Realizing the promise of Paris: Roadmap to a safer climate

Technical appendix

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Abbreviations

2DS	2°C scenario
AC	air conditioner
ASEAN	Association of Southeast Asian Nations
AQO	average quantified overlap
BECCS	bio-energy with carbon capture and storage
BAT	best available technology
BAU	Business-as-usual
CAT	Climate Action Tracker
CCS	carbon capture and storage
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPS	Current Policies Scenario of the IEA World Energy Outlook reports
EE	energy efficiency
ERP	emission reduction potential
EV	electric vehicle
GHG	greenhouse gas
ICAO	International Civil Aviation Organization
IEA	International Energy Agency
IIASA	International Institute for Applied Systems Analysis
IMO	United Nations International Maritime Organization
IRENA	International Renewable Energy Agency
LULUCF	land use, land-use change and forestry
MEPS	Minimum Energy Performance Standard
NA	not available
NDC	Nationally Determined Contribution
NPS	New Policies Scenario of the IEA World Energy Outlook reports
OR	overlap rate
QO	quantified overlap
RE	renewable energy
SDS	Sustainable Development Scenario of the IEA World Energy Outlook reports
UNEP	United Nations Environment Programme
WRI	World Resources Institute

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1 Analytical approach

The quantitative assessment of additional climate change mitigation actions was conducted by NewClimate Institute in close consultation with NRDC experts.

The quantification of emissions reduction potential was conducted in four steps:

1) Identification of actions to be quantified
2) Quantification of the emissions reduction potential
3) Categorisation of actions by feasibility level
4) Assessment of overlaps across actions

The baseline greenhouse gas (GHG) emissions scenario used in this study is the "Current policies scenario" (CPS) from the Climate Action Tracker (2017a). The Climate Action Tracker's current policies scenario projections used in this report are based on implemented policies as of November 2017, and takes into account additional factors such as expected economic growth or expected trends in activity levels and energy consumption.

Under the Climate Action Tracker's current policies scenario, the total global GHG emissions including land use, land use-change and forestry (LULUCF) are projected to increase from 49.0 $GtCO_2e$/yr in 2014 to 56.2 to 59.3 $GtCO_2e$/yr in 2030. This study set the baseline GHG emission level in 2030 to be 57.7 $GtCO_2e$/yr, which is the median estimate of the Climate Action Tracker range.

In the following subsections, each of the calculation steps is described in detail.

1.1 Identification of actions to be quantified

The actions quantified in this report ranged from global to country-specific actions, and from sector-specific to economy-wide actions. The actions for quantification were selected based primarily on two criteria:

1) Scale of the expected emissions reduction potential
2) Political importance globally or internationally

On the first criterion, the literature review started from recent studies that assessed or reviewed the potential impact of actions to fill the emissions gap between the current policies scenario or other baseline scenarios and the emissions trajectories up to 2030 or 2050 consistent with 2°C or 1.5°C (Fekete *et al.*, 2015; Blok *et al.*, 2017; Kriegler *et al.*, 2018; Roelfsema *et al.*, 2018). In addition to peer-reviewed journal publications and research reports published by NewClimate Institute and NRDC, we also reviewed studies recently published by internationally recognized think tanks and NGOs including but not limited to: International Energy Agency (IEA), International Renewable Energy Agency (IRENA), and World Resources Institute (WRI). An Ecofys report that investigated sector-level emissions reduction potential (Blok *et al.*, 2017), which also comprised a chapter in the 2017 United Nations Environmental Programme (UNEP) Emissions Gap Report (UNEP, 2017) was also reviewed in detail.

On the second criterion, NewClimate Institute and NRDC selected several country-specific and sector-specific actions that are considered by the climate policy community to have potentially far-reaching implications.

Following the two criteria describe above, this report identified a total of 24 mitigation actions to analyze. Although this report aimed to be as comprehensive as possible, the list of actions is non-exhaustive. Notably, the GHG emissions reduction potential from behavioral changes may be underrepresented partly due to the lack of literature.

1.2 Quantification of the emissions reduction potential

The emissions reduction potential values were collected from a variety of recent studies (*i.e.* peer-reviewed papers as well as reports from international and national organizations) published after 2017 (with some exceptions) for each action.

When collecting the emissions reduction potential data from the literature, we focused on studies that applied baselines consistent with the Climate Action Tracker current policies scenario. For all data collected the definitions of both the policy scenarios and the baseline scenarios were documented.

The collected emissions reduction potential data was subsequently examined by NewClimate Institute and NRDC analysts. The expert review included a brief assessment of the compatibility of each action definition and the scenarios from literature (including baseline definition and assumptions).

The central estimate (also referred to as the nominal value) of the emissions reduction potential of action *n* (A_n) (ERP_n: in $GtCO_2e/yr$) in this study is defined as the average of the maximum and minimum emissions reduction potential estimates found in the literature (*e.g.* $ERP_{n,min}$ and $ERP_{n,max}$ for action *n* (A_n)). There are, however, a few exceptions where the central estimates were based on the judgments by NewClimate Institute and NRDC researchers, *e.g.* when there are obvious outliers among the values reported in the literature or the emissions reduction potential estimates from the literature were based on a modelling base year of more than five years ago. See Section 3 for an overview of nominal values for all actions.

1.3 Categorisation of actions by feasibility level

The 24 mitigation actions were classified into three categories distinguished by the level of feasibility. The categorisation was based on the definitions of scenarios from which the emissions reduction potential values were extracted as well as the discussions between NewClimate Institute and NRDC analysts. The mitigation actions (descriptions of what each action entails are provided in Section 2) were listed and classified in one of the following feasibility categories (Table 1):

1) "On Track" — actions that are within reach and have a high likelihood of achieving their potential emission reductions based on current trends (four actions);
2) "Scale Up" — actions where there is a focused effort and some regionally confined progress already, but stepped-up efforts will be needed to roll out these actions widely (15 actions).
3) "Need Focus" — actions where there is an emerging focus or early steps, though the scale is small and will require much more concerted efforts than currently exist to achieve their potential (five actions). The actions in policy areas where no substantive GHG emissions reduction measures have currently been implemented (to the knowledge of NRDC and NewClimate Institute analysts) fell under this category.

Table 1: Overview of actions[1] identified and quantified in this study

Feasibility category	Action no.	Regional boundary	Action
Category 1: On Track	A_1	Global	Faster uptake of renewables following most recent market trends (global)
	A_2	China	China peaking its coal consumption in 2025
	A_3	Global	HFC cuts under the Kigali Amendment and more ambitious reductions (global)
	A_4	India	India renewable energy, energy efficiency penetration, and coal shifts
Category 2: Scale up	A_5	Global	Faster uptake of renewables following leaders (global)
	A_6	Global	International aviation: enhanced energy efficiency (global)
	A_7	Global	Zero deforestation and restoration of degraded forests (global)
	A_8	Global	Reduced methane emissions from oil and gas production (global)
	A_9	Global	Fashion industry: value chain GHG emissions reductions (global)
	A_{10}	Global	International shipping: full implementation of the new target (global)
	A_{11}	China	China peaking its coal earlier than 2020
	A_{12}	Southeast Asia	Southeast Asian countries slow down coal plant expansion (*e.g.* Indonesia and Vietnam)
	A_{13}	Global	Fossil fuel subsidies removal (global)
	A_{14}	Global	Fast uptake of electric vehicles (EVs) (global)
	A_{15}	China	China peaking its oil consumption early
	A_{16}	Canada	Reduction of Canadian tar sands production
	A_{17}	US	United States on track for deep 2050 targets
	A_{18}	EU	European Union's 40% to 60% GHG emissions reductions by 2030
	A_{19}	Global	Implementation of conditional NDCs
Category 3: Need Focus	A_{20}	Global	Strengthened energy and material efficiency in the industry (global)
	A_{21}	Global	Deployment of near zero emissions buildings and efficient appliances and lighting (global)
	A_{22}	Global	Agriculture: reduced meat consumption (global)
	A_{23}	Global	Efficient cooling in buildings (global)
	A_{24}	China	Reduction of China's non-CO_2 GHG emissions

[1] The names of the actions used in this technical document might slightly differ from those in the policy brief.

1.4 Assessment of overlaps across actions

1.4.1 Quantification of overlaps

This study utilized methods to calculate overlap similar to several previous studies (Blok *et al.*, 2012; Roelfsema *et al.*, 2015; UNEP, 2015).

Each of the 24 mitigation actions assessed in this study vary in scope; some actions are global, while others are national, regional, or country specific. Additionally, some actions cover all sectors of the economy, while others only focus on one or more economic (sub)sectors. Thus, the emissions reduction potential of one action could affect the amount of potential for emissions reduction of another action and lead to double counting of emissions reduction potentials if overlaps are not properly accounted for. Overlaps in this study are defined as emissions reduction potentials that are covered by more than one action due to the overlapping geographical and/or sectoral scope of these actions.

To quantify overlaps between actions, we considered geographical overlaps and sectoral overlaps as well as the feasibility level of actions and the composition of GHG emissions reductions across sectors resulting from the actions. The overlaps between actions were quantified in three main steps: 1) Overlap matrix evaluation, 2) Estimation of minimum and maximum overlap rates, and 3) Assessment of total overlap rate.

1) Overlap matrix evaluation

To avoid double counting of overlaps, only overlaps between an action and all preceding actions in the action list were considered (*e.g.* For action A_n, overlaps with actions A_{n-1} to A_1 were quantified). Following this logic, an overlap matrix was created (see Figure 1). This matrix classifies overlaps between actions binarily, specifying if an overlap between actions exists (y) or not (n).

