coverage). This reflects the share of actions not covered by cities, and thus not accounted for in the city-level calculation and still prone to overlap with regions.

The quantified overlap at the regional level ($QO_{regions}$) is thus calculated as follows:

$$QO_{regions} = (EC_{regions} * I_{cities}) + (1 - EC_{cities} * EC_{regions} * I_{companies}) + (1-EC_{cities} * EC_{regions} * I_{energy\ utilities}) + (1-EC_{cities} * EC_{regions} * I_{others})$$

And the quantified overlap at the city level (QO_{cities}) is calculated as follows:

$$QO_{cities} = EC_{cities} * (I_{others} + I_{energy\ utilites} + I_{companies})$$

Where:
EC= Emissions coverage
I = Potential impact, not accounting for overlaps

For sector cross-cutting actions, overlap is quantified by multiplying those actions' emissions coverages with the impacts of all actions, regardless of their sectors. This approach is taken because sector cross-cutting actions may overlap with any sector-specific action, given that the targeted sector is undefined. The emissions coverage of sector cross-cutting actions may also be lower than that for

[6]*Often, country level.*
[7]*For example, if regions included in the assessment cover 30 percent of a country's emissions, it is assumed that the regions also cover 30 percent of a country's cities (and cities' emissions) and therefore 30 percent of the cities' potential emission reductions included in the assessment (see Limitations).*

sector-specific actions, as it is based on a country's total emissions (as opposed to total sector-specific emissions for sector-specific actions).

Finally, the quantified overlaps for each actor level are summed, resulting in the total overlap among the actions within the assessment boundary. This total is then subtracted from the sum of the initial calculated potential raw impacts, which results in the corrected impact of all actions after accounting for overlaps.
A simplified example with dummy values of these steps is presented in Table 3. In this example, quantified overlap at the company level is zero, since no actions occur at a lower level in the hierarchy. Quantified overlap at the city level is 2.4 tCO_2e, which represents the share of city impacts already accounted for at the company level (20 percent—cities' emissions coverage—of 12 tCO_2e, companies' impact). Finally, quantified overlap at the regional level is 13.86 tCO_2e, which represents the share of regional impacts already accounted for at the city and company levels (while also correcting for the share of this overlap already accounted for in the preceding city-level step).

Adjusting overlap to align with the dataset

The default total overlap per actor level is found at the top of the Overlaps_calc sheet. Per the methods detailed above, the values shown for quantified overlap represent the aggregated potential impact of an actor type that is also covered by other actor types at lower levels. The relative values shown represent the shares of the aggregated potential impact of an actor type that overlap with potential impact from other actor types at lower levels. It is therefore the default share that will be deducted from the impact of the actor type in question.
For example, if an actor type has an aggregated emission reduction potential of 200 $ktCO_2e$ and the absolute amount of overlap for that actor type is found to be 50 $ktCO_2e$, the relative amount of

TABLE 3: SIMPLIFIED EXAMPLE OF OVERLAP CALCULATIONS

Actor	Potential impact	Unit	Emissions coverage	Quantified overlap	Unit	Potential impact corrected for overlap	Unit
Companies	12	tCO_2e	15%	0	tCO_2	12	tCO_2e
Cities	30	tCO_2e	20%	2.4	tCO_2	27.6	tCO_2e
Regions	75	tCO_2e	35%	13.86	tCO_2	61.14	tCO_2e
Summed potential impact, corrected for overlaps						100.74	tCO_2e

(35% * 30 tCO_2) + ([1-20%] * 35% * 12 tCO_2)

75 – 13.86

overlap would be 25 percent.
The potential corrected for overlaps would be 150 $ktCO_2e$ as 50 $ktCO_2e$ of emission reductions would already be achieved by other actor types.
By default, the emissions coverages (in %), aggregated per actor type, will serve as a proxy for overlap. However, this method is not without limitations and may not be appropriate in all cases. For example, with small datasets, the aggregated emissions coverage may be a less viable proxy for overlap than for large, diverse datasets. The tool, therefore, gives users the option of adjusting the default overlap by applying “change factors” to correct the default overlap, based on expert judgement. To provide some analytical basis, the number of encompassing actions per actor type is presented, as recorded by users in the ActionsList_input or ActionsList_overview sheet. Based on the actors that are recorded to be encompassing other actions and users’ region-specific knowledge, users can reduce the overlap of actor types to none or increase the default overlap to double. Users should use the scroll bars to do so. The scroll bars are actor type–specific and set to 1.0 as default (no change in overlap) and can go up to 2.0 (double the default overlap) or 0 (no overlap), with steps of ±0.1 in between.[8]

