

## SUPPLEMENTARY DATA

# Analysis of the Copenhagen Accord pledges and its global climatic impacts—a snapshot of dissonant ambitions

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### List of abbreviations

AAU: Assigned amount unit

BAU: Business-as-usual

CA: Copenhagen Accord

COP15: Fifteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change

CP1: First commitment period of the Kyoto Protocol (2008 to 2012)

CSG: PRIMAP composite source generator

EU: European Union

GDP: Gross domestic product

GHG: Greenhouse gas

IPCC: Intergovernmental Panel on Climate Change

KP: Kyoto Protocol

LUC: Land use change

LUCF: Land use change and forestry

LULUCF: Land use, land use change and forestry

NAMA: Nationally appropriate mitigation action

PRIMAP: Potsdam Real-time Integrated Model for the probabilistic Assessment of emission Pathways

RCP: Representative concentration pathways

TBD: To be determined

UNFCCC: United Nations Framework Convention on Climate Change

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## Emission reductions overview

**Supplementary table S1.** Developed country Copenhagen Accord pledges for 2020 as applied in this analysis. The lower end of the ranges below is applied for the case 1, the higher end for case 2.

Party	Information on pledges		Origin of pledge	Inclusion of LULUCF <sup>a</sup>	Inclusion of mechanisms
	Reduction by 2020	Reference year			
Australia	-5 to -15%; or -25%	2000	CA	Yes	Yes
Belarus	-5 to -10%	1990	CA	Yes	The QUELROs are conditional on access to mechanisms
Canada	-17%	2005	CA	Preliminary range of -2 to 2% of total 2006 emissions	No significant use of mechanisms
Croatia	-5%	1990	CA	Yes	TBD
European Union (EU27 <sup>b</sup> )	-20 to -30%	1990	Adopted legislation/CA	-20%: no; -30%: preliminary range of -3 to 3% of 1990 levels	Preliminary estimates of 4% for -20% and 9% for -30%
Iceland	-30%	1990	CA	Substantial contribution	Limited use of mechanisms
Japan	-25%	1990	CA	Preliminary range of 1.5 to 2.9% of 1990 emissions	TBD
Kazakhstan <sup>c</sup>	-15%	1992	CA	TBD	TBD
Liechtenstein	-20 to -30%	1990	CA	No	10 to 40%
Monaco	-30%	1990	CA	No	Yes
New Zealand	-10 to -20%	1990	CA	Yes	Yes
Norway	-30 to -40%	1990	CA	Around 6% (3 MtCO <sub>2</sub> eq)	Yes for -30%; yes for -40%
Russian Federation	-15 to -25%	1990	CA	TBD	TBD
Switzerland	-20 to -30%	1990	CA	Yes, under current accounting rules	Legally binding cap of 50% of the target on mechanisms. Preliminary estimate of around 36% of the 20% target and 42% of the 30% commitment
Ukraine	-20%	1990	CA	TBD	Yes
United States	-17%	2005	CA	Yes	Yes

<sup>a</sup> Inclusion or exclusion of LULUCF is not stated in the Copenhagen Accord submissions. For this study, this information was drawn from analysis of the party positions.

<sup>b</sup> Total emissions for the European Community include emissions from the inventory submission of the 15 member states that are bound by the provision of Article 4 from the Kyoto Protocol and emissions from the remaining member states that are also included in Annex I to the Convention.

<sup>c</sup> Not considered in the aggregates for Annex I, for comparability reasons with the IPCC ranges. Analogously, Turkey, Cyprus and Malta are considered in Annex I aggregates despite not being members of Annex B to the Kyoto Protocol.

**Supplementary table S2.** Developed country pledges for 2050 as applied in case 1.  
 Countries without a 2050 reduction target follow a reference growth scenario.

Party	Information on reductions by 2050	
	Emissions reduction	Reference year
Australia	-60%	2000
Belarus	—	—
Canada	-60%	2006
Croatia	-80%	1990
EU27	-80%	1990
Iceland	-50%	1990
Japan	-60%	2005
Liechtenstein	-50%	1990
Monaco	-60%	1990
New Zealand	-50%	1990
Norway	-80%	1990
Russian	-50%	1990
Switzerland	-80%	1990
Ukraine	-50%	1990
USA	-83%	2005
Kazakhstan	—	—

**Supplementary table S3.** Overview of developing country parties considered in this analysis and short description of their NAMAs as stated in their submissions to the CA.