Scope		Action	A_1 Faster uptake of renewables following most recent market trends	A_2 China peaking its coal consumption in 2025	A_3 HFC cuts under the Kigali Amendment and more ambitious reductions	A_4 India renewable energy, energy efficiency penetration, and coal shifts	A_5 Faster uptake of renewables following leaders	A_6 International aviation: enhanced energy efficiency	A_7 Zero deforestation and restoration of degraded forests	A_8 Reduced methane emissions from oil and gas production	A_9 Fashion industry: value chain GHG emissions reductions	A_{10} International shipping: full implementation of the new target	A_{11} China peaking its coal earlier than 2020	A_{12} Southeast Asian countries slow down coal plant expansion (i.e. Indonesia and Vietnam)	A_{13} Fossil fuel subsidies removal	A_{14} Fast uptake of electric vehicles (EVs)	A_{15} China peaking its oil consumption early	A_{16} Reduction of Canadian tar sands production	A_{17} United States on track for deep 2050 targets	A_{18} European Union's 40% to 60% GHG emissions reductions by 2030	A_{19} Implementation of conditional NDCs	A_{20} Strengthened energy and material efficiency in the industry	A_{21} Deployment of near zero energy buildings and efficient appliances and lighting	A_{22} Agriculture: reduced meat consumption	A_{23} Efficient cooling in buildings	A_{24} Reduction of China's non-CO2 GHG emissions
Global	A_1	Faster uptake of renewables following most recent market trends		y	n	y	n	n	n	n	y	n	y	y	y	n	n	n	y	y	y	n	n	n	n	n
China	A_2	China peaking its coal consumption in 2025			n	n	y	n	n	n	n	n	n	n	y	n	n	n	n	n	n	n	y	n	y	y
Global	A_3	HFC cuts under the Kigali Amendment and more ambitious reductions				n	n	n	n	n	n	n	n	n	n	n	n	n	y	y	y	y	n	n	y	y
India	A_4	India renewable energy, energy efficiency penetration, and coal shifts					y	n	n	n	y	n	n	n	y	n	n	n	n	n	y	y	y	n	y	n
Global	A_5	Faster uptake of renewables following leaders						n	n	n	y	n	y	y	y	n	n	n	y	y	y	n	n	n	n	n
Global	A_6	International aviation: enhanced energy efficiency							n	y	n	n	n	n	y	n	y	n	n	n	n	n	n	n	n	n
Global	A_7	Zero deforestation and restoration of degraded forests								n	n	n	n	n	n	n	n	n	y	y	y	n	n	n	n	n
Global	A_8	Reduced methane emissions from oil and gas production									n	y	n	n	y	y	y	y	y	y	y	n	n	n	n	y
Global	A_9	Fashion industry: value chain GHG emissions reductions										y	n	y	y	n	n	n	y	y	y	n	n	n	n	n
Global	A_{10}	International shipping: full implementation of the new target											n	n	y	n	n	y	n	n	n	y	n	y	n	n
China	A_{11}	China peaking its coal earlier than 2020												n	y	n	n	n	n	n	n	n	y	n	y	y
Southeast Asia	A_{12}	Southeast Asian countries slow down coal plant expansion (i.e. Indonesia and Vietnam)													y	n	n	n	n	n	y	y	y	n	y	n
Global	A_{13}	Fossil fuel subsidies removal														y	y	y	y	y	y	y	y	n	y	y
Global	A_{14}	Fast uptake of electric vehicles (EVs)															y	y	y	y	n	n	n	n	n	n
China	A_{15}	China peaking its oil consumption early																n	n	n	n	y	y	n	n	n
Canada	A_{16}	Reduction of Canadian tar sands production																	n	n	n	y	n	n	n	n
US	A_{17}	United States on track for deep 2050 targets																		n	n	y	y	y	y	n
EU	A_{18}	European Union's 40% to 60% GHG emissions reductions by 2030																			n	y	y	y	y	n
Global	A_{19}	Implementation of conditional NDCs																				y	y	n	y	n
Global	A_{20}	Strengthened energy and material efficiency in the industry																					n	n	n	y
Global	A_{21}	Deployment of near zero energy buildings and efficient appliances and																						n	y	n
Global	A_{22}	Agriculture: reduced meat consumption																							n	y
Global	A_{23}	Efficient cooling in buildings																								n
China	A_{24}	Reduction of China's non-CO2 GHG emissions																								

Figure 1. Overlap matrix showing the presence (y) or absence (n) of an action overlapping with any previous actions in the list

2) Estimation of minimum and maximum overlap rates

We determined a range of overlaps between an action and each of its preceding actions (following the order in the overlap matrix) by estimating maximum and minimum overlap rates (OR: in % of a preceding action) according to the presence or absence of an overlap as specified in the overlap matrix.

For example, if there is an overlap between A_1 and A_5 according to the matrix, the maximum and minimum values for the overlap rate between these two actions will be assigned, $OR_{5,1-max}$ and $OR_{5,1-min}$. In this example, $OR_{5,1-max}$ = *xx*% means that *xx*% of the emissions reduction potential from action A_1 overlaps with action A_5.

3) Assessment of total overlap rate

The maximum and minimum overlap rates were used to estimate the range of quantified overlaps between an action and all of its preceding actions by multiplying the maximum overlap rate (of the action, A_n and a preceding action A_{n-x}) by the maximum emissions reduction potential of the preceding action and the minimum overlap rate by the minimum emissions reduction potential of the preceding action.

For example, the quantified overlap QO (in $GtCO_2e$/yr) of action A_5 with each of its preceding actions A_1, A_2, A_3 and A_4 was estimated as:

Range of quantified overlaps between actions A_5 and A_1

For the low end of the range (Eq.1):

$$QO_{5,1-min} = ERP_{1-min} * OR_{5,1-min} \quad (1)$$

For the high end of the range (Eq.2):

$$QO_{5,1-max} = ERP_{1-max} * OR_{5,1-max} \quad (2)$$

Range of quantified overlaps between actions A_5 and A_2

For the low end of the range (Eq.3):

$$QO_{5,2-min} = ERP_{2-min} * OR_{5,2-min} \quad (3)$$

For the high end of the range (Eq.4):

$$QO_{5,2-max} = ERP_{2-max} * OR_{5,2-max} \quad (4)$$

Range of quantified overlaps between actions A_5 and A_3

For the low end of the range (Eq.5):

$$QO_{5,3-min} = ERP_{3-min} * OR_{5,3-min} \quad (5)$$

For the high end of the range (Eq.6):

$$QO_{5,3-max} = ERP_{3-max} * OR_{5,3-max} \quad (6)$$

Range of quantified overlaps between actions A_5 and A_4

For the low end of the range (Eq.7):

$$QO_{5,4-min} = ERP_{4-mi} \quad * OR_{5,4-min} \quad (7)$$

For the high end of the range (Eq.8):

$$QO_{5,4-max} = ERP_{4-max} * OR_{5,4-max} \quad (8)$$

All individual values in the low end of the range were added into the minimum quantified overlap of an action *($QO_{n\text{-}min}$)*, while all individual values in the high end of the range were added into the maximum quantified overlap for an action ($QO_{n\text{-}max}$). In the above instance the minimum and maximum quantified ranges for action A_5 are:

For the low end of the range (Eq.9):

$$QO_{5-min} = \sum_{i=1}^{4} QO_{5,i-min} \quad (9)$$

For the high end of the range (Eq.10):

$$QO_{5-max} = \sum_{i=1}^{4} QO_{5,i-max} \quad (10)$$

Based on these values we then estimated the average quantified overlap (AQO) as the average of the minimum and maximum quantified overlap of an action. In the above instance the average quantified overlap for action A_5 (in $GtCO_2e$/yr) is calculated as follows (Eq.11):

$$AQO_5 = \frac{QO_{5-min} + QO_{5-max}}{2} \quad (11)$$

Finally, the total overlap rate (TOR; in %) of each action – defined as the percentage overlap with all of its preceding actions in the overlap matrix – was estimated as the ratio between the average quantified overlap and the central estimate of each action multiplied by 100%. By definition the total overlap rate is a number between 0% and 100%. In the instances where the total overlap rate was found to be larger than an action's central estimate, we assumed 100% overlap. This is because the overlap of an action cannot be larger than that action's central estimate. In the above instance the total overlap for action A_5 is calculated as (Eq.12):

$$TOR_5(\%) = min\left\{\frac{AQO_5}{ERP_5} * 100, 100\%\right\} \tag{12}$$

Total overlap rates greater than 20% were rounded to the nearest 5%. For a summary of total overlap rates for each of the 24 actions ($TORn$) please see Table 24 in Section 3.

Additional considerations for the estimation of total overlap rates

This section explains and exemplifies the different criteria used in estimating the total overlap rates, including in steps 2 and 3.

For step 2, the estimation of minimum and maximum overlap rates, we assessed the following criteria: a) geographical and sectoral scope, b) level of feasibility and factors contributing to the emissions reductions, and c) exceptional cases. Below is an explanation of each criterion including examples.

a) Geographical and sectoral scope

We first aligned the geographical and sectoral scope of actions in determining their overlap. To do this, we primarily used the energy balance projections for 2030 from IEA WEO 2017 current policies scenario (IEA, 2017). For overlaps between energy supply-side actions and energy demand-side actions, we included information from sector-level shares (in *e.g.* energy, CO_2 or GHG emissions, industrial production, etc.) For these data, the sources consulted included international and national institutions (*e.g*. the IEA's WEO, IIASA), as well as data from other studies and peer-reviewed literature.

For example, the maximum overlap rate between A_9 "Apparel industry value chain GHG emissions reductions" and A_4 "India strengthening action on renewable energy, energy efficiency, and coal shifts" was estimated using the Indian global share of the fashion industry value chain.

b) Level of feasibility and factors contributing to the emissions reductions

For actions with the same geographical or sectoral scope, we evaluated the minimum and maximum overlap rates based on (i) their level of feasibility and (ii) factors contributing to the emissions reductions.

Example 1: To estimate the overlap rate between A_2 "China peaking its coal consumption in 2025" and A_5 "Faster uptake of renewables following leaders" and we first compared the emissions reduction potential for China under A_2 and A_5. If we conclude that A_2's potential comprises 90% of that of A_5, then the theoretical maximum overlap rate would be 90%. We then looked at the factors contributing to the emissions reductions potential. For A_2, on the one hand coal reduction is solely driven by renewable energy, *i.e.* 100% of A_2's potential overlap with A_5. On the other hand, it may be that only 50% of the coal reduction is attributable to renewable energy and the rest 50% is due to energy efficiency. In the above case, the maximum overlap rate ($OR_{5,2\text{-max}}$) is 90% * 100% = 90%, and the minimum overlap rate ($OR_{5,2\text{-min}}$) is 90% * 50% = 45%.

Example 2: Between the two renewable energy deployment actions (A_1 and A_5) and actions that enhance fuel switching to electricity (*e.g.* A_{14} "Fast uptake of electric vehicles (EVs)"), we assumed no overlap for the following reasons: for each renewable energy deployment action (A_1 and A_5), we quantified how much fossil fuel-fired power generation under current policies would be replaced by renewable electricity. For the EV penetration action (A_{14}), the resulting increase in electricity generation is additional to the total electricity generation under current policies. How this additional electricity demand will be met is irrelevant to the renewable energy deployment actions (A_1 and A_5).

c) Exceptional cases

There were also cases where the overlap quantification was simplified because of a lack of data. In such cases, we quantified the overlap rate to be either 0%, 25%, 50%, 75% or 100% based on NewClimate Institute's expert judgement.