It is crucial that users understand the concept of overlap and have a certain knowledge of their use case before adjusting the overlaps in the sheet. Adjusting the default overlap is not recommended unless users have identified encompassing actions for the majority of the ActionsList analysis and/or have far-stretching expert knowledge of a particular sector that merits an adjustment of these factors to be higher or lower.
The amount of overlap that is used to correct the calculated raw impacts is presented below the section with scroll bars. Similar to the default overlap, the absolute overlaps and corresponding relative overlaps are shown.

Limitations

- Users are not directly able to adjust the coverage values for each possible detailed use case. However, users have the option of adjusting the default overlap by using the change factors (hence indirectly affecting the extent to which the emissions coverage is applied as overlap).
- The overlap calculation methodology is based on the assumption that emissions coverage is a viable proxy for overlap. In other words, overlap of actions from a given set of actors is equivalent to the proportion of those actors’ emissions footprints that is shared.
- The overlap calculation methodology also implicitly relies on an assumption that actors within the assessment boundary are evenly geographically distributed (for example, if regions in the boundary represent 35 percent of national emissions, then by default 35 percent of the emissions footprint of cities included in the boundary is assumed to fall within these regions). Because of this, the calculations are more likely to be accurate when users input large datasets that are geographically representative of the assessment boundary in question, rather than smaller datasets that may be geographically skewed.
- Emissions coverages are sector-specific, unless the targeted sector is “sector cross-cutting”. This might lead to less reliable results if “sector cross-cutting” is a frequently targeted sector in the dataset.
- The overlap calculations assign overlap in a specific order, where regions are affected the most heavily, followed by cities, and so on, as “overlap” requires a notion of “additionality”. Hence, the overlap that is presented for regions might be artificially high, whereas the total, aggregated overlap is realistic. Users should not

[8] *Hence, inserting 1.1 would increase the default overlap by 10 percent, and inserting 0.8 would decrease the default overlap by 20 percent.*

emphasize this overlap too much, and results per actor type are therefore not underlined in the results sheet.

- As the impact assessment is based on *additional* emission reductions compared with a *baseline* of non-state and subnational actor actions, we do not explicitly consider overlaps with national policies. We present potential impacts in the results if the calculated emission levels from actions are lower than the calculated reference scenario, based on the assumption that non-state and subnational actions do not displace actions from national policies. This assumption is justified by the literature showing that there is little to no policy coordination or integration between national governments and NSAs (e.g., Hsu et al. 2019). Under policy schemes such as emissions trading, this may be an invalid assumption.

- Beyond this, users must analyze their assessment scopes and decide which, if any, NSAs overlap with national policies embedded in their scenario definitions. Due to the large range of use cases and methods possible, the authors here do not provide recommendations.

2.7 Results

The potential impact of non-state and subnational actions within the assessment boundary is presented in the Impact_results sheet. Several figures are shown and, if the third assessment objective is chosen, the potential impacts of NSAs on policy scenarios are also presented. The results are shown for the years of assessment, as defined in the Assessment_input sheet. The Impact_results sheet summarizes results from the overlaps and inputs from the NationalPathways_input sheet.
When users select a sector in the drop-down menu, the figures automatically update and show the results of the sector in question. If assessment Objective 3 is chosen and multiple scenarios are inserted in the NationalPathways_input sheet, users can choose the scenario they want to view in the graphics from a drop-down menu. Names of graphs, figures and tables are automatically updated where necessary.
The following sections and results are given:

