8 Harmonizing non-state and subnational actions and national policies for comparison

This chapter explains how to process collected data to convert the diverse range of non-state and subnational climate mitigation targets into common metrics so that they can be compared with national policies or included in existing climate models. It also discusses options to determine potential emissions reductions from actions (i.e. their estimated impact), depending on the action type. The chapter provides relevant metrics and steps for various sectors to estimate potential impact. Not all sectors may be applicable for every user.

This chapter should be applied in conjunction with Chapter 9 because overlap analysis may exclude some actions, and users will not need to translate these into common metrics. In other cases, users may need to first harmonize metrics to be able to assess overlaps.

Checklist of key recommendations

- Identify comparable metrics suitable for users' assessment objectives, and express non-state and subnational actions in these metrics to facilitate comparison
- Estimate the potential emissions reductions for non-state and subnational actions to facilitate comparison across the economy

8.1 Preparing for data processing and identifying comparable metrics

Non-state and subnational climate actions include a variety of target types and metrics, which may differ from those used in national policies or climate models. There may be differences in the time frame of their targets, the geographical boundary and the scope of emissions targeted, which make comparisons difficult. Users need to translate the collected information on non-state and subnational actions in Chapter 6 into a comparable form for further analysis. This step ensures that users are comparing "like" entities. This means that it is important to express targets in common metrics, harmonize base years and target years, and estimate potential impacts in terms of common indicators (e.g. emissions reductions). The more complete and clear the outputs of previous steps are, the easier it will be to conduct the following analysis.

The data collected on non-state and subnational actions should already be organized by sector from the steps described in Chapter 6. Any data gaps that still exist should be highlighted, because these non-state and subnational actions may require additional processing (e.g. to determine missing base year emissions) or may require reasonable assumptions to be made. Users should transparently record their assumptions and provide justifications.

FIGURE **8.1**

Overview of steps in the chapter

Ensure that data relating to non-state and subnational actions are organized by sector (Section 8.1) → Identify comparable metrics within sectors for the analysis, based on objectives (Section 8.1) → Express actions in comparable metrics, as needed, and record and justify all assumptions (Section 8.2) → Repeat for each sector within the assessment boundary (Section 8.2) → Estimate potential emissions reductions for comparisons across economy (Section 8.2)

Users should also consult Chapter 9 on assessing overlaps. They should translate into common metrics, and estimate the impacts for, only those actions that are not excluded from the analysis after addressing overlaps. Therefore, users may need to go back and forth between this and the next chapter because some actions may first need to be expressed in a common metric to assess overlaps and decide whether to include or exclude them.

It is a *key recommendation* to identify comparable metrics suitable for users' assessment objectives, and express non-state and subnational actions in these metrics to facilitate comparison. Users should translate the actions within a sector into comparable metrics based on their objectives. This should be repeated for each sector in the assessment boundary. For example, users interested in quantifying the impact of non-state and subnational actions without any comparison can choose to express the potential impact in emissions or other appropriate metrics for the sector (e.g. TWh of energy generation, forest area restored, number of zero-emission vehicles sold). Users quantifying the impact of non-state and subnational actions at a (sub)sector level to compare with existing sector targets (e.g. in NDCs) can also represent the impact in common metrics relevant to the sector. The metric does not need to be GHG emissions reductions if the sector- or subsector-level target is not expressed as an emissions reduction target. A non-emissions metric (e.g. renewable energy capacity installed) would be appropriate if the impacts of both non-state and subnational actions and the (sub)sector/national target are expressed in this metric. However, for determining emissions reductions against a base year, users need to use energy or emissions-related metrics.

For assessments involving integration into national emissions pathways or national emissions mitigation targets, users will need to convert non-state and subnational actions into comparable emissions impacts. If using models to facilitate economy-wide impacts, users should also review the metrics used in their selected models in Chapter 7. They can consult modellers to identify the best metrics to represent the bottom-up aggregated impacts, which can then be integrated into the model for comparison at the national level. For example, the Fulfilling America's Pledge report calculated the TWh of renewable energy demand from state and city targets. This was converted into percentage of renewable energy demand for each state to plug into the economy-wide model used to calculate emissions reductions.

Users may also need to harmonize time periods of non-state and subnational actions with the assessment period and the national targets. It is suggested that users adopt conservative assumptions to ensure that they are not overestimating impacts. Any assumptions made to harmonize policies and actions with the assessment period should be transparently recorded, with justification explaining the underlying rationale. For any targets that end before 2030, the Fulfilling America's Pledge report assumed that the subnational actors hold their GHG levels constant between the target year and 2030 (i.e. no further reductions were assumed).

8.2 Harmonizing metrics and estimating potential emissions reductions in various sectors

Any actions that need to be converted into comparable metrics should be processed. This processing may take considerable time because users may need to collect supplemental information such as emission factors, sector-specific data, or economic or demographic data. All additional data points and assumptions should be used consistently within sectors and should be documented for each action that is processed. Some examples of how actions may be processed for each sector are provided below. Appendix D provides a list of data sources for sectors and subsectors that may be consulted if appropriate national data are not available.

Users may also want to estimate the potential impact of each action within a sector in terms of emissions reductions. They can, however, choose to represent the impact in terms of non-emission, sector-appropriate metrics, depending on their objective. When comparing impacts of non-state and subnational actions across sectors in an economy-wide assessment, or comparing with national targets, users should estimate the potential impact in terms of a common indicator such as emissions reductions. The difference between the base year value and the target year value of the metric of interest (e.g. emissions, energy intensity, number of electric vehicles, forest area restored) represents impact. Impact (expressed in terms of emissions reductions) is estimated using the following equation:

Potential impact (emissions reduced) = emissions in target year – emissions in base year

When considering a large number of non-state and subnational actions, emissions in the target year are calculated using the stated target value, if it is available. This value is often not determined from scratch; instead, the non-state or subnational actor's target is taken at its face value. However, users can discount these targets based on their likelihood of achievement, as appropriate, which would help avoid overestimating impacts (discussed in Box 6.3 for the India corporate actions assessment).

The target may not always be expressed in an emissions metric. This section provides guidance on how to harmonize metrics across actions and how to convert a given metric into emissions to calculate the impact in terms of potential emissions reductions.

At this stage, users should not aggregate respective potential emissions reductions because base years and target years are not harmonized across non-state and subnational actions and national policies, and overlaps have not been addressed. Some actions may overlap and/or interact with each other and with national policies in a way that does not result in unique GHG emissions reductions (i.e. they may not be additional actions). Only additional actions should be aggregated to obtain additional reductions across the sector or economy. See Chapter 9 for further guidance on addressing overlapping and reinforcing interactions.

Quantifying potential impact involves estimating GHG reductions from each action relative to individual baseline scenarios that represent what would have happened in the absence of the action. Users should carefully select a baseline scenario and/or estimate the baseline scenario for each individual action or sector so as not to overestimate the resulting emissions impact.

Different approaches can be used to calculate baselines. For example, a constant emissions level can be used (e.g. base year emissions), or assessments can consider emissions growing at a certain rate informed by the historical or projected growth rate of the economy. Baselines for specific actors can also be determined; for example, the International Energy Agency's World Energy Outlook has industry sector projections that can be used as baselines for companies in the same sector. The India corporate actions assessment developed a baseline scenario for each company based on its GHG intensity trend, business projection and applicable emissions reduction mandates from existing policies. The Global Climate Action report developed economy-wide baselines with emissions projections assuming existing policies only ("current policy projections") to estimate the impact of non-state and subnational actions. Sector-specific baselines were used for international cooperative initiatives (e.g. a global reference scenario with emissions projections for the forestry sector).

When comparing the non-state and subnational impacts with a national mitigation target expressed as a reduction below a baseline (e.g. 12% absolute reduction by 2030 relative to a BAU scenario), it is important to consider the possibility that the baselines may not be consistent and to align the baselines for a true comparison. Care should also be taken to reduce the risk of using unsupported baselines that serve to maximize the impact. Stakeholder inputs and expert judgment can be very helpful in this context. Users may consult the *Policy and Action Standard*, the *Mitigation Goals Standard*, and sector-specific guidance on assessing impacts of policies and actions being developed under ICAT for further information on determining baselines for different kind of targets and policies.

It is a *key recommendation* to estimate the potential emissions reductions for non-state and subnational actions to facilitate comparison across the economy.

8.2.1 Agriculture, forestry and other land use

Non-state actors, including private sector entities, are playing an increasingly large role in the AFOLU sector.[52] In 2018, agriculture was the third most frequently covered sector across international cooperative initiatives, after energy efficiency and transport.[53] General challenges for the sector when quantifying impacts include the time delay between the action (e.g. planting a tree) and its impact on emissions removal/sequestration, and lack of data availability for the required time period. Users should consider these challenges when quantifying the sequestration potential and comparing it with the NDC or existing national climate efforts. Further, countries have different definitions for what constitutes a forest. Users should adjust their calculations to reflect the definition and forest types used in their country of focus, because this will impact carbon sequestration rates. See also the ICAT *Forest Methodology* and the ICAT *Agriculture Guidance*.