When an action (A) overlapped with another action that was split into two feasibility categories (*e.g.* "Faster uptake of renewables", which was split into: A_1 "Faster uptake of renewables following most recent market trends" and A_5 "Faster uptake of renewables following leaders"), overlap rates were estimated for both actions (*e.g*. overlap between A_n and A_1, as well as between A_n and A_5). These overlaps followed the steps described above but were split to the actions in both categories proportionally.

For step 3, the estimation of total overlap rates, we re-assessed actions with an estimated total overlap rate of 100% to ensure we were not double counting or underestimating overlaps. Following our method, individual overlaps with previous actions are added although not strictly additive. This may lead to a total of 100% overlap even though some sources of emission reductions are actually not covered by the previous actions. Based on expert knowledge, NewClimate Institute and NRDC decided to edit manually the total overlap rate of actions: A_9: Apparel industry value chain GHG emissions reductions, A_{17}: United States on track for deep 2050 targets, A_{18}: European Union's 40% to 60% GHG emissions reductions by 2030, and A_{19}: Implementation of conditional NDCs. For all these actions, we considered that the estimated total overlap rate was overestimated as some actions included in the emissions reduction potential of the actions were not covered by preceding actions. The total overlap rates for these actions are described in Section 3 alongside each action.

For example: For A_{17}: United States on track for deep 2050 targets, the emissions reduction potential from the literature included actions such as improving the electricity grid, implementing low carbon sources (other than renewables), decarbonisation in transport and industry *(i.e.* with CCS) and enhanced energy efficiency in industry, which are not covered in actions $A_1 - A_{16}$. Therefore, the total overlap rate was re-estimated as 75%. Here, 75% was as chosen based on expert knowledge as explained under "2c) Exceptional cases".

1.4.2 Estimation of net emissions reduction potential per feasibility category

The calculations described in Section 1.4.1 estimated the gross total and the net total emissions reduction potentials of all 24 actions in 2030 as 32.1 $GtCO_2e$/yr and 19.0 $GtCO_2e$/yr, respectively (See Table 24 and Figure 2). The gross total emissions reduction potential refers to the sum of central estimates of all 24 actions ($\sum_{n=1}^{24} ERP_n$) without accounting for overlaps, whereas the net total emissions reduction potential in 2030 was calculated taking overlaps into account. The sum of average quantified overlaps in 2030 for all 24 actions ($\sum_{n=1}^{24} AQO_n$) was calculated to be 13.0 $GtCO_2e$/yr.

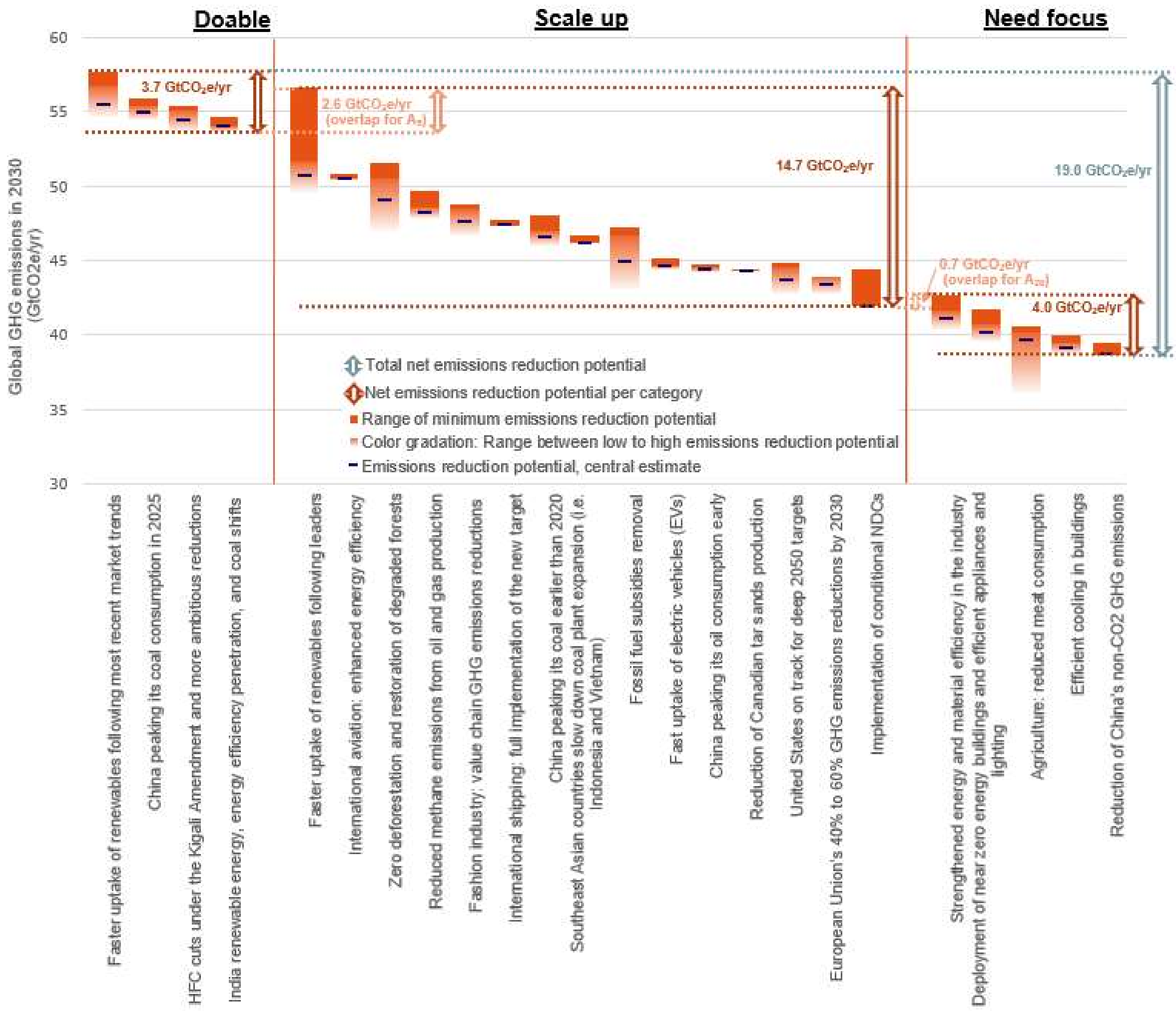
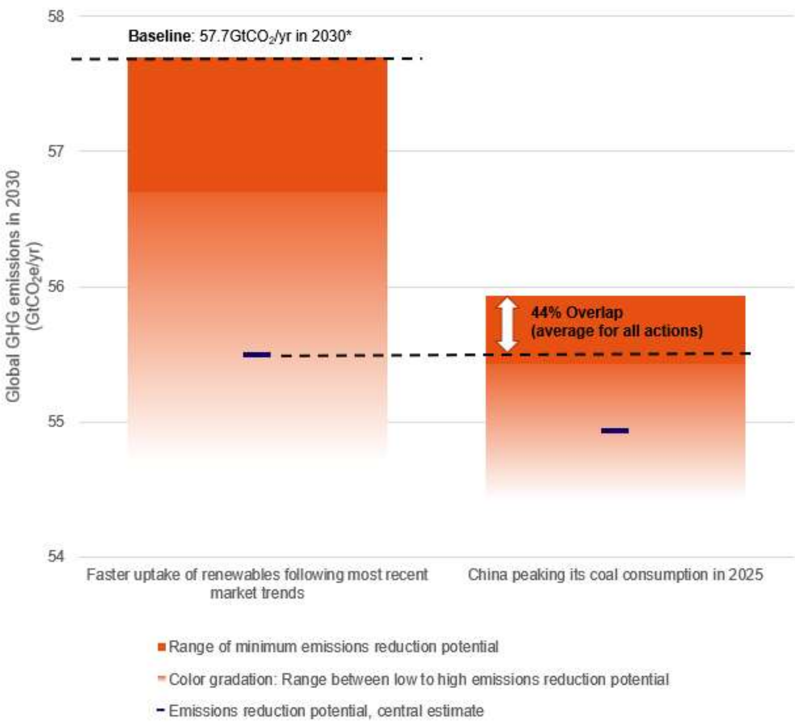


Figure 2: Annual emissions reduction potential in 2030 for all 24 actions analysed across “On Track,” Scale Up,” and “Need Focus” feasibility categories. The central estimate of each action is indicated with a dark blue line, the range of minimum emissions reduction potential with solid color, and the range between low to high emissions reduction potential in a gradient from dark to light (based on the values reported in the literature; see Section 2 for details). The first action represents emissions reduction potential relative to the 2030 current policy projections baseline (Climate Action Tracker, 2017a). Each subsequent action shows the step down in annual emissions reduction potential relative to the central estimate of the previous action accounting for proportionally distributed total overlap. The blue arrow shows the total net emissions reduction potential, which is the sum of the central estimates of all 24 actions accounting for the gross proportionally distributed overlap across all actions. The red arrows show net emissions reduction potential per category, which are the gross emissions reduction potential of actions in the category accounting for gross proportionally distributed overlap of actions in the category. The orange arrows show the overlap of the first action in the “Scale Up” category with the final action in the “On Track” category, and the overlap of the first action in the “Need Focus” category with the final action in the “Scale Up” category based on the order of actions listed in the overlap matrix. The sum of net emissions reduction potential per category minus overlaps may not sum to precisely 19.0 $GtCO_2e$ due to rounding errors.

Figure 2 also shows the overall results of applying the proportional distribution of total overlap across all actions (methodology described in the following paragraph). The net emissions reduction potential for each category is calculated by summing the gross emissions reduction potential of actions in the category and subtracting the gross proportionally distributed overlap of actions in the category. To determine the net additional emissions reduction potential for a category, the overlap of the final action in the previous category and the first action in the category in question (*i.e.* the overlap of A_4 and A_5 for the "Scale Up" category and the overlap of A_{19} and A_{20} for the "Need Focus" category) are subtracted from the net emissions reduction potential for the category. The resulting net additional emissions reduction potential is 3.7 $GtCO_2e$/yr for the "On Track" category (the gross, net, and net additional emissions reduction potential of this category are equivalent as there are no previous categories to overlap with), 12.1 $GtCO_2e$/yr for the "Scale Up" category (14.7 $GtCO_2e$/yr minus 2.6 $GtCO_2e$/yr overlap), and 3.3 $GtCO_2e$/yr (4.0 $GtCO_2e$/yr minus 0.7 $GtCO_2e$/yr overlap) for the "Need Focus" category. As Figure 2 indicates, implementing all actions in the "On Track" and "Scale Up" categories could lead to aggregate emissisons reductions of nearly 16.0 $GtCO_2e$/yr (3.7 + 12.1 = 15.8) in 2030.