- **Key results in graphics**
  - The section "Total GHG emission reductions, attributed to non-state and subnational actions within the assessment boundary" includes three main figures. The first shows the total emissions under the reference scenario and NSA target realization. The reference scenario is directly obtained from the NationalPathways_input sheet and the emissions under NSA target realization are calculated using the determined impact (accounting for overlaps). The second shows the annual potential impact in GHG emission reductions of NSAs (accounting for overlaps) in a bar chart. The third presents the relative potential emission reductions per sector.
  - The section "Breakdown of GHG emissions and GHG emission reductions" includes five figures. The first shows the emissions of actors under a reference scenario and the actors' emissions under NSA target realization. It therefore zooms in on the actors within the assessment boundary (excluding the total emissions). The second shows the origin of emission reductions, that is, the share of potential emission reductions per scope, target type and action type. The third presents the share of reductions per sector in a pie chart. The fourth and fifth figure are waterfall figures of potential emission reductions by actor type and by sector, respectively, in the final year of assessment. In these two figures, the bars overlap to symbolize the underlying overlap, but total emission reduction potential is still corrected for the overlaps. Hence, the figures show a combination of "raw" impact and impact corrected for overlap.
  - In the section "GHG emission reductions at the sector level", users can zoom in on sector-level

potential impacts by selecting a sector in the drop-down menu.
- When users choose the third assessment objective, the potential impacts of NSAs in light of other climate policies are shown in the section “Non-state and subnational actions’ contributions to climate policies”. The total emissions under different scenarios are given, as well as the size of the emissions gap compared with a scenario of choice. Users can also zoom in on sector-level emissions by selecting a sector in the drop-down menu. It should be noted that the results of NSA target realization are always based on the reference scenario. In other words, the impact is calculated by comparing a counterfactual reference scenario with the emission levels under NSA target realization. If users wish to see impacts of NSAs under an ambitious climate scenario, they need to insert this desired scenario as a reference scenario in the NationalPathways_input sheet.

- **Numerical results** include several tables that feed into the figures above. Users can use the tables to obtain a higher level of detail in their results. Users should note that the titles of the tables depend on the chosen reference scenario and sector choice in the drop-down menu, among other factors.

Limitations

- If users choose 2020 as their starting year of assessment, the impact for 2020 will be null. This is because the tool starts aggregating from 2020, and 2020 is the year when the emissions from the counterfactual scenario and those from the NSA implementation are equal.
- As touched upon in Section 2.6, the overlap calculations use a specific order for assigning overlap based on actor type. The calculation steps and quantified overlap for individual actor types in this hierarchical order are used as a methodological construct only and should not be reported separately in any presentation of results. Only the resulting total, aggregate overlap across all actor types from these calculations should be reported.

- Users cannot view the impact of NSAs on different scenarios simultaneously, as the impacts are always calculated compared with the reference scenario. If users want to compare the impact of NSAs under different scenarios, they should run the tool with different desired scenarios as the reference in NationalPathways_input.
- Users can extract graphs, figures and data from the sheet, but cannot adjust them in the tool itself.

2.8 Landscape analysis

In the Landscape_results sheet, statistical results of the actions within the assessment boundary are given, both in figures and data tables. In the section with data tables, users can choose to see the data of all actions within the assessment boundary, or a specific sector. In addition, they can enter a year for results that are time-dependent. The results in the figures are based mainly on the large table at the far end of the sheet, where actions are counted only if they are within the assessment boundary.
The section “Key statistics of actions within assessment boundary” includes several figures, which show the number of actions per characteristic. In addition, if users choose the second or third assessment objective, they can see the emissions coverage of the actions within the assessment boundary. Furthermore, several tables present additional statistics on the actions in the ActionsList that are within the assessment boundary.

Limitations

- The more data that users input in the ActionsList, the more valuable the results that will be shown in this sheet.

- If users want to do the landscape analysis for the full ActionsList, they need to define an assessment boundary that allows all criteria.