Table 8.1 provides an overview of some common non-state and subnational targets in this sector, their conversion to comparable metrics, and a few options to calculate sequestration potentials, including necessary data points and assumptions. Box 8.1 describes a hypothetical example of determining the sequestration potential of an international cooperative initiative in the agriculture sector.

[52] Hsu et al. (2016); UNFCCC (2016).

[53] UNEP (2018).

TABLE **8.1**

Agriculture, forestry and other land use sector

Examples of non-state and subnational actions	Metrics for comparison with national policies or for inclusion in existing models/ scenarios	Options for determining sequestration potential
Restore X ha of forests	Total forest area (ha); afforestation/reforestation rate (kha/year) Assumption: • density of restored forest (equal to average)	Identify the CO_2 sequestration potential of 1 ha of forest (how much CO_2 domestic forests sequester annually) and multiply by the area of forest (in ha) to be restored (simplistic approach). Data needs (use FAO resources): • total CO_2 emissions/ha • CO_2 sequestered/ha • forest density (m^2/ha) • carbon stock per type of forest (tC/ha). For a more sophisticated approach, users should follow the IPCC guidelines on forest land.[a]
Stop deforestation (from supply chains)	Put deforestation rate to zero; all other variables remain unaffected.	Stopping deforestation means zero emissions, and no further quantification is needed at this point.
Zero degradation	Put degradation to zero; all other variables remain unaffected.	Zero degradation means zero emissions, and no further quantification is needed at this point.
Reduce CO_2 emissions from deforestation by X%.	Total CO_2e emissions from deforestation ($MtCO_2$e) Assumption: • rate of deforestation from base year	Determine sequestration potential by checking total CO_2e emissions from deforestation domestically. Assumptions: • rate of deforestation from base year
Decrease CO_2e emissions from agriculture by X% compared with base/target year reference	Total CO_2e emissions in base year and projected CO_2e emissions in target year Assumptions: • specific sources of CO_2e reductions (if applicable) • projected growth in agriculture activity	Convert from relative reduction to absolute target by checking total CO_2e emissions from agriculture and projected emissions growth rates. Data points needed (use national emissions projections; if these are not available, use World Bank Data, U.S. EPA global anthropogenic GHGs): • emissions growth rate for agriculture ($GtCO_2$e) • CO_2e emissions from agricultural processes and products
Increase sustainable food production by X%	Total food production (t/person); total sustainable food production (t/person) Assumption: • definition of sustainable food production (e.g. certified food, certified production only, type of certification)	Check emissions caused by agriculture for food production. Then look at the share of sustainable food production and its CO_2e impact. Then translate the relative target into an absolute one, calculate the estimated CO_2e emissions and compare with CO_2e emissions for estimated non-sustainable food production. Assumption: • definition of sustainable food production (e.g. certified food, certified production only, type of certification). Data points needed (use World Bank, United Nations World Populations Prospects if no national data are available): • food production per person (t/person) • demographic development • share of sustainable food production in country (X%) and its CO_2e impact (tCO_2e/person).

Abbreviations: FAO, Food and Agriculture Organization of the United Nations; U.S. EPA, United States Environmental Protection Agency

[a] A tool to calculate emissions removals from reforestation is available at: www.environment.gov.au/climate-change/emissions-reduction-fund/cfi/reforestation-tools; additional methods, with limited geographical coverage, are described at: https://ww2.arb.ca.gov/resources/documents/cci-quantification-benefits-and-reporting-materials.

BOX **8.1**

Determining emissions reduction potential of international cooperative initiatives in the agriculture sector

Consider a hypothetical example of an international cooperative initiative that aims to mobilize $100 million for sustainable forestry, out of which $5 million will be mobilized in the user's country. The user wants to assess the effect of the initiative on restoring forests in the country. Forest area restored is an appropriate metric for comparison with national policies.

The user can convert $5 million mobilized into hectares (ha) of forest area restored. This can be done by using domestic data, if available, on the average amount of investment needed to restore 1 ha of forest. If national data are not readily available, the user can consider international sources that provide such data, while clearly noting that they have done this and acknowledging that these may not be the most accurate data for their context, if applicable. For example, the user could check restoration projects financed by development banks in comparable countries, assuming that efficiency of resources is the same across countries. Alternatively, survey companies and non-profit organizations engaged in restoration may have data.

If the data show that $50 is needed to restore a hectare of forest in the country, $5 million can restore 5,000,000/50 = 100,000 ha of forest.

8.2.2 Energy and industrial processes and product use

Energy supply, industry, buildings and transport are individually discussed below to show how to convert energy-related non-state and subnational targets to comparable metrics. Options to estimate their potential impact in terms of emissions reductions are also described.

Energy supply

The energy supply sector is the largest contributor to global GHG emissions.[54] Together with the transport sector, it is one of the sectors that is most frequently targeted by non-state and subnational actions.[55] Actions may include energy demand or consumption-specific targets, or targets in other metrics that can be translated into energy supply targets – that is, energy supply needed for the targeted demand or consumption to be achieved (Table 8.2). Box 8.2 describes an example of determining the emissions reduction potential of a non-state action in the energy supply sector. Appendix D provides an overview of international data sources that can be consulted if national data are not available. See also the ICAT *Renewable Energy Methodology*.

[54] Bruckner et al (2014).

[55] Yale University (2015).

TABLE 8.2

Energy supply sector

Examples of non-state and subnational actions	Metrics for comparison with national policies or for inclusion in existing models/ scenarios	Options for determining potential emissions reductions
Increase the share of electricity generated from RE to X (% or absolute amount in MW) Procure X (amount or %) of total energy supply from RE	RE electricity generation capacity installed (MW); share of RE electricity in national grid Assumptions: • Potential RE electricity generation from additional capacities installed is equal to additional RE electricity consumed (no idle capacities). Data points needed to convert % to MW or MW to %: • full load hours, either average over all technologies or technology-specific, if available • total electricity generation.	If capacity (MW) target, convert to generation (TWh) using full load hours. If % target, convert to generation (TWh) using total electricity generation in target year. To calculate potential emissions reductions, users can derive different estimates of emissions impacts depending on whether RE electricity displaces natural gas first, then oil and then coal (low estimation[a]) or coal first, then oil and then gas (high estimation). Assumptions: • RE electricity installed is equal to RE electricity generated. • National fuel mix remains unvaried (once the change in RE has been accounted for). Data points needed (use IEA World Energy Outlook/Statistics if no national data are available): • projected electricity generation and fuel mix • emission factors for fossil fuels.
Drive down the cost of RE and/or its generation by X amount ($/MWh)	Cost of one unit of RE generated ($/MWh) Assumption: • linear cost trend (costs do not change if more RE capacity is installed).	Suggest using an existing model, if available, due to several complex assumptions needed to calculate realistic emissions reduction potential.
Reduce electricity consumption by X% compared with base/target year reference	Total electricity demand (MWh) Assumption: • Consumption is equal to supply.	Check total projected electricity consumption and convert relative target to an absolute one. To calculate the emissions reduction potential, follow the process detailed in the earlier examples. Assumptions: • Consumption is equal to supply. • National fuel mix remains unvaried. Data points needed (use IEA resources if no national data are available): • projected demand for electricity (in MW) • total CO_2 emissions from generated electricity ($MtCO_2$) • national fuel mix • emission factor for fossil fuels.

Abbreviations: IEA, International Energy Agency; RE, renewable energy

[a] This is due to their different carbon contents.

BOX **8.2**

Calculating potential emissions reductions from an international cooperative initiative in the energy supply sector

An international cooperative initiative aims to engage 100 companies to procure 100% of their energy demand from renewable energy (RE). Four of these companies will be mobilized in the user's country, and both the company and the utility from which the company sources its power are physically located in the country. The user wants to understand whether the additional demand from RE targets can be met by existing RE capacity, and the impact of the initiative in terms of potential emissions reductions. The user should first collect data on current RE installed capacity and RE procurement levels of the four companies. The next step is to convert the targets of the four companies into additional RE to be procured. This is done by subtracting what they already procure through RE from the 100% target. This value is compared with current RE capacity in the country to obtain the additional demand from RE procurement targets of the four companies. If the additional procurement needed to meet the target is less than the current RE capacity, the additional demand can be met by the existing capacity in the country, provided everything else remains constant.

To calculate the potential impact in terms of emissions reductions, the additional RE capacity needed should be converted to emissions displaced. The user can derive different estimates of emissions impacts depending on whether RE displaces natural gas first, then oil and then coal (low impact), or coal first, then oil and then gas (high impact), using appropriate emission factors for different fuels (e.g. from the International Energy Agency's – IEA's – World Energy Outlook data). Location-specific information on the marginal grid mix can be collected and applied in this assessment for improved accuracy.