To generate the waterfall chart presented in Figure 2, we plotted each action's central estimate (including minimum and maximum emissions reduction potentials) starting from the current policy projections baseline of 57.7$GtCO_2e$/yr in 2030 (Climate Action Tracker, 2017a). To avoid being biased toward the order of actions as listed in the overlap matrix, we distributed the sum of average quantified overlaps in 2030 for all 24 actions ($\sum_{n=1}^{24} AQO_n$; 13.0 $GtCO_2e$/yr) proportionally to the magnitude of gross total emissions reduction potential of A_2 to A_{24} (A_1 is excluded here because it does not have a preceding action in the overlap matrix). This redistribution was applied in order to be unbiased toward the order in which the actions are presented in the overlap matrix (*i.e.* an action ordered later in the overlap matrix will have a greater overlap with all previous actions by simple virtue of having more actions precede it).

The average overlap rate for actions A_2 to A_{24} in 2030 was calculated to be 44% (13.0 $GtCO_2e$/yr which is the sum of average quantified overlaps for all 24 actions, divided by 29.9 $GtCO_2e$/yr which is the gross sum of emissions reduction nominal values for actions A_2 through A_{24}). Therefore, 44% of the central estimate's emissions reduction potential from A_2 is shown to be overlapping in the waterfall chart. A simplified schematic of how the waterfall chart is generated for A_1 and A_2 is presented in Figure 3.



*The baseline corresponds to the median of the Climate Action Tracker's current policy scenario range (update: November 2017) (Climate Action Tracker, 2017a).

Figure 3: Simplified schematic of the overlap calculation for actions 1 and 2 (A_1 and A_2) in the waterfall chart. The first action represents emissions reduction potential relative to the 2030 current policy projections baseline (Climate Action Tracker, 2017a). Each subsequent action shows the step down in annual emissions reduction potential relative to the central estimate of the previous action accounting for the 44% proportionally distributed average overlap rate. The central estimate of each action is indicated with a dark blue line, the range of minimum emissions reduction potential with solid color, and the range between low to high emissions reduction potential in a gradient from dark to light (based on the values reported in the literature; see Section 2 for details).

2 Description of actions

2.1 Feasibility category 1: On Track

A_1: Faster uptake of renewables following most recent market trends (global)

The mitigation action of faster renewable uptake was split into feasibility categories 1 (On Track) and 2 (Scale up) resulting into two actions. This was done as the sources consulted had different forecasts on future renewable energy shares, some more ambitious than others.

The mitigation action in the "On Track" feasibility category includes more conservative estimations of emissions reduction potential from future renewable energy deployment. The literature chosen for this category includes Bloomberg New Energy Finance (2017), IEA (2017), and Roelfsema *et al.* (2018).

Based on expert judgement of the literature in Table 2 we estimate the emissions reduction potential in 2030 to be 2.2 GtCO$_2$e/yr (range 1.0 to 3.0 GtCO$_2$e/yr).

Both nominal and range values were defined manually based on expert judgement of the consulted literature. The chosen nominal value corresponds to the emissions reduction potential reported in IEA WEO's NPS (2017).

Table 2. Emissions reduction potential reported in the recent literature for "Faster uptake of renewables following most recent market trends (global)"

Source	**Emissions reduction potential in 2030 (GtCO$_2$e/yr)**	**Scenario definition**	**Baseline definition**	**Included (yes=1, no=0)**
Bloomberg New Energy Finance (2017)	2.0	NEO2017	WEO 2017 Current policy scenario	1
Roelfsema *et al.* (2018)	4.0	Good practice policies scenario	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
IEA (2017)	2.21	NPS	Current policies	1

*A*2: China peaking its coal consumption in 2025

China peaking its coal consumption was split into feasibility categories 1 (On Track) and 2 (Scale up) resulting into two actions. The action was split becase the literature consulted considered different coal consumption peak years for China which resulted in a wide range of emissions reduction potential in 2030.

The mitigation action in the "On Track" feasibility category reflects a more conservative scenario, where emissions from coal power in China are peaked in 2025. Literature assuming a coal peak in 2025 in China include ERI *et al.* (2016), IEA (2017) and Zhang *et al.* (2017).

Sources older than 2016 were not considered (Chandler *et al.*, 2015; Chinese Academy of Social Sciences (CASS), 2015). Some scenarios were reviewed but excluded from the determination of the central estimate of the emissions reduction potential.

Based on expert judgement of the literature in Table 3*, we estimate the emissions reduction potential in 2030 to be 1.0 $GtCO_2e/yr$ (range 0.5 to 1.5 $GtCO_2e/yr$).*

Both nominal and range values were defined manually based on expert judgement of the consulted literature. We decided to take this approach as the peaking years for coal consumption in China varied between sources.

Table 3. Emissions reduction potential reported in the recent literature for "China peaking its coal in 2025"

Source	**Emissions reduction potential in 2030 ($GtCO_2e/yr$)**	**Scenario definition**	**Baseline definition**	**Included (yes=1, no=0)**
Zhang *et al.* (2017)	2.87	Carbon policy	no carbon policy	1
IEA (2017)	1.19	NPS	CPS	1
Climate Action Tracker (2017b)	1.49	Continued coal abatement scenario	CPS consistent with the definition in the UNEP Emissions Gap Report	0
Chandler *et al.* (2015)	4.87	High efficiency scenario	Baseline scenario (CPS)	0
Chandler *et al.* (2015)	6.07	High renewables scenario	Baseline scenario (CPS)	0
Chandler *et al.* (2015)	6.22	low carbon mix scenario	Baseline scenario (CPS)	0
ERI *et al.* (2016)	4.02	Reinventing fire scenario coal peaks in 2025 (total emissions: 9,590 $MtCO_2$.)	Reference scenario coal peaks 2036 (total emissions: 14,600 $MtCO_2$)	0
IEA (2017)	3.81	SDS	CPS	0

*A*3: HFC cuts under the Kigali Amendment and more ambitious reductions (global)

This action leads to a higher reduction of HFC emissions than those expected from the full implementation of the Kigali Amendment. The literature reviewed are primarily those that assessed the emissions reduction potential of proposals made to the Montreal Protocol before the Kigali Amendment was adopted.

Based on the literature in Table 4, *we estimate the emissions reduction potential in 2030 to be 1.0 GtCO₂e/yr (range 0.3 to 1.7 GtCO₂e/yr).*

Table 4. Emissions reduction potential reported in the recent literature for "HFC cuts under the Kigali Amendment and more ambitious reductions (global)"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Velders *et al.* (2015)	0.3	Japan regulation	Baseline low end 2.5 $GtCO_2$	1
Velders *et al.* (2015)	0.5	USA SNAP change	Baseline low end 2.5 $GtCO_2$	1
Velders *et al.* (2015)	0.8	EU MAC + F-gas	Baseline low end 2.5 $GtCO_2$	1
Velders *et al.* (2015)	1.5	North America proposal to amend Montreal Protocol	Baseline low end 2.5 $GtCO_2$	1
Velders *et al.* (2015)	0.4	Japan regulation	Baseline high end 2.6 $GtCO_2$	1
Velders *et al.* (2015)	0.6	USA SNAP change	Baseline high end 2.6 $GtCO_2$	1
Velders *et al.* (2015)	0.9	EU MAC + Fgas	Baseline high end 2.6 $GtCO_2$	1
Velders *et al.* (2015)	1.6	North America proposal to amend Montreal Protocol	Baseline high end 2.6 $GtCO_2$	1
Velders (2016)	0.5	Kigali (difference with baseline low end)	Baseline low end 2.5 $GtCO_2$	1
Velders (2016)	0.6	Kigali (difference with baseline high end)	Baseline high end 2.6 $GtCO_2$	1
Höglund-Isaksson *et al.* (2017)	0.7	Quantifies the impact of the Kigali Amendment	GAINS baseline	1
Roelfsema *et al.* (2018)	1.7	Proposal to the Montreal Protocol amendment: 70% reductions of F-gas emissions below 2010 levels by 2030	CPS as defined in the UNEP Emissions Gap Report.	1
Purohit and Höglund-Isaksson (2017)	1.5	This study does not account for the impact of the Kigali Amendment	GAINS baseline	0

*A*4: India strengthening action on renewable energy, energy efficiency and coal shifts

This action leads to India boosting its renewable electricity share — up to 1.35 %/yr in Fekete *et al.* (2015) — and strengthening energy efficiency measures in both the industry and buildings sectors.

Based on the literature in Table 5 *and expert judgement we estimate the emissions reduction potential in 2030 to be 0.6 GtCO_2e/yr (range 0.6 to 1.04 GtCO_2e/yr).*

Since Mitra *et al.* (2017) includes more measures than only renewable energy, energy efficiency and coal shifts in India in its Enhanced Policy Scenario *(i.e.* targeted investment toward rail transport), we used the lower value from Fekete *et al.* (2015) as the central estimate.

Table 5. Emissions reduction potential reported in the recent literature for "India: renewable energy, energy efficiency and coal shifts"

Source	Emissions reduction potential in 2030 (GtCO_2e/yr)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Fekete *et al.* (2015)	0.6	Total emission reductions through increased renewable electricity and energy efficiency improvement in industrial processes and in buildings. Low end of range	Current policy scenario (CPS) as defined in the UNEP Emissions Gap Report.	1
Fekete *et al.* (2015)	1.0	Total emission reductions through increased renewable electricity and energy efficiency improvement in industrial processes and in buildings. High end of range	CPS as defined in the UNEP Emissions Gap Report.	1
Mitra *et al.* (2017)	1.04	Enhanced Policy Scenario	CPS as defined in the UNEP Emissions Gap Report.	1

2.2 Feasibility category 2: Scale Up

A_5: Faster uptake of renewables following leaders (global)

Faster renewable uptake was split into feasibility categories 1 (On Track) and 2 (Scale up) resulting in two actions. This was done because the sources consulted had different forecasts on future renewable energy shares, some more ambitious than others.

