

# Greenhouse gas accounting for national climate change targets: A comparative study

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## Acronyms

<b>AAU</b>	Assigned Amount Unit
<b>AEA</b>	Annual emission allocation (under EU Effort Sharing Decision)
<b>AFOLU</b>	Agriculture, Forestry and Other Land Use
<b>AR</b>	Afforestation/Reforestation
<b>AR4/AR5</b>	IPCC Fourth/Fifth Assessment Report
<b>BAU</b>	Business-as-usual
<b>CDM</b>	Clean Development Mechanism
<b>CER</b>	Certified Emission Reduction
<b>CH<sub>4</sub></b>	Methane
<b>CO<sub>2</sub></b>	Carbon dioxide
<b>CO<sub>2</sub>e</b>	Carbon dioxide equivalent
<b>CP1/CP2</b>	KP first/second commitment period (2008-2010)/(2013-2020)
<b>EEA</b>	European Economic Area
<b>ERU</b>	Emission Reduction Unit
<b>ESD</b>	Effort Sharing Decision
<b>ESR</b>	Effort Sharing Regulation (proposed)
<b>EU</b>	European Union
<b>EU ETS</b>	European Union Emissions Trading System
<b>EUA</b>	EU Allowance
<b>GHG</b>	Greenhouse gas
<b>GTP</b>	Global Temperature Potential
<b>GWP</b>	Global Warming Potential
<b>HFCs</b>	Hydrofluorocarbons
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>JI</b>	Joint Implementation
<b>KP</b>	Kyoto Protocol
<b>LULUCF</b>	Land Use, Land-Use Change and Forestry
<b>MMR</b>	Monitoring Mechanism Regulation
<b>Mt</b>	Megatonne (one million tonnes)
<b>N<sub>2</sub>O</b>	Nitrous oxide
<b>NDC</b>	Nationally determined contributions (under Paris Agreement)
<b>PFCs</b>	Perfluorocarbons
<b>RMU</b>	Removal Unit
<b>SF<sub>6</sub></b>	Sulphur hexafluoride
<b>t</b>	Tonne (metric)
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change

## 1. Executive Summary

This report describes the key differences between greenhouse gas (GHG) accounting frameworks underlying international and domestic national climate change targets and reporting, for a selection of countries: **Ireland, France, Denmark, Sweden, Estonia, Norway, New Zealand** and **Mexico**.

Countries report in different ways against different targets, making both cross-country and within-country comparisons difficult. This report clarifies how countries with national climate change targets account for progress towards these targets, relative to their internationally reported GHG inventories. The research has been based on a desk review of relevant documentation from each country, carried out in November 2017.

The tables below summarise key findings. Table 1 sets out the various international and domestic national targets for each of the eight countries. Although the targets may appear superficially comparable, variations in the following can impede direct comparison:

- **Base years.** 1990 and 2005 are the most commonly used base years, but Mexico has a target based on year 2000 emissions, and uses a hypothetical ‘business as usual’ baseline for its other targets. Although different base years complicate direct comparisons between countries, the fact that 1990 data is widely available for most countries means that targets using different base years can relatively easily be re-expressed in relation to 1990 emissions.
- **Target years.** The most common target years are 2020, 2030 and 2050, but some countries have domestic targets for years such as 2040 (Estonia) and 2045 (Sweden). Different target years make comparisons difficult, unless the trajectory of emissions is also specified, in which case the trajectory points for common years can be directly compared.
- **Final-year targets versus multi-year budgets or trajectories.** Some targets, such as the nationally determined contributions (NDCs) put forward by each country under the Paris Agreement, only specify the level of reductions to be achieved by the target year, whereas others, such as those under the Kyoto Protocol (KP), specify the total carbon ‘budget’ of GHGs that may be emitted over a ‘commitment period’ (e.g. 2013-2020). Final-year targets are less ambitious than the equivalent percentage would be for a multi-year budget, due to the latter being averaged over a period.<sup>1</sup> Furthermore, as the impact on the global climate depends on cumulative emissions (i.e. budgets), final-year targets are really only comparable if countries also specify the trajectory towards the target, *and* accept this trajectory as a fixed budget: this can then be compared with other countries’ budgets.
- **Scope and coverage.** Targets may be more or less comprehensive in their inclusion of emissions from different sectors, geographic territories and/or GHGs. The sector subject to the greatest variability of inclusion in targets is land-use, land-use change and forestry (LULUCF). In order to make like-with-like comparisons between countries with different scopes, their GHG inventory data would need to be re-expressed according to the same scope. Fortunately, as all developed countries report in a standardised way to the United Nations Framework Convention on Climate Change (UNFCCC), this is usually

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<sup>1</sup> An example of this is New Zealand’s domestic target of 5% below 1990 levels by 2020, which is equivalent to a 2013-2020 budget of 96.8% of 1990 emissions, being based on a trajectory that only *reaches* 95% in 2020.

possible. However, developing countries are allowed more flexibility in their UNFCCC reporting, which may make it more difficult to re-express their data in consistent terms.