Industry

The industry sector is very diverse and emissions-intensive, and non-state and subnational actions targeting the sector are growing. The industry sector includes energy-related emissions as well as non-energy emissions from industrial processes and product use.[56]

Table 8.3 provides information on how to convert common non-state and subnational mitigation targets into metrics suitable for comparison with national policies or for inclusion in existing climate mitigation models. It also outlines options for calculating potential impact in terms of emissions reductions from such actions. Appendix D provides an overview of international data sources that can be consulted if national data are not available.

Buildings

Non-state and subnational actions are increasingly targeting the building sector, which accounts for 32% of global energy consumption, half of global electricity consumption and around 18% of GHG emissions, making it a key sector for GHG mitigation.[57] Table 8.4 provides information on how to convert common non-state and subnational mitigation targets into suitable metrics for comparison with national policies or for inclusion in existing climate mitigation models. It also outlines options for calculating emissions reduction potentials. Appendix D provides an overview of international data sources that can be consulted if national data are not available. See also the ICAT *Buildings Efficiency Guide*.

[56] IPCC (2014).

[57] IEA (2016a).

TABLE 8.3

Industry sector

Examples of non-state and subnational actions	Metrics for comparison with national policies or for inclusion in existing models/ scenarios	Options for determining potential emissions reductions
Decrease CO_2e intensity per tonne of steel/ cement produced	Absolute values from the reduction of CO_2e intensity per tonne of steel/cement produced	Look at projected CO_2e intensity per tonne of steel/cement produced and target values (% or fixed reduction). On this basis and using emission factors, the emissions reduction potential can be calculated per tonne (or unit of industry product) first and, by multiplying by projected production levels, for the entire sector. Data points needed: • projected growth for steel/cement production (in tonnes or per capita income/population) • projected steel or cement intensity (CO_2e per tonne per capita, etc.) • emission factors • if applicable, population and economic trends.
Adopt best-practice industry standards	Specific steel/cement intensity per tonne (or per capita income/ population) Assumption: • All steel/cement production could reasonably be compliant with best-practice industry standards. Data points needed: • best-practice industry standard specific information • if applicable, population trends.	Look at what best-practice standards mean for a specific industry sector (translate into CO_2e emissions per tonne or other unit of product) and compare with projected CO_2e emissions per tonne produced following non-best-practice industry standards. To determine emissions reduction potentials, multiply the amount of CO_2e saved per unit of product by total amount of projected production. Data points needed: • best-practice industry standard specific information • projected growth for steel/cement production (in tonnes or per capita income/population) • projected steel or cement intensity (CO_2e per tonne per capita, etc.) • emission factors • if applicable, population trends.
Decrease total CO_2e emissions from steel/cement production by X (amount or %)	Total reduction in CO_2e emissions per tonne of steel/ cement produced	Look at projected CO_2e emissions per tonne of steel/cement produced. Then multiply by projected total amount of production and subtract the targeted decrease (% or fixed reduction). Data points needed: • steel or cement CO_2e emissions • projected growth for steel/cement production (in tonnes or per capita income/population).

TABLE **8.4**

Building sector

Examples of non-state and subnational actions	Metrics for comparison with national policies or for inclusion in existing models/ scenarios	Options for determining potential emissions reductions
Improve energy performance of buildings by X%	Energy performance of buildings (kWh/m^2) Assumptions: • linear trend in the energy consumption per m^2 • linear trend in the share between commercial and residential buildings. Data points needed: • total (projected) national floor area • heating and cooling requirements.	Look at projected average energy consumption of residential and commercial buildings, and divide by total floor area to determine estimated future energy performance of buildings. Where available, consult international sources such as the IEA's World Energy Outlook. In addition, data availability for commercial and public buildings is usually better, and so the user could start with those. To determine the emissions reduction potential, look at the country's projected energy fuel mix and from that information derive the potential GHG impact. Assumptions: • linear trend in the energy consumption per m^2 • national fuel mix remains unvaried • linear trend in the share between commercial and residential buildings. Data points needed (use IEA's Energy Technology Perspective or other IEA resources if no national data are available): • projected growth in floor area • total (projected) energy consumption from commercial and residential buildings (kWh/m^2) • national fuel mix • emission factors for oil, gas, coal.
Increase the renovation rate of buildings by X%	Renovation rate of buildings (%) Data point needed: • current renovation rate (%).	Look at the average buildings intensity of new built versus retrofitted buildings. Determine the CO_2 emission savings for a renovated building compared with a non-renovated one, based on the difference in the buildings intensity and calculations of how the energy was produced (taking into account the national fuel mix and emission factors). Then determine the additional number of projected renovated buildings by converting the relative renovation target to an absolute number. Assumptions: • Additional renovations will proportionately reduce CO_2 emissions. • Linear trend in the buildings intensity. • Number of buildings remains unchanged. • National fuel mix remains unchanged. Data points needed (use IEA's Energy Technology Perspective or other IEA resources if no national data are available): • total (projected) buildings intensity (kWh/m^2) • national fuel mix • emission factors.

Transport

The transport sector is a popular target for non-state and subnational actors. Apart from the energy supply sector, it is the sector most often targeted by non-state and subnational actions.[58] Transport emissions associated with bunkers – that is, emissions from fuels used for international aviation and maritime transport – are not accounted for within the boundaries of national GHG inventories and would therefore be outside the scope of this guide (which focuses on national emissions).[59] Users could choose to assess the impact of non-state and subnational actions relating to bunkers as a distinct exercise. See also the ICAT *Transport Pricing Methodology*.

Table 8.5 provides information on converting common non-state and subnational mitigation targets into metrics suitable for comparison with national policies or for inclusion in existing climate mitigation models. It also outlines options for calculating potential emissions reductions of these actions. Appendix D provides an overview of international data sources that can be consulted if national data are not available.

TABLE **8.5**

Transport sector

Examples of non-state and subnational climate mitigation targets	Suitable metrics for comparison with national policies or inclusion in existing climate mitigation models/scenarios	Options for determining potential emissions reductions
Reduce average car fuel consumption by X%	Average fuel consumption by cars (in km/L)	Look at the projected fuel consumption of an average car. Calculate the relative % reduction in fuel consumption and the corresponding fuel consumption avoided. Then determine the corresponding CO_2 emissions reduction potential, taking into account projected fuel mix and emission factors, and multiply by the projected number of cars on the road and the average distance driven. Assumption: • Average km travelled by car remain unchanged. Data points needed (use internationally available data if no national data are available): • projected fuel consumption of average car (km/L) • projected number of cars on road, considering macroeconomic variables such as economic growth • national fuel mix • emission factors.

[58] Yale University (2015).

[59] IEA (2016b).

TABLE **8.5, continued**

Transport sector

Examples of non-state and subnational climate mitigation targets	Suitable metrics for comparison with national policies or inclusion in existing climate mitigation models/scenarios	Options for determining potential emissions reductions
Increase the number of EVs domestically to X%	Number of EVs (in thousands) Data points needed: • current number of EVs • average final energy consumption of EVs (kJ/PKM).	Look at the projected number of domestic vehicles on the road and their projected average final energy consumption. Then look at the average final energy consumption of EVs and determine the difference from traditional cars. Then convert the relative EV target to an absolute one, multiply the difference in final energy consumption by the number of EVs and convert to CO_2e emissions, by using emission factors, to determine potential savings from fossil fuels. Then calculate the additional electricity demand from the increase in EVs, and multiply this by the grid emission factor, and hold this against the savings from fossil fuels to determine the overall emissions reduction potential. Assumptions: • Distances travelled by traditional cars and EVs are equal. • Distance travelled remains unchanged or follows linear growth trend. Data points needed (use internationally available data if no national data are available): • projected number of vehicles sold (including EVs) • average projected final energy consumption of traditional cars and EVs • national fuel mix • emission factors.
Increase rail share of freight land transport to X%	Share of rail freight land transport Data points needed: • current rail share of freight land transport • total freight land transport traffic volume.	Look at the current share of freight land transport and the average freight rail distance ridden (as well as average CO_2 emissions per unit distance). Then look at road freight transport, average distance and average CO_2 emissions per unit distance. Finally, look at projections about freight transport, taking into account macroeconomic variables over time (e.g. economic growth, fuel prices, population). On this basis, calculate and compare emissions to determine emissions savings potential. Data points needed (use internationally available data if no national data are available): • average final energy consumption from train operations (kJ/tkm). • total freight land transport traffic volume • fuel mix • emission factors.