The mitigation action in the "Scale up" feasibility category includes literature with estimates of a higher future level of renewable energy deployment and thus a higher level of emissions reduction potential by 2030 than the action in the "On Track" feasibility category. The sources included for the quantification of this mitigation action include are the UNEP Emissions Gap Report 2017 (UNEP, 2017), the World Energy Outlook 2017's Sustainable Development Scenario (IEA, 2017), and the 2°C scenario in Perspectives for the Energy transition report (OECD/IEA and IRENA, 2017), some which are scenarios back-casted from long-term climate goals.

Based on expert judgement of the literature in Table 6*. we estimate the emissions reduction potential in 2030 to be 6.0 GtCO$_2$e/yr (range 5.0 to 7.0 GtCO$_2$e/yr)*[2]*.*

Both nominal and range values were chosen manually based on expert judgement of the consulted literature. Some sources older than 2016 were reviewed but were not considered to determine emissions reduction potential values.

Table 6. Emissions reduction potential reported in the recent literature for "Faster uptake of renewables following leaders (global)"

Source	Emissions reduction potential in 2030 (GtCO$_2$e/yr)	Scenario definition	Baseline definition	Included (yes=1, no=0)
UNEP (2017)	7.9	Low value	Current policies scenario as defined in the UNEP Emissions Gap Report. Action under USD100/tCO$_2$ in 2030.	1
UNEP (2017)	9.2	High value	Current policies scenario as defined in the UNEP Emissions Gap Report. Action under USD100/tCO$_2$ in 2030.	1
OECD/IEA and IRENA (2017)	5	IEA 66%2DS Read manually from Figure ES.1 (only renewables)	NPS (current and planned policies including NDCs)	1
OECD/IEA and IRENA (2017)	10	IRENA Remap scenario (from p.130 – the 10Gt/yr reduction is only from renewable energy)	Reference Case (current and planned policies including NDCs)	1
IEA (2017)	8	SDS	WEO2017 Current policy scenario	1
IEA (2017)	3.4	SDS	WEO2017 New policy scenario	1
Teske, Sawyer and Schäfer (2015)	17.3	E[R] scenario. Widely decarbonised energy system by 2050. Includes renewable energy and efficiency measures.	Reference Scenario based on IEA WEO 2014	0
Teske, Sawyer and Schäfer (2015)	19.3	Advanced E[R] scenario. Fully decarbonised energy system by 2050. Includes power, heat and transport sector	Reference Scenario based on IEA WEO 2014	0

[2] Since the faster deployment of renewable energy was split into two feasibility categories resulting into actions A_1 and A_5, the total range was also split. This means that even if A_5 has a range of 5.00 to 7.00 GtCO$_2$e/yr the total range for both actions is in line with the maximum emissions reduction potential shown in Table 6.

*A*6: International aviation: enhanced energy efficiency (global)

This action assumes that the international aviation sector achieves their emissions reduction target set out by International Civil Aviation Organization (ICAO) without using offsets. Only values from the UNEP Emissions Gap Report (UNEP, 2017) are taken into account as they consider aviation efficiency measures. Values from the Environmental Defense Fund (*no date)* are not considered as they quantify offsets and not emissions reductions.

Based on the literature in Table 7*, we estimate the emissions reduction potential in 2030 to be 0.37 GtCO$_2$e/yr (range 0.32 to 0.42 GtCO$_2$e/yr).*

Table 7. Emissions reduction potential reported in the recent literature for "International aviation: enhanced energy efficiency"

Source	Emissions reduction potential in 2030 (GtCO$_2$e/yr)	Scenario definition	Baseline definition	Included (yes=1, no=0)
UNEP (2017)	0.32	Low estimation. Aviation efficiency. Action under USD100/tCO$_2$ in 2030.	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
UNEP (2017)	0.42	High estimation. Aviation efficiency. Action under USD100/tCO$_2$ in 2030.	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
UNEP (2017)	0.3	ICAO's market measures-CORSIA	1.1 GtCO$_2$e in 2030	0
Environmental Defense Fund (*no date)*	2.5	ICAO's market measures-CORSIA	BAU	0
Environmental Defense Fund (*no date)*	3	ICAO's market measures-CORSIA	BAU	0

*A*7: Zero deforestation and restoration of degraded forests (global)

This action aims to achieve zero deforestation by 2025 to 2030 as well as achieving restoration of a considerable amount of degraded forests. A wide range of GHG emissions reduction potential was found in the literature.

Based on the assessment of the literature presented in Table 8*, we estimate the emissions reduction potential in 2030 to be 2.5 GtCO$_2$e/yr (range 1.0 to 4.5 GtCO$_2$e/yr).*

Both nominal and range values were defined manually based on expert judgement. This approach was chosen as the values from the literature considered different assumptions resulting in a wide range of emissions reduction potential as shown in Table 8. Outliers as well as values from literature not especifying a baseline were not considered.

Table 8. Emissions reduction potential reported in the recent literature for "Zero deforestation and restoration of degraded forests (global)"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Roelfsema *et al.* (2018)	0.7	Avoided deforestation. Good practice policies scenario. New York Declaration of Forests	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
Wolosin (2014)	2.2	Avoided deforestation under New York Declaration of Forests. Low estimation	Net forests emissions may fall through 2030 by about 25% with no intervention (from 2010?).	1
Wolosin (2014)	4.1	Avoided deforestation under New York Declaration of Forests. High estimation	Net forests emissions may fall through 2030 by about 25% with no intervention (from 2010?).	1
Wolosin (2014)	1.6	Restoration of degraded forests under New York Declaration of Forests. Low estimation	Net forests emissions may fall through 2030 by about 25% with no intervention (from 2010?).	1
Wolosin (2014)	3.4	Restoration of degraded forests under New York Declaration of Forests. High estimation	Net forests emissions may fall through 2030 by about 25% with no intervention (from 2010?).	1
UNEP (2017)	1.6	Restoration of degraded forests under New York Declaration of Forests. USD100/tCO_2 in 2030. Low estimation based on Verdone *et al.* 2015	Current policies scenario as defined in the UNEP Emissions Gap Report. Action under USD100/tCO_2 in 2030.	1
UNEP (2017)	3.4	Restoration of degraded forests under New York Declaration of Forests. USD100/tCO_2 in 2030. High estimation based on Verdone *et al.* (2015)	Current policies scenario as defined in the UNEP Emissions Gap Report. Action under USD100/tCO_2 in 2030.	1
Roe *et al.* (2017)	1.4	Total Land use change. Lower end. Annual total technical emissions reduction potential for deforestation, wetlands and savannas.	Numbers based on multiple studies, baseline (including baseline year) is not defined	0
UNEP (2017)	3.0	Avoided deforestation under New York Declaration of Forests. USD100/tCO_2 in 2030.	Current policies scenario as defined in the UNEP Emissions Gap Report. Action under USD100/tCO_2 in 2030.	0
Forsell *et al.* (2016)	0.5	Full implementation of INDCs (all conditional and unconditional). Lower end. Reductions compared to 2010 levels	2010 levels and BAU	0
Forsell *et al.* (2016)	1.3	Full implementation of INDCs (all conditional and unconditional). Higher end. Reduction compared to 2010 levels	2010 levels and BAU	0
Roe *et al.* (2017)	6.8	Total land use change. Higher end. Annual total technical emissions reduction potential for deforestation, wetlands and savannas.	Numbers based on multiple studies, baseline (including baseline year) is not defined	0
Roe *et al.* (2017)	1.2	Avoided deforestation. Lower end. Technical emissions reduction potential / year of avoided deforestation. Part of land use change	Numbers based on multiple studies, baseline (including baseline year) is not defined	0
Roe *et al.* (2017)	5.8	Avoided deforestation. Higher end. Technical emissions reduction potential / year of avoided deforestation. Part of land use change	Numbers based on multiple studies, baseline (including baseline year) is not defined	0
Roe *et al.* (2017)	2.1	Restoration of degraded forests. Technical emissions reduction potential part of land use change	Numbers based on multiple studies, baseline (including baseline year) is not defined	0

*A*8: Reduced methane emissions from oil and gas production (global)

This action aims to significantly reduce the amount of methane (CH_4) vented in the oil and gas extraction process around the globe.

Based on the literature values in Table 9*, we estimate the emissions reduction potential in 2030 to be 1.45 GtCO₂e/yr (range 1.1 to 1.8 GtCO₂e/yr).*

Table 9. Emissions reduction potential reported in the recent literature for " Reduced methane emissions from oil and gas production (global)"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Blok *et al.* (2017)	1.8	Action under USD100/tCO_2 in 2030. The number does not include methane emissions from coal, which would add reductions of 0.41 GtonCO_2e/yr	Current policy scenario consistent with the definition in the UNEP Emissions Gap Report. 3.1 GtonCO_2e in 2030 for coal mining, oil and gas systems- From Klimont and Hoglund-Isaksson 2017 (personal communication)	1
Roelfsema *et al.* (2018)	1.1	Good practice policies scenario	Current policy scenario consistent with the definition in the UNEP Emissions Gap Report.	1
UNEP (2017)	1.78	Action under USD100/tCO_2 in 2030.	Current policy scenario	0

*A*9: Apparel industry value chain GHG emissions reductions (global)

This mitigation action aims to reduce GHG emission from the apparel industry value chain, which amounts up to about 8% of global total GHG emissions.

Current estimations are based on the *Measuring Fashion* report (Quantis, 2018), which estimates environmental impacts in the apparel and footwear global industries. The emissions reduction potential stems from including renewable energy, energy efficiency and recycling measures in the apparel industry.

Based on the literature values in Table 10*, we estimate the emissions reduction potential in 2030 to be 1.17 $GtCO_2e$/yr (range 0.29 to 2.04 $GtCO_2e$/yr).*

Table 10. Emissions reduction potential reported in the recent literature for "Fashion industry: value chain GHG emissions reductions (global)"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Quantis (2018)	1.91	Reduction when reaching a 60% RE target by 2030	4.91 $GtCO_2$ in 2030	1
Quantis (2018)	2.04	Reduction when reaching a 60% energy productivity target by 2030. Includes heat and electricity generation during manufacturing processes or yarn preparation, fabric preparation, dyeing and finishing, and assembly.	4.91 $GtCO_2$ in 2030	1
Quantis (2018)	0.29	Reduction when achieving 40% share of recycled fibres by 2030	4.91 $GtCO_2$ in 2030	1

*A*10: International shipping: full implementation of the new target (global)

An emissions reduction potential of 0.39 $GtCO_2$/yr by 2030 (no range) was estimated for the shipping sector based on the new adopted initial strategy by the United Nations International Maritime Organization (IMO, 2018).