- **GHG accounting methods.** Even with identical scope and coverage, targets for two identical countries could mean different things if the GHG accounting methods differ. For example, if countries use different metrics to convert emissions of different GHGs into a common equivalent, physically identical emissions could appear to be numerically different. Most countries convert emissions of GHGs other than carbon dioxide into carbon dioxide equivalents using the 100-year Global Warming Potential (GWP) metrics published in the Fourth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC). However, Mexico uses different GWPs, as published in the IPCC's Fifth Assessment Report. All countries in this study follow the most recent international GHG accounting guidance (the '2006 IPCC Guidelines') for their UNFCCC reporting, which tends to flow through to reporting against different targets. There are no known exceptions, but some countries have not yet confirmed that they will apply this guidance, particularly for long-term targets.
- **Flexibility mechanisms.** Finally, targets may differ in the extent to which the desired reductions are to be achieved individually, or in collaboration with other countries through mechanisms such as emissions trading or offsetting. Further mechanisms may also provide temporal flexibility (e.g. 'banking'/'borrowing' in cases of target over-/under-achievement) or sectoral flexibility (e.g. counting reductions from a sector not included in the target).

Tables 2 and 3 below summarise the scope, coverage, accounting methods and use of flexibility mechanisms for each of the international and national targets and GHG accounting frameworks. In each table, the text refers to the column heading, e.g. "√(all)" in the 'Non-LULUCF sectors' column means that all non-LULUCF sectors are included in the target or accounting framework (for all countries in that row, unless otherwise noted). As there are many different types of flexibility mechanism, the summary tables focus on international trading/offsetting as the most relevant aspect.

Taken together, the tables show that **countries do indeed report in different ways against different targets**, making cross-country comparisons difficult. **However, there is substantial convergence on the use of comparable accounting methods**, driven by UNFCCC reporting. It appears that **the same underlying GHG data is typically adapted for accounting against different targets**. UNFCCC accounting (plus, for most developed countries, KP accounting) provides the core comprehensive dataset, from which elements can be removed or recalculated as required. The fact that UNFCCC accounting is highly standardised for developed countries ensures a high degree of consistency, whereas more variation is to be expected from developing countries.

LULUCF is the one sector that is actually subject to two different standardised calculation methodologies (UNFCCC and KP accounting). Further variations in sub-sectors, as well as in underlying assumptions and models, make LULUCF a particular challenge to cross-country comparability.

Finally, while substantial convergence can be seen in targets for 2020, there is more variation seen in targets for 2030, and generally not a great deal of clarity for targets beyond 2030. This suggests that the international accounting frameworks are critically important in driving consistency between countries, which otherwise have a strong incentive to pursue more idiosyncratic accounting that suits national circumstances, at the expense of cross-country comparability.

**Table 1: International and domestic national targets**

Country	KP CP2 target (2020) <sup>1</sup>	EU ESD target (2020) <sup>2</sup>	Domestic target (2020)	Paris NDC target (2030) <sup>3</sup>	EU ESR target (2030) <sup>4</sup>	Domestic target (2030)	Other domestic targets
<b>Ireland</b>	80% of 1990	20% below 2005	N/A (ESD)	EU: 40% below 1990	30% below 2005	-	80% below 1990 by 2050 for electricity generation, built environment and transport Carbon neutrality by 2050 for agriculture and LULUCF
<b>France</b>	80% of 1990	14% below 2005	N/A (ESD)		37% below 2005	40% below 1990	75% below 1990 by 2050
<b>Denmark</b>	80% of 1990	20% below 2005	40% below 1990		39% below 2005	N/A	Low emission society by 2050
<b>Sweden</b>	80% of 1990	17% below 2005	40% below 1990		40% below 2005	63% below 1990 (non-ETS sectors)	75% below 1990 (non-ETS sectors) by 2040. Carbon neutrality by 2045 (with offsetting) 85% below 1990 by 2045 (without offsetting)
<b>Estonia</b>	80% of 1990	11% above 2005	N/A (ESD)		13% below 2005	70% below 1990 by 2030	72% below 1990 by 2040 80% below 1990 by 2050
<b>Norway</b>	84% of 1990	N/A	30% below 1990	40% below 1990	N/A	Carbon neutrality	
<b>New Zealand</b>	-	N/A	5% below 1990	30% below 2005 (11% below 1990)	N/A	-	50% below 1990 by 2050 Carbon neutral by 2050
<b>Mexico</b>	N/A	N/A	30% below BAU by 2020	25% below BAU (22% GHGs and 51% black carbon)	N/A	N/A (NDC)	50% below 2000 by 2050