2.9 Reporting results

The Reporting_results sheet can be used as a print-out cover page when presenting analysis reports and is meant to be a summary overview page with key information from the assessment. Additionally, the sheet should be filled in by the primary analyst or user conducting the tool assessment. Blue arrows indicate locations where input is needed from users. All other information or data can be automatically updated.
The "Reporting update" button populates this sheet by extracting the following key information in the tool:

- **Assessment objective:** Extracts the objective selected in the Assessment_input sheet
- **Assessment boundary:** Summarizes the sector choice, actor types, action types, target types, emissions scopes, period of assessment and electricity emission factors chosen or defined in the Assessment_input sheet
- **Scenarios:** Notes the scenarios selected in the analysis in the column headers and populates the sector emission shares defined in the end year of assessment for the sectors within the assessment boundary.
- **Results:**
  - Impact: Summarizes emission levels in each scenario at the start and end year and the impact of NSAs on total emissions per scenario
  - Landscape: Summarizes the aggregated GHG emission reductions in the end year of assessment, the number of NSAs recorded in the analysis and the percentage of total emissions covered by the assessment scope in the reference scenario
- **Annex:** Records the list of NSAs and national policies input in the ActionsList_overview and NationalPathways_input sheets:

The "Data check" button ensures that required information has been entered (e.g., name of analyst), while the "Reset" button clears the form to its original state. Clicking the "Reporting Update" and "Reset" buttons toggles the current status of the tool (i.e., Has the reporting sheet been updated already? Yes/No), thus preventing users from updating the sheet if it has already been updated and vice versa for resetting. At the bottom of the assessment, users are also able to save the sheet in Microsoft Excel, PDF-short, or PDF-long formats, depending on their needs. "PDF-short" saves a PDF of the sheet excluding the Annex (which can be long depending on the number of entries), while "PDF-long" includes the Annex.

3 Datasets embedded in the tool

Population data and projections were obtained from the United Nations Department of Economic and Social Affairs (2020) while GDP data and projections were obtained from the Organisation for Economic Co-operation and Development (OECD 2020). Both public datasets are available in the tool as references for users to use directly for personal calculations and are not associated with the authors of the tool or the ICAT Guide. Datasets were updated to the most recent year when the tool was updated; users will need to update them regularly.

These datasets are provided to support users lacking national emission projections (which the tool does not include). For example, users can make their own assumptions to estimate emission projections by multiplying per-capita emissions by the population data. Similarly, depending on the national assumptions, missing emissions in actors' target years could be estimated using GDP data. For example, if the target year of a given non-state or subnational action is 2030, the trend of GHG emissions leading to 2030 can be estimated using the GDP growth rate between the actors' base year and 2030. However, the tool does not offer any guidance on how these datasets should be used.

Glossary

Users can reference this glossary when using the User Guide, Methodology Document, and Climate Action Aggregation Tool.

absolute value	The non-negative value of a number without regard to its sign. For example, the absolute value of 5 is 5, and the absolute value of –5 is also 5.
assessment boundary	The scope of the assessment in terms of the sectors and subsectors and greenhouse gas emissions included in it.
assessment report	A report, completed by users, that documents the assessment process, methods and results relating to the impact of non-state and subnational action.
ex-ante assessment	The process of assessing expected future impacts of non-state and subnational actions, or national policies and actions (i.e., a forward-looking assessment).
ex-post assessment	The process of assessing historical impacts of non-state and subnational actions, or national policies and actions (i.e., a backwards-looking assessment).
impact assessment	The qualitative or quantitative assessment of impacts resulting from non-state and subnational actions, or from national policies and actions. This can be conducted either ex-ante or ex-post.
indicator	A metric that can be estimated, measured and monitored over time to understand the impact of non-state and subnational actions, and track changes toward targeted outcomes.
jurisdiction	The geographic area within which an entity's (such as a government's) authority is exercised.
land use, land-use change and forestry (LULUCF)	Land use, land-use change and forestry is defined as the sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use such as settlements and commercial uses, land-use change, and forestry activities.
non-state actor	Any actor other than a national or subnational government.
non-state commitment	Planned non-state action that has been publicly announced but, unlike non-state mitigation action, has not yet been implemented.