TABLE **8.5**, continued

Transport sector

Examples of non-state and subnational climate mitigation targets	Suitable metrics for comparison with national policies or inclusion in existing climate mitigation models/scenarios	Options for determining potential emissions reductions
Increase rail share of passenger travel to X%	Share of rail passenger travel Data points needed: • current share of rail passenger travel • total rail traffic volume.	Look at the existing rail share of passenger travel and train distance travelled (as well as average CO_2 emissions per unit distance). Then look at road passenger travel, average distance and average CO_2 emissions per unit distance. Finally, look at projections about passenger travel, taking into account macroeconomic variables. On this basis, calculate and compare emissions to determine emissions savings potential. Data points needed (use internationally available data if no national data are available): • average final energy consumption from train and road operations (kJ/tkm and PKM) • total rail traffic volume • fuel mix • emission factors.
Increase public transport by X (amount or %)	Modal split (as share of bus/ train, etc. in public transport)	Look at the existing share of public transport, relative to total passenger transport and distance travelled (as well as average CO_2 emissions per unit distance). Then look at other passenger transport, average distance and average CO_2 emissions per unit distance. Finally, look at projections about public transport travel. On this basis, calculate and compare emissions to determine emissions savings potential. Data points needed (use internationally available data if no national data are available): • average final energy consumption from public transport and other forms of transport • current share of public transport • fuel mix • emission factors. For more sophisticated calculations, users should deal with different technologies separately, because of different efficiencies of different public transport modes.

Abbreviations: EV, electric vehicle; PKM, passenger kilometres; tkm, train kilometres

8.2.3 Waste

The waste sector is of particular importance to cities because waste-related issues fall under their jurisdiction. Non-state actors, on the other hand, can be an important source of waste. Few non-state and subnational actors and initiatives currently target the waste sector.

Table 8.6 provides information on converting common non-state and subnational mitigation targets into metrics suitable for comparison with national policies or for inclusion in existing climate mitigation models. It also outlines options for calculating potential emissions reductions of these actions. Appendix D provides an overview of international data sources that can be consulted if national data are not available.

TABLE **8.6**

Waste sector

Examples of non-state and subnational actions	Metrics for comparison with national policies or for inclusion in existing models/ scenarios	Options for determining potential emissions reductions
Recover methane emissions from waste	Eliminate methane emissions from waste sector in models. Assumption: • All methane emissions from waste can technically be recovered.	If all methane emissions from waste can be recovered, methane emissions from waste would be equal to zero. The emissions reduction potential can be calculated by looking at the projected amount of waste and the projected waste intensity (CO_2e/kt). Multiplying the two gives the potential emissions reduction potential. Users also need to take into account previous years' wastes (using a first order decay equation).[a] Assumptions: • The growth trend in waste intensity is linear (composition of waste remains unchanged). • The decrease in X amount of waste will proportionately reduce CO_2e emissions. Data point needed (use United Nations or IPCC resources if no national data are available): • waste intensity.
Decrease amount of waste by X tonne (decrease GHG emissions from waste by X amount or X%)	Remaining amount of waste (in kt)	First, calculate the CO_2e emissions of 1 kt of waste, by multiplying it by the waste intensity. To determine the emissions savings potential from the decrease in waste, multiply the absolute reduction in waste (in kt) by the projected CO_2e emissions of 1 kt of waste. Assumptions: • The growth trend in waste intensity is linear (composition of waste remains unchanged). • The decrease in X amount of waste will proportionately reduce CO_2e emissions. • Emissions from decay of waste on landfills from previous years are ignored. • There is no change in recycling or reuse. Data point needed (use United Nations or IPCC resources if no national data are available): • waste intensity (per capita per day).

[a] For more information on how to calculate emissions reduction potential from waste, see the IPCC guidelines on "Waste" (www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html).

8.2.4 Template for potential emissions reductions across actions/sectors

Table 8.7 illustrates how to convert hypothetical non-state actions in different sectors to comparable metrics and estimate impacts in terms of potential emissions reductions. This template can be replicated for additional actors and sectors. Here, users have information regarding the base year emissions and the target, which is used to estimate target year emissions and the emissions reduction impact against the base year emissions. It should be noted that the results are sensitive to assumptions that users make, and it is therefore critical that the assumptions are clearly recorded and justified. For example, for company A, if the user assumed a 20% increase in total electricity generation by 2030, the target year GHG emissions would be 8,100,000 tCO_2e. This means that the emissions reduction impact compared with the base year would be smaller. Similarly, if the user assumed a 10% reduction in emissions intensity for electricity generated from fossil fuels by 2030, the target year emissions would be lower than in the table, and the resulting emissions reduction impact would be higher.

TABLE **8.7**

Determining potential emissions reductions in an assessment

	Hypothetical example	Hypothetical example
Non-state actor	Company A	Company B
(Sub)sector(s)	Energy supply	Industry
Target (including reference levels, target year and assumptions, if available)	25% renewable electricity (excluding large hydro) in 2030 (no renewables in 2005 base year)	Reduce scope 2 emissions by 100% from 2015 to 2021
Base year emissions in user country's boundary (tCO_2e)	9,000,000 tCO_2e (in 2005)	2,000,000 tCO_2e in 2015
Estimated emissions in target year in user country's boundary (tCO_2e)	In 2005, 100% of electricity is generated by fossil fuels, accounting for 9,000,000 tCO_2e emissions. In 2030, 75% of electricity is generated by fossil fuels. Emissions in 2030 = 0.75 × 9,000,000 = 6,750,000 tCO_2e	There will be no scope 2 emissions in target year.
Estimated emissions reductions in target year (tCO_2e)	Emissions in base year – emissions in target year = 2,250,000 tCO_2e (in 2030)	Emissions in base year – emissions in target year = 2,000,000 tCO_2e (in 2030)
Notes (any assumptions and underlying rationale)	No changes assumed in total electricity generation levels and the fuel mix or emission factor for electricity generation from fossil fuel non-renewables between 2005 and 2030	

9 Assessing overlaps and estimating potential impacts

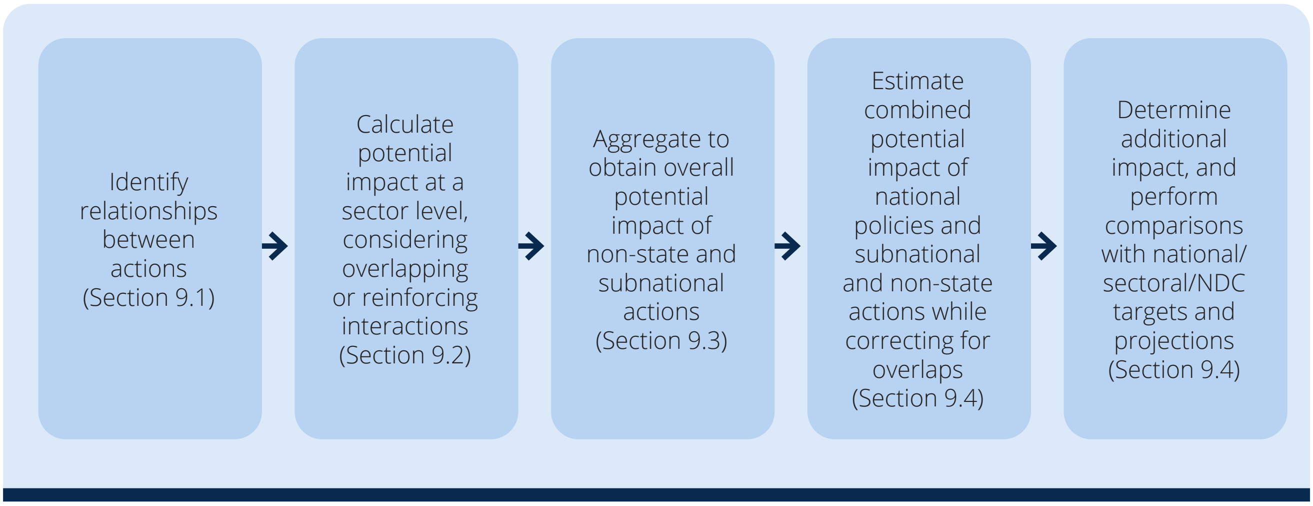
This chapter provides steps for adding non-state, subnational and national climate mitigation actions, while avoiding double counting, and comparing their combined potential impact with national/sectoral emissions pathways. It also discusses how to distribute the potential impact of international cooperative initiatives and actions of multinational companies among countries. Users may find it more efficient to apply Sections 9.1 and 9.2 together with Section 8.2, which includes guidance on harmonizing metrics and estimating potential impacts in terms of emissions reductions.

Checklist of key recommendations

- Understand interactions between multiple non-state and subnational actions and international cooperative initiatives within a sector and across sectors, and with national policies if determining additional impacts
- Calculate potential impact at a sector level, considering overlapping and reinforcing interactions across multiple actions
- Document all overlaps and record assumptions, along with the underlying rationale to include or exclude specific actions in the assessment
- Aggregate the potential impact of non-state and subnational actions within the assessment boundary
- Determine the potential additional impact of non-state and subnational actions after correcting for overlapping and reinforcing interactions with national policies. Also incorporate the influence of socioeconomic factors if using a model to determine additional impact.

FIGURE **9.1**

Overview of steps in the chapter



9.1 Identify relationships between actions

Users should identify the relationships and interactions between policies and actions to avoid double counting of impacts. These may be between national policies and non-state and subnational actions, or between multiple non-state and subnational actions in the same sector or across sectors. Policies and actions may be independent, fully or partially overlapping, reinforcing, or overlapping and reinforcing. Users should also consult with relevant stakeholders to enhance their understanding of how different actions and policies interact. This exercise may have started in Chapter 5 with organizing information on non-state and subnational actions.