Party	NAMA
Brazil	Detailed list of domestic actions with quantified mitigation potentials
China	To lower its carbon dioxide emissions per unit of GDP by 40–45% by 2020 compared to the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020 and increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from the 2005 levels
Costa Rica	To become carbon neutral by 2021
Ethiopia	Detailed list of actions in the field of energy and forestry No quantified mitigation potentials
India	To reduce emission intensity of its GDP by 20–25% by 2020 in comparison to the 2005 level
Indonesia <sup>a</sup>	To reduce emissions 26% from BAU by 2020 unilaterally, 41% with international support
Israel	Reduce its CO <sub>2</sub> emissions by 20% compared to a BAU scenario
Jordan	A qualitative list of NAMAs without quantified mitigation potentials
Macedonia (FYR)	Extensive ‘climate change mitigation’ plan with quantified mitigation potentials for various sectors.
Maldives	To become carbon neutral by 2020
Mexico	To reduce its GHG emissions up to 30% with respect to the business as usual scenario by 2020.
Morocco	Detailed list of NAMAs with quantified mitigation potentials
Republic of Korea	To reduce national GHG emissions by 30% from BAU emissions by 2020
Singapore	To reduce its GHG emissions by 16% below BAU levels in 2020
South Africa	Nationally appropriate mitigation action to enable a 34% deviation below BAU emissions by 2020 and 42% by 2025 (both conditional on provision of support)

<sup>a</sup> Indonesia did not include the higher end of their NAMA in their Copenhagen submission. See the main paper for a discussion of the influence of this modification.

**Supplementary table S4.** International aviation and shipping pledges.

Sector	Target
International aviation	<p>The International Air Transportation Association (IATA) states that: 'a collective CO<sub>2</sub> efficiency target should be established for the near-term through 2020. The aviation sector recommends that a target to improve CO<sub>2</sub> efficiency by an average of 1.5 per cent per annum (on a CO<sub>2</sub> emissions per revenue tonne kilometre (RTK) basis) be established. [...] a mid-term target to stabilize net CO<sub>2</sub> emissions from aviation from 2020 onward (carbon-neutral growth), [...]. A long-term aspirational goal would be to reduce aviation net carbon emissions by 50 per cent in 2050, compared to 2005 levels.'</p> <p><i>Quantitative</i> For this analysis, emissions for the international aviation sector are increasing 60% above 2005 levels in 2020 after which they stay constant for a decade. Furthermore, emission levels are halved with respect to 2005 by 2050.</p>
International shipping	<p>The International Chamber of Shipping (ICS) states that: 'The shipping industry therefore accepts that the CO<sub>2</sub> emission reduction which ships must aim to achieve should be at least as ambitious as the CO<sub>2</sub> emission reduction agreed under any new United Nations Climate Change Convention.'</p> <p><i>Quantitative</i> For this analysis emissions from the international shipping sector are thus following the same growth path as the aggregated emissions of all countries after application of the emission reductions.</p>

**Supplementary table S5.** Developed country (Annex I) 2020 emission levels.

ANNEX I	Assessment of 2020 target [MtCO <sub>2</sub> eq]		
	Total emissions excluding LULUCF		
	Party	PRIMAP4	Case 1
Australia	577.64	529.45	425.56
Belarus	86.53	127.84	116.22
Canada	766.85	583.71	606.70
Croatia	35.02	31.06	29.81
EU27	4 718.56	4 454.77	3 899.23
Iceland	4.10	2.48	2.32
Japan	1 175.26	989.15	952.24
Kazakhstan	337.99	269.00	269.00
Liechtenstein	0.28	0.18	0.16
Monaco	0.11	0.08	0.08
New Zealand	78.02	68.38	49.48
Norway	48.17	36.77	29.82
Russian Federation	2 540.92	2 954.20	2 489.50
Switzerland	45.31	42.49	36.90
Turkey	485.75	485.75	485.75
Ukraine	479.50	790.68	740.83
United States	6 779.98	6 121.62	5 878.24

**Supplementary table S6.** Developing country (Non-Annex I) 2020 emission levels.

NON-ANNEX I  Party	Assessment of 2020 emissions [MtCO <sub>2</sub> eq]		
	Total emission excluding LUC		
	PRIMAP4	Case 1	Case 2
Brazil	1 184	819	819
China	11 894	11 898	11 098
Costa Rica	15	1	1
Ethiopia	116	116	116
India	2 961	2 660	2 660
Indonesia	839	515	515
Israel	128	102	102
Jordan	60	54	54
Macedonia (FYR)	14	11	11
Maldives	1	1	1
Mexico	810	640	640
Morocco	98	59	59
Republic of Korea	637	605	605
Singapore	67	56	56
South Africa	541	496	496

**Supplementary table S7.** 2020 emission levels for international bunkers (global).

INTERNATIONAL BUNKERS  Sector	Nominal 2020 target [MtCO <sub>2</sub> eq]	
	Total emission excluding LUC	
	Case 1	Case 2
Shipping	1 136	1 022
Aviation	737	737

## Scenario overview

**Supplementary table S8.** 2020 case definition and assumptions.

Name	Definition and assumptions
Case 1	Lower end of ranges of targets and actions pledged to the CA. Credits and debits from LULUCF accounting influence 2020 emission levels. Surplus AAUs banked from KP CP1 are used as a linearly increasing wedge from 2013 onwards.
Case 2	Higher end of ranges of targets and actions pledged to the CA. Credits and debits from LULUCF accounting have net zero effect on 2020 emission levels. Surplus AAUs are eliminated.