Glossary

non-state mitigation action	Any kind of activity that is directly or indirectly aimed at reducing greenhouse gas emissions and that is led by non-state actor(s).
overlapping non-state and subnational actions	Non-state and subnational actions that interact with each other or with national policies and that, when implemented together, have a combined effect less than the sum of their individual effects when implemented separately. This includes both actions that have the same or complementary goals (such as national and subnational energy efficiency standards for appliances), and counteracting or countervailing actions that have different or opposing goals (such as a national fuel tax and a subnational fuel subsidy).
national policy or action	An intervention taken or mandated by a national government, which may include laws, regulations and standards; taxes, charges, subsidies and incentives; information instruments; voluntary agreements; implementation of new technologies, processes or practices; and public or private sector financing and investment.
proxy data	Data from a similar process or activity that are used to stand in for the given process or activity.
qualitative assessment	An approach to impact assessment that involves describing the impacts of a policy or action on selected impact categories in numerical terms.
quantitative assessment	An approach to impact assessment that involves estimating the impacts of a policy or action on selected impact categories in quantitative terms.
reinforcing non-state and subnational actions	Non-state and subnational actions that interact with each other or with national policies and that, when implemented together, have a combined effect greater than the sum of their individual effects when implemented separately.
Scope 1 emissions	Direct greenhouse gas emissions, controlled by the actor (e.g., from production processes)
Scope 2 emissions	Indirect greenhouse gas emissions, occurring from electricity or heat generation.
Scope 3 emissions	All indirect emissions (not included in Scope 2) that occur in the value chain of the reporting entity, including both upstream and downstream emissions.
stakeholders	People, organizations, communities or individuals who are affected by, and/or who have influence or power over, a policy.
subnational actor	Any form of government that is not a national government.
subnational commitment	Planned subnational action that has been publicly announced but, unlike subnational mitigation action, has not yet been implemented.
subnational mitigation action	Any kind of activity that is directly or indirectly aimed at reducing greenhouse gas emissions and that is led by subnational actor(s).
sustainable development impact	Changes in environmental, social or economic conditions that result from a policy or action, such as changes in economic activity, employment, public health, air quality and energy security.
uncertainty	1. Quantitative definition: Measurement that characterizes the dispersion of values that could reasonably be attributed to a parameter. 2. Qualitative definition: A general term that refers to the lack of certainty in data and methodological choices, such as the application of non-representative factors or methods, incomplete data or lack of transparency.

References

Hsu, A., Brandt, J., Widerberg, O., Chan, S., & Weinfurter, A. (2019). *Exploring links between national climate strategies and non-state and subnational climate action in nationally determined contributions (NDCs).* Climate Policy, 0(0), 1–15. https://doi.org/10.1080/14693062.2019.1624252

ICAT (Initiative for Climate Action Transparency). (2020). *Non-State and Subnational Action Guide: Integrating the Impact of Non-State and Subnational Mitigation Actions into National Greenhouse Gas Projections, Targets and Planning*. https://climateactiontransparency.org/wp-content/uploads/2020/04/Non-State-and-Subnational-Action-Assessment-Guide.pdf

Kuramochi, T., Roelfsema, M., Hsu, A., Lui, S., Weinfurter, A., Chan, S., Hale, T., Clapper, A., Chang, A., & Höhne, N. (2020). *Beyond national climate action: The impact of region, city, and business commitments on global greenhouse gas emissions.* Climate Policy, 20(3), 275–291. https://doi.org/10.1080/14693062.2020.1740150

Lui, S., Kuramochi, T., Smit, S., Roelfsema, M., Hsu, A., Weinfurter, A., Chan, S., Hale, T., Fekete, H., Lütkehermöller, K., de Villafranca Casas, M. J., Nascimento, L., Sterl, S., & Höhne, N. (2020). *Correcting course: How international cooperative initiatives can build on national action to steer the climate back towards Paris temperature goals*. Climate Policy. https://doi.org/10.1080/14693062.2020.1806021

OECD (Organisation for Economic Co-operation and Development). (2020). *OECD Economic Outlook: Statistics and Projections.*

United Nations Department of Economic and Social Affairs. (2020). *2019 Revision of World Population Prospects.* Population Dynamics.

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