Table 9.1 specifies different types of relationships that are possible between national policies and actions, and non-state and subnational policies and actions, and how to address these. In the table, A and B stand for the impact of different non-state, subnational and national policies and actions; C stands for their overlapping impact; and D stands for the additional or reinforcing impact of implementing A and B together. Generally speaking, the more diverse the targets and the sectors covered by policies and actions, the smaller the chance of overlap between them.

It is a *key recommendation* to understand interactions between multiple non-state and subnational actions and international cooperative initiatives within a sector and across sectors, and with national policies if determining additional impacts. This is needed to determine potential overlaps and avoid double counting.

9.2 Calculate potential impact, considering interactions between actions

This section provides guidance on calculating the potential impact of actions, taking into account their interactions with each other. Users can consult Appendix B of the *Policy and Action Standard* for further guidance on addressing interactions between actions.

Users are encouraged to be conservative in their approach to estimating potential impacts of overlapping and reinforcing actions, so that they do not overestimate the impacts. For example, if the overlap cannot be determined with confidence, users are advised to assume full overlap, with the total potential impact being less than the sum of the impacts of the individual actions. Users should also state the underlying rationale used to determine

TABLE **9.1**

Types of relationships between national policies and non-state and subnational actions

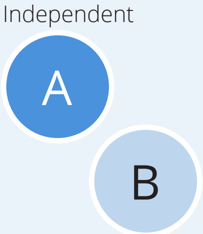
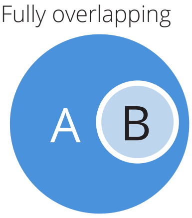
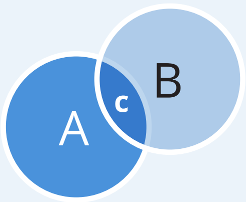
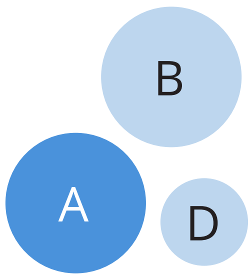
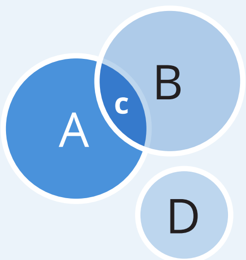
Type	Description	How to address this relationship
Independent 	There is no interaction between policies and actions: national, non-state and subnational. The combined effect of implementing these policies and actions together is equal to the sum of the individual effects of implementing them separately (A + B). That is, national policies and actions do not interact with non-state and subnational actions that are being assessed. In practice, users will encounter this situation in a very limited number of cases.	Users will be able to aggregate the impact of actions without quantification of overlaps once data are harmonized (e.g. different targets are harmonized for a specific target year/base year, as applicable).
Fully overlapping 	Some actions fully encompass other actions. Full overlap is an indication that the broader action is likely to be achieved.	Users should not include the encompassed action in the final impact assessment.

TABLE **9.1,** continued

Types of relationships between national policies and non-state and subnational actions

Type	Description	How to address this relationship
Overlapping 	Policies and actions interact, and the combined effect of implementing them together is less than the sum of the individual effects of implementing them separately (A + B – C). This may include: • policies or actions with the same or complementary goals (e.g. national energy efficiency standards for buildings and non-state action aimed at reducing GHG emissions from buildings; solar and wind initiatives in a country aiming to increase the share of renewable energy) • actions that are counted more than once because the same actor considers one target towards multiple initiatives, or the actor lists a target as an individual action as well as part of a cooperative initiative. Use of the same metric for different targets may indicate potential overlap.	Users should carefully check whether the potential combined impact is realistic or possible. Where there is doubt, users should consult sector experts to determine overlap. Overlap should be determined and subtracted from the overall impact. If quantification of overlap is not possible, users should take a conservative approach and assume complete overlap. For example, actions of cities located within regions with mitigation actions should be excluded to avoid double counting, unless these city-level actions are significantly more ambitious than the actions of the regions in which the cities are located.
Reinforcing 	Policies and actions interact, and the combined effect of implementing them together is greater than the sum of the individual effects of implementing them separately (A + B + D). An example could be an initiative promoting electric vehicles (EVs) and a policy to increase the share of renewable energy. Considered on its own, EVs may have a marginal impact on emissions unless the grid becomes green. The renewable energy policy can make the grid cleaner, thus potentially increasing the emissions impact of rising numbers of EVs.	The reinforcing effect should be calculated and added to the overall impact.
Overlapping and reinforcing 	Policies and actions interact, and have both overlapping and reinforcing interactions. The combined effect of implementing them together may be greater or less than the sum of the individual effects of implementing them separately. An example could be a company target to increase the procurement of renewable energy and a national policy to increase the share of renewable energy generation in the country. Both the company action and the national policy pull in the same direction, while their combined effect could either be greater than the sum of the individual effects or less.	Overlap should be calculated and subtracted from the overall impact; reinforcing effects should be calculated and added.

Source: Adapted from WRI (2014b), based on Boonekamp (2006).

the nature of interactions and potential impact, and document all assumptions for transparency and increased confidence in the assessment.

It is a *key recommendation* to calculate potential impact at a sector level, considering overlapping and reinforcing interactions across multiple actions. It is also a *key recommendation* to document all overlaps and record assumptions, along with the underlying rationale to include or exclude specific actions in the assessment. For example, some city-level actions may help larger jurisdictions achieve the intended impact of their actions and are therefore subsumed within the larger jurisdiction's overall impact. Actions by private corporations may be responding to a subnational or national government mandate and should be encompassed within that mandate.

Users should quantify the potential impact of actions within a sector and repeat this for each sector included in the assessment boundary.

9.2.1 Calculating potential overlaps

To avoid double counting of impacts, overlap can be estimated by comparing the calculated impact of each action in a sector with the impact of other actions that have potentially overlapping interactions.

Users should quantify overlaps between actions within a sector and across sectors, for each sector included in the assessment boundary. Within each sector, users should calculate overlaps among actions by each actor group included in the analysis. If subnational actions are included in the analysis, users may want to begin with these, followed by non-state actions. If subnational actions are not included, users may start directly by calculating overlaps of non-state actions. Organizing actions into tiers to highlight actions that may be subsumed under others and highlight geographical overlaps is a good starting point to further determine whether the impacts of actions are additional and unique (also see Section 5.2).

There is no single approach to assessing overlaps that fits all situations, and quantifying overlaps often requires several assumptions. Users may also find it useful to consult with sector-specific experts to determine reasonable, conservative assumptions.

Subnational actions
As a first step in calculating overlaps within a sector, users may want to calculate the overlaps between subnational actions, such as in regions and cities with GHG targets. There may be full overlap, partial overlap or no overlap:

- **Full overlap.** Users may assume that subnational action, regardless of the level of ambition, yields no additional effect if the scope of the action is within the scope of a larger jurisdiction with its own action. Full overlap means that the action of the smaller jurisdiction would not be included in the final aggregation.

- **Partial overlap.** If cities within the assessment boundary have highly ambitious targets compared with larger jurisdictions, users may assume some additional impact from cities' actions, resulting in partial overlap. Users should compare the actions of cities and larger jurisdictions; if the city target is more ambitious than the target of the larger jurisdiction, any additional impact – above and beyond the action of the larger jurisdiction – can be included in the final aggregation.

- **No overlap.** For cities and other subnational entities where no larger governing jurisdiction has a similar action of its own, the entirety of the calculated potential impact of the subnational actions may be included in the final aggregation.

To avoid double counting between scope 1 and scope 2 emissions, users may assume that all electricity consumed by cities (scope 2) is generated in the regions in which the cities are located and may apply additional assumptions to calculate overlaps.

A hypothetical example (Box 9.1) and an example from the Fulfilling America's Pledge report (Box 9.2) further illustrate how to address overlaps involving subnational actions.

Non-state actions
As a next step, users should determine the geographic overlaps between the actions of non-state actors (including companies consuming electricity and electricity-generating companies) and the actions of subnational actors. If subnational actions are excluded from the analysis, this step may not be necessary.

It is important to note that this step will require significant data on geographical location for non-state actions, which may not be easily available. If users can determine the geographic overlaps between business actors and subnational actors (not only for headquarter locations, but at the facility

BOX **9.1**

Hypothetical example of overlap in subnational actions

Province A has committed to a 30% target share of renewable energy in its total final energy consumption by 2020, and can use electricity imported from other provinces to meet its commitment. Province B has a renewable electricity generation goal of 30% and sells most of its renewables to province A. Although provinces A and B both meet their commitments in real and measurable ways, at the national level, the amount of renewable electricity generation may be smaller than simply adding individual renewable energy targets, and the risk of double counting is high. To identify this kind of double counting, additional data collection and quantitative analysis are recommended. In this case, users will need detailed data on electricity sales between the provinces. Many regional governments document their yearly electricity imports and exports. In the absence of data, it is recommended that users provide a realistic conservative range of renewable energy generation.