Notes:

1. Kyoto Protocol (KP) second commitment period (CP2) targets are expressed as percentages of 1990 emissions, to be achieved on average over the 8 years from 2013-2020.
2. EU Effort Sharing Decision (ESD) targets are expressed as percentages of 2005 emissions, to be achieved by 2020, with interim budgets interpolated on a linear basis.
3. Paris NDC targets are expressed as percentage reductions from stated base year emissions, to be achieved by 2030.
4. EU Effort Sharing Regulation (ESR) targets are those proposed by the Commission in July 2016 and still under negotiation at the time of writing. As with the ESD targets, they are expressed as percentages of 2005 emissions, to be achieved by 2030, with interim budgets interpolated on a linear basis.

**Table 2: International targets and accounting frameworks scope and coverage**

Framework (countries in this study)	Non- LULUCF sectors	LULUCF sectors	sub- International aviation	International maritime transport	Geographic scope	GHGs <sup>1</sup>	100-year AR4 GWPs	2006 IPCC Guidelines	Flexibility mechanisms <sup>2</sup>
<b>UNFCCC</b> (all)	☐(all)	☐(all)	☐(separately)	☐(separately)	National boundaries (all territories)	KP7 (minimum)	☐(Annex I) <sup>3</sup>	☐(Annex I) <sup>3</sup>	☐
<b>KP CP2</b> (IE, FR, DK, SE, EE, NO; NZ voluntarily)	☐(all)	☐(D, AR, FM mandatory CM, GM, RV and WDR optional)	☐	☐	As per UNFCCC unless derogated	KP7	☐	☐	☐(IET, JI, CDM)
<b>Paris Agreement NDCs</b> (all)	☐(all)	☐(all)	☐	☐	As per UNFCCC unless derogated	IE, FR, DK, SE, EE, NO, NZ: KP7 MX: KP6 plus black carbon	☐(all except MX) MX: 100- year GWPs from AR5	☐	Varies by country <sup>4</sup>
<b>EU ESD</b> (IE, FR, DK, SE, EE)	☐(all)	☐	☐	☐	Only EU territories	KP6	☐	☐ (plus EU guidelines)	☐
<b>EU ESR</b> (IE, FR, DK, SE, EE)	☐(all)	☐	☐	☐	Only EU territories	KP7	☐	☐ (plus EU guidelines)	☐

Key: IE = Ireland; FR = France; DK = Denmark; SE = Sweden; EE = Estonia; NO = Norway; NZ = New Zealand; MX = Mexico

D = deforestation; AR = afforestation/reforestation; FM = forest management; CM = cropland management; GM = grazing land management, RV = revegetation; WDR = wetland drainage and rewetting

IET = International Emissions Trading; JI = Joint Implementation; CDM = Clean Development Mechanism

Notes:

1. 'KP6' means CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs and SF<sub>6</sub>. 'KP7' adds NF<sub>3</sub>.
2. Mechanisms allowing flexibility to meet targets through trading or offsetting with other countries.
3. Annex I countries in this study include IE, FR, DK, SE, EE, NO and NZ. GWPs and methods are not specified for non-Annex I countries. MX uses 100-year GWPs from AR5.
4. The EU will not use international offsets, but has a collective target which means there is flexibility between Member States. NO will either achieve its target collectively with the EU (in which the same rules will apply) or individually, in which case it may use international offsets. NZ intends to use a variety of flexibility mechanisms. MX has a lower unconditional target which does not rely on international offsets and a higher conditional target which assumes flexibility mechanisms will exist.