Table 11. Emissions reduction potential reported in the recent literature for "International shipping: full implementation of the new target"

Source	Emissions reduction potential in 2030 ($GtCO_2e$/yr)	Scenario definition	Baseline definition	Included (yes=1, no=0)
IMO (2018)	0.39	50% reduction of 2008 by 2050	IEA Current policy scenario	1

*A*11: China peaking its coal consumption earlier than 2020

China peaking its coal consumption was split into feasibility categories 1 (On Track) and 2 (Scale up) resulting into two actions. This was done because the literature consulted considered different coal peak years for China which resulted in a wider range of emissions reduction potential in 2030.

The mitigation action in the “Scale up” feasibility category reflects a more ambitious pathway, where China peaks its coal consumption before 2020. Some sources consider peak year to be 2020 ERI and CNREC (2017), and NRDC (2016), while the China Energy Outlook (Chinese Academy of Social Sciences (CASS), 2015) assumed that Chinese coal consumption already peaked in 2017.

Sources older than 2016 were not considered (Chandler *et al.*, 2015; Chinese Academy of Social Sciences (CASS), 2015). Some scenarios were reviewed but excluded from the determination of the central estimate of the emissions reduction potential.

Based on expert judgement of the literature in Table 12. *we estimate the emissions reduction potential in 2030 to be 1.5 $GtCO_2e$/yr (range 1.0 to 2.0 $GtCO_2e$/yr).*

Both nominal and range values were defined manually based on expert judgement of the consulted literature. We opted for this approach as the peaking years for coal consumption in China varied between sources.

Table 12. Emissions reduction potential reported in the recent literature for "China peaking its coal earlier than 2020"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
ERI and CNREC (2017)	0.99	Below two degree scenario (2DS) scenario coal has already peaked in 2017 (page 355).	Stated policies scenario, similar to Current policy scenario, coal power peak in 2025 (p.355).	1
NRDC (2016)	1.06	Coal cap scenario	Reference scenario. CO_2 emissions to peak in 2020.	1
NRDC (2016)	1.60	Two degree scenario (2DS)	Reference scenario. CO_2 emissions to peak in 2020	1
Zhang *et al.* (2017)	2.87	Carbon policy	no carbon policy	1
IEA (2017)	1.19	NPS	Current policy scenario	1
Climate Action Tracker (2017d)	1.49	Continued coal abatement scenario	Current policy scenario consistent with the definition in the UNEP Emissions Gap Report	0
Chandler *et al.* (2015)	4.87	High efficiency scenario	Baseline scenario (Current policy scenario)	0
Chandler *et al.* (2015)	6.07	High renewables scenario	Baseline scenario (Current policy scenario)	0
Chandler *et al.* (2015)	6.22	low carbon mix scenario	Baseline scenario (Current policy scenario)	0
ERI *et al.* (2016)	4.02	Reinventing fire scenario coal peaks in 2025 at 9,590 $MtCO_2/yr$. Reference scenario coal peaks 2036 at 14,600 $MtCO_2/yr$	Reference Scenario	0
Chinese Academy of Social Sciences (2015)	2.23	EES, coal peaks in 2019	Current policy scenario	0
IEA (2017)	3.81	Sustainable development scenario	Current policy scenario	0

*A*12: Southeast Asian countries slow down coal plant expansion (*e.g.* Indonesia and Vietnam)

This action aims to minimise the growth of coal-fired power plants in the southeast Asia, particularly in Vietnam and Indonesia where a large number of coal plants are currently in the pipeline (Cornot-Gandolphe, 2016; CoalSwarm, 2018; University of Maryland, 2018).

Based on the literature values in Table 13*, we estimate the emissions reduction potential in 2030 to be 0.56 GtCO*$_2$*e/yr (no range).*

The nominal value is solely based on our own calculations of data from the University of Maryland (2018) assuming cancellation of coal plants planned, permitted and in permitting, and taking retirement of existing capacity into account. Values reported in other sources were not considered due to lack of scenario definition or use of different regional scope.

Table 13. Emissions reduction potential reported in the recent literature for "Southeast Asian countries slow down coal plant expansion *(i.e.* Indonesia and Vietnam)"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
University of Maryland (2018)	0.56	Value for ASEAN, based on own calculations. Emissions reduction based on cancellation of plants planned, permitted and permitting. Retirement of existing capacity are accounted for.	IEA WEO 2017 Current policy scenario	1
IEA (2017)	0.41	Sustainable Development Scenario	New policy scenario	0
University of Maryland (2018)	0.2	Value for Indonesia. Emissions reduction based on cancellation of all projects (under construction, planned, permitted and permitting) including expected retirement of current plants. Read manually from Figure 5.	Based on planned, permitted, permitting and projects under construction, as well as expected retirement of current coal plants by 2030.	0

*A*13: Fossil fuels subsidies removal (global)

This mitigation action aims to remove subsidies to fossil fuels globally. The literature reviewed for this mitigation action includes those that assessed the impact of removing fossil fuel subsidies from consumption (Burniaux and Chateau, 2014; Schwanitz *et al.*, 2014; Jewell *et al.*, 2018) as well as subsidies on production (Merrill *et al.*, 2015; Mendelevitch, 2016; Gerasimchuk *et al.*, 2017; Richter, Mendelevitch and Jotzo, 2018). Studies which only estimated emissions reductions potential of removing subsidies in coal (Mendelevitch, 2016; Richter, Mendelevitch and Jotzo, 2018) were not included in the final numbers.

Based on the literature values in Table 14*, we estimate the emissions reduction potential in 2030 to be 2.3 GtCO*$_2$*e/yr (range 0.5 to 4.12 GtCO*$_2$*e/yr).*

Table 14. Emissions reduction potential reported in the recent literature for “Fossil fuels subsidies removal (global)”

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Gerasimchuk *et al.* (2017)	1.09	Low estimate	IEA Current policy scenario	1
Gerasimchuk *et al.* (2017)	4.12	High estimate. Assumes oil price remains at 2015-16 level	IEA Current policy scenario	1
Jewell *et al.* (2018)	0.5	Manually read from Figure 3-a. The impact of subsidy removal on global annual CO_2 emissions from fossil fuels and industry compared to each model’s Baseline in Gt/yr. Emissions reductions based on different IAMs. Lower end. IAM model IMAGE	Different in each model but based on SSP2- middle of the road. Represents continuation of current trends	1
(Jewell *et al.*, 2018)	2.2	Manually read from Figure 3-a. The impact of subsidy removal on global annual CO_2 emissions from fossil fuels and industry compared to each model’s Baseline in Gt/yr. Emissions reductions based on different IAMs. Higher end. IAM model WITCH	Different in each model but based on SSP2- middle of the road. Represents continuation of current trends	1
Merrill *et al.* (2015)	0.7	Removal of fossil fuel subsidies in 20 countries	BAU	1
Burniaux and Chateau (2014)	2.73	Central scenario	ENV-Linkages baseline. BAU in terms of policies	1
Schwanitz *et al.* (2014)	2.8	All subsidies are removed by 2020	No climate policy scenario Ref case- keeps subsidies and taxes constant at current (2014) levels	1
Schwanitz *et al.* (2014)	0.8	Optimistic interpretation of G20 initiative to reduce subsidies	No climate policy scenario Ref case- keeps subsidies and taxes constant at current (2014) levels	1
Schwanitz *et al.* (2014)	1.8	Subsidies are removed for Iran, Nigeria, members of APEC and G20	No climate policy scenario Ref case- keeps subsidies and taxes constant at current (2014) levels	1
Mendelevitch (2016)	0.08	Removal of coal subsidies. 87% of coal production in 2013 is covered	Reference scenario adapted from WEO NPS	0
Richter, Mendelevitch and Jotzo (2018)	1.90	Coal tax. Common 10USD/tCO_2 tax. All producers+ production tax	WEO NPS	0
Jewell *et al.* (2018)	1.3	Manually read from Figure 3-a. The impact of subsidy removal on global annual CO_2 emissions from fossil fuels and industry compared to each model’s Baseline in Gt/yr. Emissions reductions based on different IAMs. Higher end. IAM model MESSAGE	Different in each model but based on SSP2- middle of the road. Represents continuation of current trends	0
Jewell *et al.* (2018)	1.3	Manually read from Figure 3-a. The impact of subsidy removal on global annual CO_2 emissions from fossil fuels and industry compared to each model’s Baseline in Gt/yr. Emissions reductions based on different IAMs.. Higher end. IAM model REMIND	Different in each model but based on SSP2- middle of the road. Represents continuation of current trends	0
Jewell *et al.* (2018)	1.0	Manually read from Figure 3-a. The impact of subsidy removal on global annual CO_2 emissions from fossil fuels and industry compared to each model’s Baseline in Gt/yr. Emissions reductions based on different IAMs. Higher end. IAM model GEM-E3	Different in each model but based on SSP2- middle of the road. Represents continuation of current trends	0

*A*₁₄: Fast uptake of electric vehicles (EVs) (global)

This action will accelerate electric vehicle (EVs) uptake within the global light-duty vehicles market, putting EVs far along the steep technology diffusion “S-curve,” in the light duty vehicles market globally by 2030.

Based on the literature values in Table 15*, we estimate the emissions reduction potential in 2030 to be 0.6 GtCO₂e/yr (range 0.5 to 0.7 GtCO₂e/yr).*

Table 15. Emissions reduction potential reported in the recent literature for “Fast uptake of electric vehicles (EVs) (global)”

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Roelfsema *et al.* (2018)	0.7	Good practice policies scenario: 50% EV share in new sales in 2030, powered by RE electricity.	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
Fulton, Mason and Meroux, (2017)	0.5	Low value (2R scenario). By 2040 automated EVs dominate LDV sales worldwide.	BAU (The BAU scenario includes no major changes to the course of current policies affecting urban transport or land use.)	1
Fulton, Mason and Meroux, (2017)	1.2	High value (3R scenario). Shared mobility strengthened compared to the 2R scenario.	BAU (The BAU scenario includes no major changes to the course of current policies affecting urban transport or land use.)	0

*A*₁₅: China peaking its oil consumption early

China’s oil consumption is projected to grow in the coming years because of its growing car market (IEA, 2017). This mitigation action looks at China peaking it oil consumption earlier than anticipated.