**Supplementary table S9.** Overview of scenarios.

Nr	Short name	Description
0	PRIMAP4 reference scenario	Reference scenario based on the composite PRIMAP4 scenario and the global deforestation pathway of the RCP8.5 scenario. The reference scenarios for international shipping and international aviation (see the main article) are also part of the used reference scenario.
1	Case 1 scenario with reference post-2020 growth	Scenario with case 1 assumptions for 2020. Where applicable weak 2050 pledges from before the CA are used for developed countries. If no 2050 pledge was available, emissions are kept at a fixed percentage below BAU, equivalent to the percentage observed in 2020. For the global deforestation pathway, the RCP8.5 scenario is used, reduced by the deforestation reduction pledges. In the lower case only Brazil and Indonesia are significant contributors to these reductions.
2	Case 1 scenario with global 2050 target	Scenario with the same assumptions as Scenario 1, but with a global 2050 target of halving global emissions by 2050 from 1990 levels. After 2050 emissions are further declining exponentially with the average reduction found in the last decade before 2050.
3	Case 2 scenario with reference post-2020 growth	Scenario with case 2 assumptions for 2020. Where applicable weak 2050 pledges from before the CA are used for developed countries. If no 2050 pledge was available, emissions are kept at a fixed percentage below BAU, equivalent to the percentage observed in 2020. For the global deforestation pathway, the RCP8.5 scenario is used, reduced by the deforestation reduction pledges. In this optimistic case reductions for Indonesia are significant increased. The full difference between Indonesia's low and high pledge are assumed to take place in reduction of deforestation and peat emissions. Half of the additional support for a 0.72 GtCO <sub>2</sub> eq reduction of deforestation pledged by the USA is used for reductions in Brazil and Indonesia, while the other half supports reductions in Africa.
4	Case 2 scenario with global 2050 target	Scenario with the same assumptions as Scenario 3, but with a global 2050 target of halving global emissions by 2050 from 1990 levels. After 2050 emissions are further declining exponentially with the average reduction found in the last decade before 2050.
5	IPCC AR4 Box 13.7 compliant scenario '2°C compliant'	<i>Scenario only used for determination of 2020 levels for comparison.</i> Scenario with aggregate developed country emission reductions of 30% below 1990 levels in 2020 and a "substantial deviation from baseline" of 20% for developing countries. A global 2050 target of halving global emissions by 2050 from 1990 levels is assumed. After 2050 emissions are further declining exponentially with the average reduction found in the last decade before 2050. The international transport sectors do not have additional specifications guiding their emission paths. For the global deforestation pathway, the RCP4.5 scenario is used.

## **Methodology of calculations**

### **PRIMAP4 reference scenario construction**

Not all initial emission data sources (listed in the main article) provided emission data with the required spatiotemporal resolution. The PRIMAP composite source generator takes care of temporal inter- and extrapolation, but a manual downscaling of the WEO and POLES datasets was necessary. The WEO data was downscaled with the CO<sub>2</sub> energy emissions of the MATCH source as the downscale key. The POLES data was downscaled with total Kyoto greenhouse gas (GHG) emission shares excluding land use, land use change and forestry (LULUCF) of the MATCH source as the downscale key.

In addition to the specification given in the main article, the following approximations and assumptions were used:

National communication emissions levels reported for the BI5 category (land use change and forestry) for Non-Annex I are used as a proxy for CAT5 (LULUCF).

At the end of the CSG run, missing emissions for the 'LULUCF' category were assumed zero for the countries in question.

EDGAR emissions for the 'national total excluding LULUCF' category are assumed to be equal to the sum of all categories available in the framework of the EDGAR project except for categories 'forest land remaining forest land', 'grassland remaining grassland', 'international bunkers aviation' and 'international bunkers marine' in the case of CH<sub>4</sub>; and additionally 'other LULUCF' in the case of N<sub>2</sub>O.

CDIAC data for countries which have changed political boundaries over time has been harmonised to current geographical regions. Eastern and Western Germany have been summed to construct a complete time series for Germany. For countries which have been split up during the course of history (Yugoslavia, USSR, Corea, Rwanda-Urundi, Czechoslovakia, French Equatorial Africa, French Indochina, French West Africa, Saint Kitts and Nevis and Anguilla, and the Federation of Rhodesia and Nyasaland) the shares of the first year in which all members have values are taken as the downscale key.

GWPs Second Assessment Report of the IPCC are used to sum up single gases to the Kyoto-GHG basket.

### **Region definitions**

Emission reduction targets are only assumed for the countries listed in the tables above. For the aggregate numbers of the developed countries group, the sums for all countries listed in Annex I of the Kyoto Protocol are assumed. Although Kazakhstan was added to this list during the last COP session, it is not yet counted to the developed countries group for this analysis to assure comparability of the aggregate Annex I numbers with the IPCC ranges specified in Box 13.7 of the Working Group III contribution to IPCC AR4.