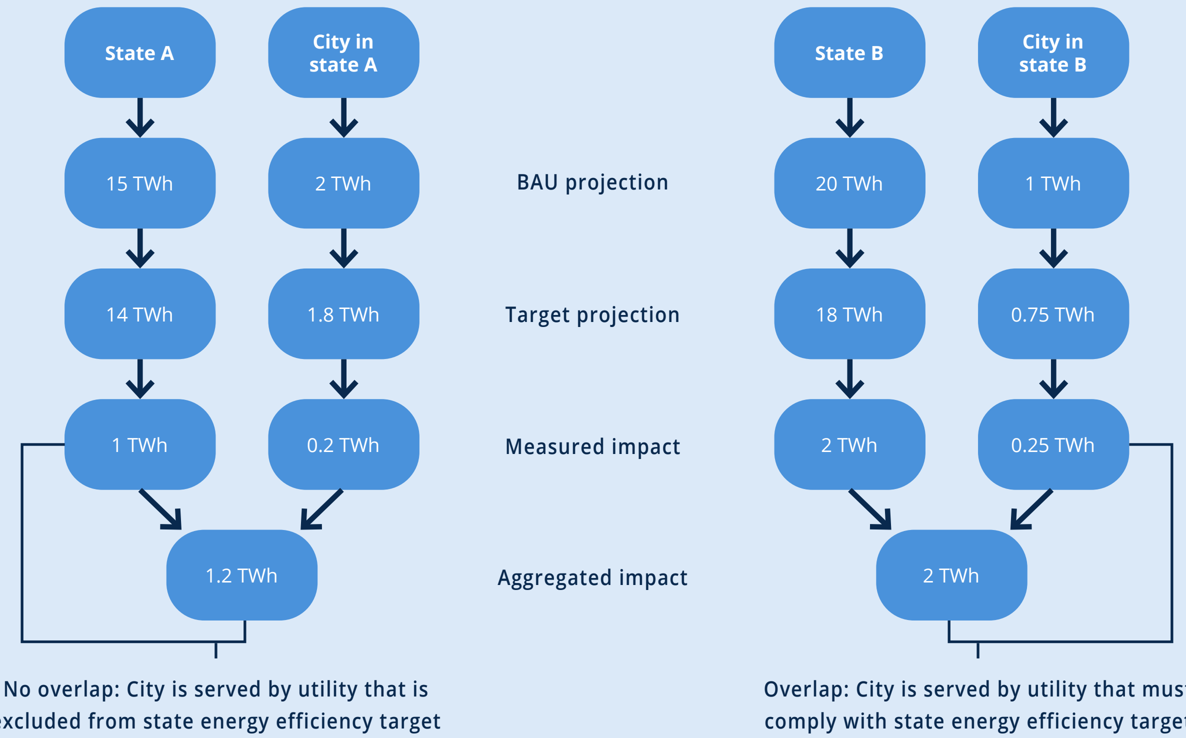
BOX **9.2**

Example of calculating overlap in subnational actions from Fulfilling America's Pledge report

The Fulfilling America's Pledge report addressed potential overlap in actions at state level in the following manner. It should be noted that this example represents a simplified version of the approach and does not apply to all sectors included in the assessment.

Assume that two states (state A and state B) have energy efficiency targets that would result in 1 TWh and 2 TWh of energy savings, respectively. In addition, at least one city in each state has its own energy savings goal.

For the city in state A, the city's utility is excluded from compliance with the state's policy, and thus no overlap is assumed. The resulting aggregate figure is obtained by adding the city- and state-level impacts. In state B, the city is located within a utility region that must comply with the state goal, and thus overlap is assumed to occur. In this case, the city's impact is seen as contributing to the state's, and the aggregate is equal to the state's impact.



Source: America's Pledge (2018b).

level, to determine where GHG emissions occur), they can calculate overlaps following a similar set of assumptions as used for subnational actions:

- **Full overlap.** In this case, users may determine that non-state actions are the result of public actions, such as public policies that mandate climate action or guide businesses towards climate action. If the action of the governing jurisdiction is included in the assessment, full overlap can be assumed, and the impact of the non-state actions should be excluded from the final aggregation. In some cases, the private sector action may not be the result of public policy, but may still contribute to the achievement of the governing jurisdictions' action, and should also be excluded from the final aggregation.

- **Partial overlap.** The relationship between non-state and subnational actions may be such that a business or corporation may dramatically exceed the ambition of the governing jurisdiction. In this case, users may assume there is some additional impact and may include this in the final aggregation.

- **No overlap.** If a non-state action exists within a jurisdiction where there are no public actions by a governing body, the full effect of the actions' impact may be included in the final aggregation.

Without specific facility-level data, it may be impossible to calculate overlaps with subnational actions because users will not be able to determine which subnational GHG emission sources the actions may overlap with. In some sectors, geographical data may be available, but, in many cases, it may not be detailed enough to calculate overlaps with smaller subnational actors such as cities. In this case, users will need to make a best-guess estimate of potential overlaps, or otherwise exclude such non-state action to avoid inaccurate results. This can be decided on a case-by-case basis, depending also on the objectives and scope of the assessment.

Separately, overlaps between electricity-generating companies with commitments and all other non-state actors with commitments may be quantified. This overlap is calculated to avoid double counting of emissions from electricity generation by electricity utilities (scope 1), and the use of electricity by other sectors (scope 2). Users could assume that the overlap rate for actions of electricity-generating companies and non-state action on the demand side (e.g. efficiency improvements in companies) is equal to the share of electricity purchased by the non-state actors from the electricity-generation companies with a commitment. If a company purchased all its electricity from only one utility, there would be 100% overlap between the company and this utility.

Cooperative initiatives

Often, cooperative initiatives include individual non-state and subnational actions that are already included in the assessment boundary. Individual actions tend to be more specific than the target of the cooperative initiative. Users should calculate overlaps associated with cooperative initiatives included in the assessment boundary. The overlap may be between multiple cooperative initiatives or between cooperative initiatives and non-state and subnational actions:

- **Full overlap.** If the overlap is complete – for example, when the cooperative initiative includes non-state and subnational actions that are all also individually considered within the assessment boundary – the cooperative initiative should not be considered in the assessment, to avoid double counting. For example, Credit Agricole, a French financial institution, had a target to supply 100% of total electricity consumption from renewables by 2016 (up from 46% in 2015). The institution is also a part of the RE100 initiative, which aims to procure 100% electricity from renewable sources. This action should be counted only once in the assessment. It may still be valuable to review data sources for international cooperative initiatives to help identify specific actions within the assessment boundary.

  When the membership of a cooperative initiative includes individual non-state or subnational actors in the same sector that are already part of the assessment, users can assume full overlap and exclude the cooperative initiative, to be conservative. If the impact from individual non-state and subnational actions in the same sector is incorporated into the assessment, the impact from the cooperative initiative should not be added.

  In another situation, the activity described in the cooperative action may be part of a broader non-state or subnational action (e.g. GHG emissions reduction target) and should therefore also be excluded. For example, a cooperative action aims to increase the share of bicycle transportation in cities. If the participating cities have broader emissions reduction actions or specific transport sector actions, the impact from the cooperative initiative may help the cities achieve their broader actions but may not necessarily be additional.

Users can also assume full overlap when actors with targets participate in more than one initiative in the same sector.

- **Partial overlap.** Where participating actors (e.g. cities) do not have broader actions encompassing the activity that is the focus of the cooperative initiative, the expected emissions reduction impact from the cooperative initiative can be included in the aggregation.

  Further, when different cooperative initiatives in the same sector have targets that overlap directly (as they are expressed in the same metric), aim to achieve the same goal or could potentially compete with each other, users should examine potential overlap between them.

  Another situation where users may encounter partial overlap is between subnational initiatives and all other types of initiatives (in other sectors). Various cities and regions have set GHG emissions reduction targets, usually expressed as a percentage reduction to be achieved by a target year and relative to a certain base year. But there is often no clarity on how the targets may be achieved and through actions in which sector(s). Cooperative actions in relevant sectors, if implemented, could simultaneously contribute to the achievement of these subnational targets.

- **No overlap.** When the activity described in the cooperative initiative is not part of any non-state or subnational action, the expected emission reduction impact from the initiative can be included in the aggregation.

Box 9.3 provides some examples of addressing overlaps between cooperative initiatives.

Distributing impacts of international cooperative initiatives

When the list of selected actions includes international cooperative initiatives, users should distribute the potential emissions reductions of these initiatives across individual countries and only consider the share relevant to their country. Figure 9.2 outlines the decision flow process for determining when this needs to be done:

- Where the cooperative initiative is already fully covered by individual non-state and subnational actions that comprise the cooperative initiative, it will be excluded from the assessment, because actions should be counted only once in the assessment.

- Where there is no overlap, users should evaluate the potential impact from the initiative for their specific country.

- Where there is partial overlap, users can evaluate the potential impact of the initiative’s target for a specific country after disregarding the portion of the initiative covering individual non-state and subnational actions within the assessment boundary that overlap with the initiative. This is done because individual actions often carry more detailed information and it is preferable to include this, where feasible.