Based on the literature values in Table 16*, we estimate the emissions reduction potential in 2030 to be 0.35 $GtCO_2e/yr$ (range 0.19 to 0.52 $GtCO_2e/yr$).*

Table 16. Emissions reduction potential reported in the recent literature for “China peaking its oil consumption early”

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
ERI and CNREC (2017)	0.45	2°C scenario	Standard polices	1
IEA (2017)	0.21	NPS	Current policy scenario	1
IEA (2017)	0.52	SDS	Current policy scenario	1
NRDC (2016)	0.19	Energy savings scenario. Peak in 2030	Reference scenario	1
NRDC (2016)	0.27	2°C scenario peak in 2030	Reference scenario	1
NRDC (2016)	0.19	Coal cap scenario. Peak in 2030	Reference scenario	1

A_{16}: Reduction of Canadian tar sands emissions

To the authors' knowledge there are no studies estimating emissions reduction potential from reducing Canadian tar sands production consistent with Canada's international climate commitment. Therefore, we estimated two possible pathways based on the following assumptions:

- Canada committed to an (overall) GHG reduction target of 30% below 2005 levels without providing specifics on sector emission allocations (Environment and Climate Change Canada, 2017). Assuming equal emission reduction allocation per sector, we estimate a scenario where emissions from tar sands are cut by 30% in 2030 from 2005 levels.
- As emissions from tar sands increased from 2005 and 2015, we estimate the low end of the emissions reduction potential as 30% reduction by 2030 from 2015 values.

Based on the assumptions, we estimate the emissions reduction potential in 2030 to be 0.08 $GtCO_2e/yr$ (range 0.07 to 0.09$GtCO_2e/yr$).

A_{17}: United States on track for deep 2050 targets

In accordance with Article 4 of the Paris Agreement, the Obama administration submitted a "Mid-century Strategy for Deep Decarbonization" (The White House, 2016). The strategy sets an emissions reduction target of 80% or more below 2005 levels in 2050[3], which according to the Climate Action Tracker's US assessment (Climate Action Tracker, 2018b), is equivalent to 68 to 76% emissions reduction below 2005, excluding LULUCF — depending on the magnitude of the LULUCF sinks. This strategy mentions required actions in three main categories:1) transitioning to a low-carbon energy system (*e.g.* reducing energy waste and decarbonising the electricity, transports and buildings sectors — through the use of low and zero carbon emission fuels) 2) Sequestering carbon through forests, soils, and CO_2 removal technologies, and 3) reducing non-CO_2 emissions. This mitigation action focuses on the United States being on track to achieve its Mid-century Strategy for Deep Decarbonization target in 2030.

Based on the literature values in Table 17*, we estimate the emissions reduction potential in 2030 to be 1.15 $GtCO_2e/yr$ (range 0.3 to 2.0 $GtCO_2e/yr$).*

These values include all sources listed in Table 17 with exception of Ramseur (2017), as no economy-wide projections were included in this source and only projected emissions from electricity generation and not the other measures specified above.

We estimate that this action has approximately 75% overlap with all of the previous actions in the overlap matrix. This value is not 100% (full overlap with previous actions) as some economy-wide decarbonization actions such as fuel decarbonization (*e.g*. use of hydrogen or biofuels), energy efficiency or industrial CCS included in the United States' Mid-century Strategy for Deep Decarbonization are not included in this study.

[3] This target includes emissions from Land Use, Land Use Change and Forestry Sector (LULUCF).

Table 17. Emissions reduction potential reported in the recent literature for "United States on track for deep 2050 targets"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Climate Action Tracker (2017c)	1.5	Manually read from Exhibit I, vs. AEO2017. CO_2 only	AEO2017	1
Climate Action Tracker (2017c)	0.37	Current policy projections with Clean Power Plan (CPP) vs CPS without CPP	Current policy projections	1
Larsen *et al.* (2017)	0.47	26-28% emissions reduction below 2005 levels as per Rhodium 2017	Rhodium baseline. Includes current policies at federal level (CAFÉ stds, oil and gas methane stds, Kigali) as well as state and city policies as of April 2017 (excluding emission reduction targets without support of binding policies). Does not include Clean Power Plan or Trump's potential policies from its campaign (expansion of offshore oil and gas)	1
Larsen *et al.* (2017)	0.91	26-28% reduction below 2005 levels as per Rhodium 2017	Rhodium baseline. Includes current policies at federal level (CAFÉ stds, oil and gas methane stds, Kigali) as well as state and city policies as of April 2017 (excluding emission reduction targets without support of binding policies). Does not include Clean Power Plan or Trump's potential policies from its campaign (expansion of offshore oil and gas)	1
Climate Advisers (2017)	0.8	Obama scenario vs. reference scenario	reference scenario	1
Gowrishankar and Levin (2017)	1.4	DDPP mixed case	DDPP/NRDC baseline	1
Gowrishankar and Levin (2017)	1.9	NRDC core scenario	DDPP/NRDC baseline	1
The White House (2016)	0.3	Straight line pathways to 74-86% reductions in 2015 high	EIA AEO2016 low	1
The White House (2016)	2.0	Stretch technology + policy	EIA AEO2016 high	1
Ramseur (2017)	0.38	Ramseur Clean Power Plan scenario	Baseline scenario (16% below 2005 levels in 2030)	0

*A*18: European Union's 40% to 60% GHG emissions reductions by 2030

The Climate Action Tracker (2017d) has estimated that the European Union (EU) can reach its target of 40% GHG emissions reduction by 2030 with current implemented policies. This mitigation action aims at the European Union setting and achieving a more ambitious GHG emissions reduction target for 2030.

Based on expert judgement of the literature in Table 18 *and Climate Action Tracker's EU's country analysis* (2017d), *we estimate the GHG emissions reduction potential in 2030 to be 0.55 $GtCO_2e/yr$ (range 0 to 1.1 $GtCO_2e/yr$).*

The nominal value corresponds to a 50% reduction by 2030 below 1990 levels, while the range corresponds to a 40% to 60% reduction. The lower end is 0 $GtCO_2e/yr$ because according to analysis by the Climate Action Tracker (2017d), the EU can reach its target of 40% GHG emissions reduction by 2030 with current implemented policies (CPS). Thus, the 40% GHG emissions reduction in 2030 corresponds to the baseline. Conservative estimates were made by excluding scenarios with more than 60% reduction below 1990 levels in 2030.

We estimate that this action has approximately 75% overlap with all of the previous actions in the overlap matrix. The overlap is not 100% because some actions, such as electrification of heat, faster coal reduction in the EU, circular economy in the industry, bio-energy with carbon capture and storage (BECCS) and a carbon tax could be implemented to achieve the target. However, these actions are not included in this study.

Table 18. Emissions reduction potential reported in the recent literature for "European Union's 40% to 60% GHG emissions reductions by 2030"

Source	**Emissions reduction potential in 2030 ($GtCO_2e/yr$)***	**Scenario definition**	**Baseline definition**	**Included (yes=1, no=0)**
Cornet *et al.* (2018)	0.83	55% reduction by 2030. Lower end. EU-wide implementation of best practice policies in the power, transport, buildings and industrial sectors.	EU current policy projections in 2030 from Climate Action Tracker (2017d).	1
Cornet *et al.* (2018)	1.22	62% reduction by 2030. Higher end. EU-wide implementation of best practice policies in the power, transport, buildings and industrial sectors.	EU current policy projections in 2030 from Climate Action Tracker (2017d).	0
Climate Action Tracker (2018c)	0.66	52% reduction vs. 1990 levels Scaling up action in the EU;s electricity supply, residencial building and passenger rorad and rail transport.	EU current policy projections in 2030 from Climate Action Tracker (2017d).	1
Pestiaux *et al.* (2018)	0.55	50% reduction below 1990 levels under 32.5 EE / 32 RES scenario	EU current policy projections in 2030 from Climate Action Tracker (2017d).	1
Pestiaux *et al.* (2018)	0.83	55% reduction below 1990 levels under Technology Scenario	EU current policy projections in 2030 from Climate Action Tracker (2017d).	1
Pestiaux *et al.* (2018)	1.11	60% reduction below 1990 levels under Shared Efforts Scenario	EU current policy projections in 2030 from Climate Action Tracker (2017d).	1
Pestiaux *et al.* (2018)	1.38	65% reduction below 1990 levels under Demand Focus Scenario	EU current policy projections in 2030 from Climate Action Tracker (2017d).	0

* The emissions reduction potential values were calculated by the authors based on the percentage reduction values below 1990 levels reported in the literature. We used the EU's Curent Policy Projections from the Climate Action Tracker (2017d) as baseline, which estimated that the EU is will achieve 40% emissions reductions in 2030 below 1990 levels. For example, a scenario with a 60% reduction below 1990 levels in 2030 was assumed to deliver an additional annual emissions reductions equivalent to (60% - 40%) = 20% of 1990 emissions as reported in the Climate Action Tracker (2017d).

*A*19: Implementation of conditional NDCs (global)

Individual countries have submitted Nationally Determined Contributions (NDCs) under the Paris Agreement. Some countries have put forward two different types of NDCs: conditional and unconditional. These NDCs are emission reduction targets for 2030 where countries commit either on a voluntary basis—unconditional NDCs—or conditional basis contingent on the provision of international financial support, technology transfer, and capacity building. Countries' conditional NDCs represent a higher level of feasibility than their unconditional counterparts. This action assumes all countries with unconditional NDCs receive the resources they need to achieve their conditional NDCs.

Based on the UNEP Emissions Gap Report (2017)*, we estimate the emissions reduction potential in 2030 to be 2.5 GtCO$_2$e/yr (no range).*

We consider that this action has approximately 75% overlap with all of the previous actions in the overlap matrix. This value is not 100% because some actions, such as efficiency in passenger vehicles, efficient appliances (except for India), afforestation, and use of low energy sources (including CCS), are not included in this study.

2.3 Feasibility category 3: Need Focus

*A*20: Strengthened energy and material efficiency in the industry (global)

The industrials sector is often considered one of the most challenging in terms of unlocking GHG emissions reduction potential. Although the sector can be politically — and for some sub-sectors technologically — challenging, a long-term decarbonisation of the industry is essential to meet the long-term goal of the Paris Agreement. This mitigation action assumed strengthened energy and material efficiency in the industrial sector.

Based on the literature values in Table 19*, we estimate the emissions reduction potential in 2030 to be 1.6 $GtCO_2e/yr$ (range 1.0 to 2.2 $GtCO_2e/yr$).*

Table 19. Emissions reduction potential reported in the recent literature for "Strengthen energy and material efficiency in the industry"

Source	**Emissions reduction potential in 2030 ($GtCO_2e/yr$)**	**Scenario definition**	**Baseline definition**	**Included (yes=1, no=0)**
Blok *et al.* (2017)	2.2	Direct energy efficiency Action under USD100/tCO_2 in 2030.	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
Roelfsema *et al.* (2018)	1.0	Good practice policies scenario: 1% annual energy savings improvement above current efforts until 2030	Current policies scenario as defined in the UNEP Emissions Gap Report.	1

*A*21: Deployment of near zero emissions buildings and efficient appliances and lighting (global)

Another area with major challenges in unlocking GHG emissions reduction potential is the buildings sector. Studies indicate that urgent large-scale deployment of near zero energy buildings for new builds and enhanced retrofits of existing buildings to near zero emissions will be necessary to achieve the long-term goal of the Paris Agreement (Climate Action Tracker, 2016). This action assumes a high global deployment of near zero energy buildings and efficient appliances and lighting.

Based on the literature values in Table 20*, we estimate the emissions reduction potential in 2030 to be 1.55 $GtCO_2e/yr$ (range 1.0 to 2.1 $GtCO_2e/yr$).*

Table 20. Emissions reduction potential reported in the recent literature for "Deployment of near zero emissions buildings and efficient appliances and lighting (global)"

Source	**Emissions reduction potential in 2030 ($GtCO_2e/yr$)**	**Scenario definition**	**Baseline definition**	**Included (yes=1, no=0)**
UNEP (2017)	1.6	Low value. Includes enhanced retrofitting, near zero energy new buildings and efficient appliances and lighting. Action under USD100/tCO_2 in 2030	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
UNEP (2017)	2.1	High value. Includes enhanced retrofitting, near zero energy new buildings and efficient appliances and lighting. Action under USD100/tCO_2 in 2030	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
Roelfsema *et al.* (2018)	1.0	Good practice policies scenario: net zero energy in new buildings by 2030 and efficiency standards for appliances and lighting	Current policies scenario as defined in the UNEP Emissions Gap Report.	1

*A*22: Agriculture: reduced meat consumption (global)

This action assumes a reduction of meat consumption globally. The literature reviewed included studies focusing only on demand-side estimates of emission reduction potentials from reducing meat consumption. Values estimated from switching to a vegetarian or vegan diet are not considered.

Based on expert judgement of the literature values in Table 21, we estimate the emissions reduction potential in 2030 to be 1.0 $GtCO_2e$/yr (range 0.37 to 4.41 $GtCO_2e$/yr).

The nominal value was defined manually based on expert judgement of the consulted literature. We decided on this approach given the high uncertainty in the emissions reduction potential of reducing meat consumption.

Table 21. Emissions reduction potential reported in the recent literature for "Agriculture: reduced meat consumption (global)"

Source	Emissions reduction potential in 2030 ($GtCO_2e$/yr)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Blok *et al.* (2017)	0.37	Low estimate Action under USD100/tCO_2 in 2030.	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
Blok *et al.* (2017)	1.37	High estimate Action under USD100/tCO_2 in 2030.	Current policies scenario as defined in the UNEP Emissions Gap Report.	1
Roe *et al.* (2017)	2.15	Represents healthy diet (based on Harvard's definition- 0.8g/kilo body weight) From Dickie *et al.* 2014. Lower end. Technical emissions reduction potential/ year of shifting to healthy diets (demand side measures)	Baseline:11.9$GtCO_2e$ in 2030 in Dickie *et al.* 2014 from Stehefest *et al.* 2009 and Smith *et al.* 2013.	1
Grosso and Cavigelli (2012)	2.86	Low emissions reduction potential: At least 50% of global population convert to recommended healthy diet	Current projection (2008,2010) approx. 17500TgCe or 64$GtCO_2e$	1
Grosso and Cavigelli (2012)	4.41	Medium emissions reduction potential: At least 50% of global population convert to no ruminants diet	Current projection (2008,2010) approx. 17500TgCe or 64$GtCO_2e$	1
Roe *et al.* (2017)	5.8	Represents vegetarian diet (From Stehfest 2009, Tilman and Clark 2014, Bajzelj 2014, Hedenus *et al* 2014, Springmann *et al.* 2016). Higher end. Technical emissions reduction potential/ year of shifting to healthy diets (demand side measures)	Baseline:11.9$GtCO_2e$ in 2030 in Dickie *et al.* 2014 from Stehefest *et al.* 2009 and Smith *et al.* 2013.	0
Grosso and Cavigelli (2012)	6.4	High emissions reduction potential: At least 50% of global population convert to vegan diet	Current projection (2008,2010) approx. 17500TgCe or 64$GtCO_2e$	0

*A*23: Efficient cooling in buildings (global)

Regions with hot weather are now experiencing higher temperatures which are likely to increase in coming years with climate change. Energy use for air conditioning and fan ventilation accounts for 20% of the world's energy use (OECD/IEA, 2018). This mitigation action assumes adoption of efficient cooling in buildings worldwide.

Based on the literature values in Table 22*, we estimate the emissions reduction potential in 2030 to be 0.84 $GtCO_2e$/yr (range 0.48 to 1.20 $GtCO_2e$/yr).*

For the estimation of the nominal and range values, only literature with global values were considereds whereas studies considering only certain regions or countries were not.

Table 22. Emissions reduction potential reported in the recent literature for " Efficient cooling in buildings (global)"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Green Cooling Initiative (2015)	1.20	Mitigation scenario. (MIT) WORLD	BAU (6.48 Gt CO_2e in 2030 from cooling sector)	1
CLASP (2018)	0.48	Emissions savings from transitioning to energy-efficient ACs in 150 countries. Based on U4E study. Aggregation of all studies countries. The emissions reduction is estimated by supplying the 2030 demand of air conditioners (~1600 Million units) with already available energy efficient ACs.	BAU - no policies (projected demand of air conditioners: 1600 Million units in 2030)	1
Green Cooling Initiative (2015)	0.14	Mitigation scenario for India (MIT India)	BAU (0.852 Gt CO_2e in 2030 from cooling sector)	0
U4E and UNEP (2018)	0.028	Only India Policy Scenario (MEPS)	BAU (no policy intervention, Energy efficiency improves at 1% per year)	0
U4E and UNEP (2018)	0.033	Only China. Best Available Technology (BAT) Scenario	BAU (no policy intervention, Energy efficiency improves at 1% per year)	0

*A*24: Reduction of China's non-CO_2 GHG emissions

This action looks at the potential for reducing non-CO_2 gas emissions in China. Non-CO_2 GHGs accounted for around 17% of China's total emissions in 2012 (People's Republic of China, 2016) and the share is expected to increase substantially by 2030 (Climate Action Tracker, 2018a).

Based on literature in Table 23*, we estimate the emissions reduction potential in 2030 to be 0.82 $GtCO_2e/yr$ (no range).*

Currently, only the emissions reduction potential from Bo *et al.* (2016) is used as emissions from ERI and CNREC (2017) are not provided in CO_2e and conversion would implicate multiple assumptions.

Table 23. Emissions reduction potential in recent literature for "Reduction of China's non-CO_2 GHG emissions"

Source	Emissions reduction potential in 2030 ($GtCO_2e/yr$)	Scenario definition	Baseline definition	Included (yes=1, no=0)
Bo *et al.* (2016)	0.82	Reduction potential based on technical feasibility (neglecting policy, legislative and financial barriers). Equivalent to almost a third of China's estimated non-CO_2 GHG emissions in 2030	Baseline projection: approx. 2.8 $GtCO_2e/yr$ in 2030. Baseline based on three different studies published between 2012 and 2015 (existing policies and current growth projections all differ due to different publication date).	1
ERI and CNREC (2017)	NA	Below 2°C scenario	Stated Policies scenario	0

3 Summary of nominal GHG emission reduction potentials (central estimate values) for all actions and overlaps between actions

Table 24. Overview of nominal GHG emission reduction potentials for all actions and total overlap rate with preceding actions

Action no.	Action	Category	GHG emissions reduction potential ($GtCO_2e/yr$) (central estimate based on the literature) (*ERP*)	Total overlap with preceding actions in the list (%-potential of action)* (*TOR*)
A_1	Faster uptake of renewables following most recent market trends	1 - On Track	2.2	0%
A_2	China peaking its coal in 2025	1 - On Track	1.0	13%
A_3	HFC cuts under the Kigali Amendment and more ambitious reductions (global)	1 - On Track	1.0	0%
A_4	India renewable energy, energy efficiency penetration, and coal shifts	1 - On Track	0.6	5%
A_5	Faster uptake of renewables following leaders (global)	2 - Scale Up	6.0	8%
A_6	International aviation: enhanced energy efficiency	2 - Scale Up	0.37	0%
A_7	Zero deforestation and restoration of degraded forests (global)	2 - Scale Up	2.5	0%
A_8	Reduced methane emissions from oil and gas production (global	2 - Scale Up	1.45	10%
A_9	Fashion industry: value chain GHG emissions reductions (global)	2 - Scale Up	1.17	95%
A_{10}	International shipping: full implementation of the new target	2 - Scale Up	0.39	7%
A_{11}	China peaking its coal earlier than 2020	2 - Scale Up	1.5	70%
A_{12}	Southeast Asian countries slow down coal plant expansion (*i.e.* Indonesia and Vietnam)	2 - Scale Up	0.56	25%
A_{13}	Fossil fuel subsidies removal (global)	2 - Scale Up	2.3	60%
A_{14}	Fast uptake of electric vehicles (EVs) (global)	2 - Scale Up	0.6	100%
A_{15}	China peaking its oil consumption early	2 - Scale Up	0.35	100%
A_{16}	Reduction of Canadian tar sands production	2 - Scale Up	0.08	100%
A_{17}	United States on track for deep 2050 targets	2 - Scale Up	1.15	75%
A_{18}	European Union's 40% to 60% GHG emissions reductions by 2030	2 - Scale Up	0.55	75%
A_{19}	Implementation of conditional NDCs	2 - Scale Up	2.5	75%
A_{20}	Strengthened energy and material efficiency in the industry (global)	3 - Need Focus	1.6	75%
A_{21}	Deployment of near zero emissions buildings and efficient appliances and lighting (global)	3 - Need Focus	1.55	90%
A_{22}	Agriculture: reduced meat consumption (global)	3 - Need Focus	1.0	12%
A_{23}	Efficient cooling in buildings (global)	3 - Need Focus	0.84	100%
A_{24}	Reduction of China's non-CO_2 GHGs	3 - Need Focus	0.82	100%
A_1-A_{24}	**Gross sum of GHG emissions reduction potential ($GtCO_2e/yr$) from all 24 actions (central estimate)**	**N/A**	**32.1**	**N/A**

*Note: for all overlaps >20%, the total overlap rate was rounded to the nearest 5%

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