If an international cooperative initiative does not contain specific information clarifying how impacts are distributed to individual countries, users may need to make several assumptions to distribute the impact. Since these assumptions will influence the accuracy of the assessment, users should record all assumptions and the underlying rationale. Assumptions may vary, depending on whether the international cooperative initiative focuses on non-state or subnational action.

For international cooperative initiatives that bring together *non-state* actors (such as the Science Based Targets initiative – SBTi), users will need information about the number of installations or facilities, asset value, volume of production or value added, share of emissions from the (sub)sector compared with national emissions, and so on. If this information is not available, users can make rational assumptions about these quantities.

BOX **9.3**

Addressing overlaps between cooperative initiatives from the Global Climate Action report

Three main types of overlaps between cooperative initiatives are discussed below.

Same actors with targets under more than one initiative. This often occurs when cities set an emissions reduction target (e.g. under the C40 initiative and/or the Global Covenant of Mayors), while their corresponding regions simultaneously set a reduction target (e.g. under the Under2 MOU initiative – the Memorandum of Understanding on Subnational Global Climate Leadership). Another instance could be when companies subscribe to more than one business initiative.

The Global Climate Action report addressed the potential double counting in such cases by checking for instances of memberships in multiple initiatives for each country (or at the global level for business initiatives) and selecting the most ambitious commitment. For example, if a city is a part of both the C40 and Under2 MOU initiatives, and its target is substantially more ambitious in the Under2 MOU initiative, only the latter is counted.

Initiatives targeting the same emissions. The renewable energy initiatives in the United States and the European Union are examples of such kinds of overlap. In both cases, one initiative targets a certain percentage of power generation to come from solar by 2020 or 2030, and the other a certain percentage of power generation to come from wind power. Although these targets are in principle complementary, quantifying their potential impact is only possible by considering potential competition between the two. For instance, the upper range of reduction of the European Wind Initiative on its own could be calculated by assuming that wind power replaces first coal, then oil and then gas in the power mix. The same can be done for the Solar Europe Industry Initiative. But the sum of the two upper bounds of both initiatives is not equal to the upper bound of the two initiatives together, because they would then be replacing more coal than exists in the power mix. So, the fact that the two can compete in "replacing fossil fuels" affects their potential maximum impact when both are assumed to be implemented.

Targets that are not sector-specific. Subnational cooperative initiatives may overlap with initiatives in the sustainable energy sector (e.g. renewable energy cooperative initiatives), road transport sector, buildings sector or non-CO_2 sector, or initiatives targeting energy efficiency.

Where there is potentially significant overlap between subnational and sector initiatives, the Global Climate Action report made simplified assumptions of either no additional effect or 50% additional effect to derive an uncertainty range. In other instances, where quantified sector initiatives do not have large overlaps with city/regional initiatives, overlaps were calculated by subtracting the impacts of buildings, transport, renewables and energy efficiency initiatives from the city/regional impact.

Source: Data-Driven Yale, NewClimate Institute and PBL (2018c).

FIGURE **9.2**

Distributing aggregated impact to countries

When distributing the impact of international cooperative initiatives that bring together multiple subnational actors, users can assume equal distribution across countries (e.g. the same amount of additional renewable energy installed in each participating country). Alternatively, they can assume distribution of impacts relative to the size of country, in terms of population or GDP, or relative to the size of a relevant indicator for the country, such as the rate of deforestation. The UNEP Cities and Regions Pledges Pipeline provides information on international cooperative initiatives by cities and regions, listed by country. It also features information on cities' and regions' quantified GHG reduction commitments over time through 2050.[60] These assumptions entail a trade-off between accuracy and completeness. The most conservative approach is to not include initiatives in the assessment in the absence of information. Boxes 9.4 and 9.5 provide examples of applying these assumptions to determine potential impact for countries.

Distributing potential impacts of actions of companies operating globally

Targets of multinational companies are similar to international cooperative initiatives in that these businesses operate across national borders, and their targets often apply to operations in several countries. However, many do not specify targets per sector or country, and this can create difficulties in determining country-specific impacts. For example, HeidelbergCement has a target of reducing its direct (scope 1) GHG emissions by 30% per tonne of cementitious materials by 2030 from a 2016 base year. Because the company has operations in multiple countries, users will have to determine what portion of the target can be considered for their country. If detailed information (e.g. at facility level) cannot be obtained directly from companies or cannot be deduced reasonably (e.g. a company aims to reduce emissions from a specific product, which is only produced/sold in one country), users should adopt a conservative approach and exclude these targets, as a result of lack of information. Box 9.6 illustrates ways to distribute impacts in some hypothetical examples.

BOX **9.4**

Examples of distributing potential impacts of international cooperative initiatives to countries

Example 1: An international subnational cooperative initiative has an objective of installing 50 GW of solar photovoltaic capacity by 2020 globally. It meets the suitability criteria for inclusion outlined in Section 6.1. The initiative includes 50 cities with a projected total of 100 million inhabitants by 2020. Of these inhabitants, 10 million are projected to be in country A. Distributing the impact using the relative sizes of countries, expressed in population, would translate into 5 GW of potential impact in country A.

Example 2: An international cooperative initiative aims to restore 20 million ha of degraded land globally by 2020. To distribute the impact among countries, users can split the potential impact of the initiative by using historical data on afforestation from the Food and Agriculture Organization of the United Nations (FAO). First, users can calculate the share of afforestation annually in the global total afforested area. Second, this share is used to split the target across countries. For example, the user might be interested in estimating the potential impact of this initiative in China. Data from the FAO show that the afforestation rate in China is 1.497 Mha/year.[63] In comparison, the global afforestation rate is 5.622 Mha/year.[64] China is thus responsible for 26.6% of global afforestation annually. Applying this to the international cooperative initiative, the estimated impact for China is 5.32 million ha of afforested land. This approach assumes that the effort is proportional to the current rates of afforestation in respective countries; in reality, the initiative may impact countries' behaviour and lead to a shift in current afforestation rates.

[60] UNEP DTU Partnership publishes a continually updated pipeline, available at: http://web.unep.org/climatechange/resources/climate-initiatives-platform.

[61] FAO (2015).

[62] FAO (2015).

BOX **9.5**

Distributing impact – an example from the Global Climate Action report

The Under2 MOU is an initiative that brings together subnational governments committed to ambitious climate action. The signatory regions within selected key countries were listed, so that the potential impact of the initiative under the assessment could be distributed. The assessment assumed that regional emissions can be approximated by multiplying the share of national population residing in the region by the country's total emissions. In other words, it was assumed that the region's inhabitants have the same average per capita emissions as the country.

Regions' emissions reduction targets were then compared with their current policy emissions pathways to estimate the additionality of their Under2 MOU commitments. It was assumed that the regions follow the same current policy emissions pathway as their respective countries. Countries' current policy pathways were downscaled to the regional level using the regions' populations and the assumption that all regions have the same average per capita emissions.

Then, the potential emissions reduction impact for the downscaled current policy scenario for the region was compared with the Under2 MOU scenario. The additional emissions reduction contributions from cities were thus estimated. These contributions were finally added to the country level.

Source: Data-Driven Yale, NewClimate Institute and PBL (2018c).

BOX **9.6**

Examples of distributing impact of a multinational company action to a country

Example 1: Multinational company A has a company-wide target to improve energy efficiency by 40% across its operations. In this case, users can request or collect information on energy use in the country they are interested in and apply the 40% improvement to its operations within the country, assuming equal distribution across all countries.

Example 2: Multinational company B has committed to reduce its scope 1 emissions in Europe by 30% by 2020 compared with its current annual emissions. Users interested in conducting the assessment for a European country can first determine the total emissions of company B in their country of interest. Assuming equal distribution, they can then estimate a 30% reduction in the current emissions of company B by 2020.

9.2.2 Consider possible reinforcing impacts

In some instances, actions may reinforce each other to produce a combined impact that is greater than the sum of the intended impacts of each action individually. Reinforcing actions may additionally lead to an increase in the likelihood of implementation of individual actions. For example, two or more actions that aim to help businesses set climate targets, operating among the same set of actors, could potentially overlap; at the same time, they may drive more businesses to take on more ambitious targets than originally intended. Depending on the situation, users can estimate the number of businesses that are expected to adopt targets, which is higher than the number that would have adopted targets under each action operating independently. It is critical that the assumptions behind the estimated impact of potentially reinforcing actions are robust and grounded in reasonable evidence, to maintain the integrity of the assessment.

For considering interactions with national policies and accounting for associated overlaps, see Section 9.4.

9.3 Aggregate impacts

Next, users should add the potential impacts of non-state and subnational actions calculated for each sector within the assessment boundary (in Section 9.2) to arrive at the overall impact of non-state and subnational actions. This is represented by the solid red line in Figure 9.3. It is a *key recommendation* to aggregate the potential impact of non-state and subnational actions within the assessment boundary. Users can also aggregate the potential impact for legally binding and voluntary actions separately (e.g. as done in the Fulfilling America's Pledge report). This allows greater flexibility in interpreting results; the potential impact of legally binding actions provides a conservative value compared with the potential impact of both categories combined.

It should be noted that this value does not account for potential overlap with national policies, and therefore should not be considered additional to national action without further analysis. Users can correct for overlaps with national policies in Section 9.2 to obtain the additional impact. Section 9.4 provides further information on incorporating overlaps with national policies.

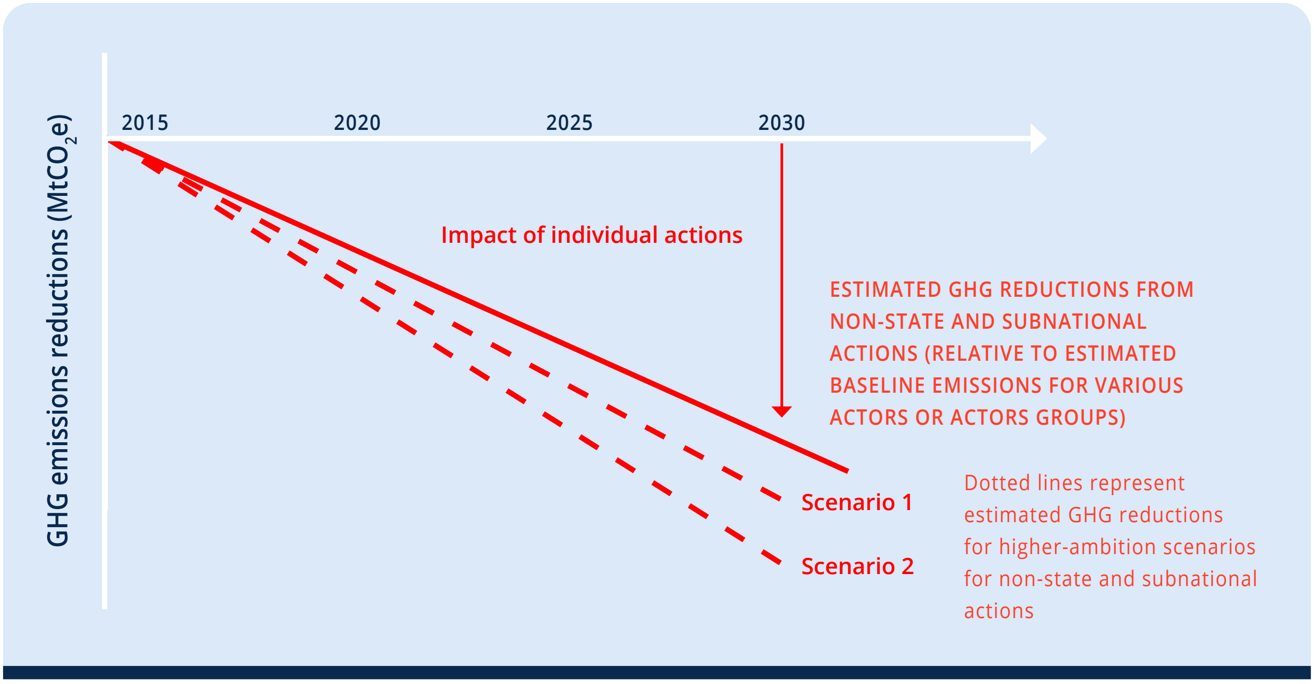
Depending on their objectives, users can further develop different scenarios for different levels of ambition in non-state and subnational actions, which can be compared with the estimated impact obtained above by bottom-up aggregation of existing and pledged actions (Figure 9.3). This is done by assuming increased (or reduced) ambition compared with existing actions, following the same logic to determine the nature of interactions and overlaps as used for existing actions, aggregating the impacts for each sector and then aggregating across sectors for each scenario.

For example, the Indian corporate actions study developed two scenarios pertaining to different ambition levels:

- increased ambition scenario, which assumes that the ambition level of all corporate actions within the assessment boundary increases by 10% after 2020
- reduced ambition scenario, which assumes that the ambition level decreases by 10% after 2020.

FIGURE **9.3**

Bottom-up aggregation of non-state and subnational actions



Similarly, the Fulfilling America's Pledge report estimated the impacts for two scenarios and for the current measures scenario through bottom-up aggregation. The two scenarios reflect increased ambition compared with the current measures scenario:

- The Climate Action Strategies scenario estimated the emissions reduction potential of 10 high-impact, near-term and readily available opportunities led by non-state and subnational actors.
- The Enhanced Engagement scenario estimated the emissions reduction potential if an even broader set of ambitious non-state and subnational actions were implemented.

9.4 Estimate potential additional impact of non-state and subnational actions, and perform other comparisons

Users who are interested in determining the potential additional impact of non-state and subnational actions should do so by considering overlapping and reinforcing interactions with national (sectoral) policies. It is a *key recommendation* to determine the potential additional impact of non-state and subnational actions after correcting for overlapping and reinforcing interactions with national policies; and to incorporate the influence of socioeconomic factors if using a model to determine additional impact. Users can consider each national (sectoral) policy individually and apply the same rationale for determining overlaps with national policies as for assessing overlaps for subnational actions. However, manually and individually determining the overlaps between national policies and non-state/subnational actions is quite complicated.

Where possible, users should use existing economy- or sector-wide models to explore interactions among various policies and actions at different scales. Using a model allows users to fully account for overlaps between sectors across the economy. A model also allows users to account for socioeconomic drivers and other extraneous systems interactions, such as non-climate actor activity, energy supply–demand interactions and technological advances. Referred to as top-down integration, it involves estimating the impacts of non-state and subnational actions, and incorporating these impacts into national projections and scenarios, often based on existing national models. The starting point is an up-to-date national GHG emissions projection or scenario that serves as the reference scenario for comparison, depending on the user's objectives. Examples of possible reference scenarios (baseline scenarios) for comparison include:

- a scenario based on current national policies, assuming no change in policies over time; this may include at least some existing subnational policies
- a scenario based on a certain rate of growth in the sector of interest
- a scenario based on fully implementing NDCs.

For example, if there is interest in determining how non-state and subnational actions modify the emissions trajectory of current national policies, users should start with a current national policies scenario, which requires information about the GHG implications of national policies or national emissions projections. The blue line in Figure 9.4 shows the current national policies scenario. The chosen model may already include such scenarios. However, if the information is not already available in the model or gathered as part of Chapter 7, users can consult internationally developed reference scenarios for their respective countries for similar scenarios.[63]

The national emissions projection should then be adjusted to reflect the impacts of non-state and subnational actions. The result is a revised GHG emissions projection that represents the combined impact of national policies, along with non-state and subnational actions, while taking into consideration overlapping and reinforcing interactions between them. This is represented by the red line in Figure 9.4. The difference between the original (blue) and updated (red) projections reveals the potential additional impact of non-state and subnational action in the country. The revised projection can then be used to inform a more ambitious national mitigation target that builds on the additional GHG mitigation efforts undertaken by non-state and subnational actors.

It is important to review which policies, targets and drivers are already included in the national projection or model. The projection may only reflect the impacts of national policies and targets, and

[63] Potential sources include Climate Watch (www.climatewatchdata.org); Climate Action Tracker (https://climateactiontracker.org); Deep Decarbonization Pathways Project (http://deepdecarbonization.org); and IEA World Energy Outlook scenarios (www.iea.org/weo).

various socioeconomic drivers and trends, such as GDP, population and energy prices. Models may already include some subnational actions, but other actions may need to be included as part of the assessment. Users should review which non-state and subnational actions are already included to avoid double counting.

Users can input the results of the bottom-up aggregation assessment into models to determine the combined impact of non-state, subnational and national actions while accounting for interactions between them and incorporating the effect of socioeconomic drivers. The Fulfilling America's Pledge report, for instance, used a version of the Global Change Assessment Model that included a detailed representation of the United States economy and energy system at the state level. The model included the impact of non-state and subnational actions within each sector from the bottom-up aggregation exercise. It was helpful for analysing economy-wide interactions while taking care of overlaps and double counting between sectoral and national actions.

9.4.1 Other comparisons

Users may be interested in different types of comparisons. For example, some may want to understand the gap between NDC targets and the combined impact of national policies and non-state and subnational actions, or the additional impact from non-state and subnational actions at the sectoral level. Depending on their objectives, users can select one or more reference scenarios to understand the contribution of non-state and subnational actions. For example, in Figure 9.4, the difference between the red line (emissions projection representing non-state and subnational actions along with current national policies) and the green line (NDC target) is the emissions gap. Users can also model enhanced ambition for non-state and subnational actions (dotted red lines in Figure 9.4) – for example, to determine how to bridge the emissions gap. They can also model emissions projections for enhanced ambition at the national level, and analyse the extent to which the existing non-state and subnational actions can help achieve it.

FIGURE **9.4**

Modelled additional impact of non-state and subnational actions using top-down integration