**Table 3: Domestic targets and accounting frameworks scope and coverage**

Country	Target	Sectors included in target:		GHGs <sup>1</sup>	100-year AR4 GWPs	2006 IPCC Guidelines	Flexibility mechanisms <sup>2</sup>
		Non-LULUCF	LULUCF				
Ireland	80% below 1990 by 2050	☐(electricity generation, built environment, transport)	☐	CO <sub>2</sub> only	Unclear	Unclear	Unclear
	Carbon neutrality by 2050	☐(agriculture)	☐	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Unclear	Unclear	Unclear <sup>3</sup>
France	40% below 1990 by 2030	☐(all)	☐	KP7	☐	☐	☐ <sup>4</sup>
	75% below 1990 by 2050	☐(all)	Possibly	KP7	☐	☐	☐ <sup>4</sup>
Denmark	40% below 1990 by 2020	☐(all)	☐(KP)	KP7	☐	☐	☐ <sup>4</sup>
Sweden	40% below 1990 by 2020	☐(non-ETS) <sup>5</sup>	☐	KP7	☐	☐	☐(no limit) ☐(up to 8%) ☐(up to 2%)
	63% below 1990 by 2030						
	75% below 1990 by 2040						
	Carbon neutrality by 2045	☐(all)	☐	KP7	☐	☐	☐
	85% below 1990 by 2045	☐(all)	☐	KP7	☐	☐	☐ <sup>6</sup>
Estonia	70% below 1990 by 2030	☐(all)	☐	Unclear	Unclear	Unclear	Unclear
	72% below 1990 by 2040						
	80% below 1990 by 2050						
Norway	30% below 1990 by 2020	☐(all)	☐	KP7	☐	☐	☐
	Carbon neutrality by 2030						
New Zealand	5% below 1990 by 2020	☐(all)	☐(KP)	KP7	☐	☐	☐
	50% below 1990 by 2050						
	Carbon neutral by 2050	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Mexico	30% below BAU by 2020	☐(all)	☐	KP6	☐(AR5)	☐	Unclear
	50% below 2000 by 2050						

Notes:

1. 'KP6' means CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs and SF<sub>6</sub>. 'KP7' adds NF<sub>3</sub>.
2. Mechanisms allowing flexibility to meet targets through trading or offsetting with other countries.
3. It appears only domestic offsetting, possibly including emission reductions in energy generation sector from use of biomass, is under consideration.
4. As these national targets include ETS sectors, they indirectly benefit from the EU ETS as a flexibility mechanism, but do not appear to take account of any imported credits.
5. ETS = emissions covered by the EU ETS (large point sources in various sectors plus domestic and EU aviation). Non-ETS = all other non-LULUCF domestic emissions.
6. Sweden's 85% target may continue to count domestic LULUCF and carbon capture and storage as offsets.

## 2. Introduction

This report was commissioned by ClimateXchange in response to a request from the Scottish Government for a study on key differences between greenhouse gas (GHG) accounting frameworks underlying international and national targets and reporting, for a selection of countries: Ireland, France, Denmark, Sweden, Estonia, Norway, New Zealand and Mexico.

The problem motivating this research is that countries report in different ways against different targets, making both cross-country and within-country comparisons difficult. The main objective of this report is to clarify how countries with national climate change targets account for progress towards these targets, relative to their internationally reported GHG inventories.

The research has been based on a desk review of relevant documentation from each country, carried out in November 2017.

The report is structured as follows:

- **Section 1** is the executive summary;
- **Section 2** is this introduction;
- **Section 3** sets out the key international targets and GHG accounting frameworks applicable to the countries in this study;
- **Section 4** reviews their domestic targets and GHG accounting frameworks; and
- **Section 5** summarises the overall findings.

The views expressed in this report are those of the author and do not necessarily represent the views of ClimateXChange, the Scottish Government, the University of Edinburgh or any other organisation with which the author is affiliated.

### 3. International targets and GHG accounting frameworks

The countries covered in this study (Ireland, France, Denmark, Sweden, Estonia, Norway, New Zealand and Mexico) account for their national GHG emissions and removals under several international agreements, as well as against their own domestic targets, which may differ in various ways from these international targets and accounting frameworks. This section reviews each of the major international frameworks, explaining how they differ from each other in general, and variations in accounting by each country, where applicable. The next section (section 4) then reviews domestic national targets and accounting frameworks.

For each framework we consider the accounting methods used, the sectoral and geographic scope, which GHGs are included and how they are converted to common equivalents, and whether the target includes any mechanisms to provide flexibility, such as counting emission reductions made elsewhere via some form of carbon credit.

#### 3.1. United Nations Framework Convention on Climate Change (UNFCCC)

This is the original national GHG accounting framework, which applies to all of the countries in this study. It is only a reporting framework and does not impose GHG targets on specific countries. Article 4, paragraph 1 (a) requires all Parties to “Develop, periodically update, publish and make available... national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases...using comparable methodologies...” There is some differentiation between developed countries (as listed in Annex I to the UNFCCC) and developing (non-Annex I) countries. Developed countries report annually, for all years from the 1990 base year to the present, while developing countries may report less frequently. Mexico (the only non-Annex I country in this study) has submitted five ‘national communications’ to the UNFCCC in 1997, 2001, 2006, 2009 and 2012.<sup>2</sup> This is unique: to date, the majority of developing countries have submitted only two such communications, and only one other country (Uruguay) has submitted as many as four. Mexico also submits regularly updated national inventory reports, which again goes beyond requirements as a non-Annex 1 country.

##### 3.1.1. Methods and guidelines

The UNFCCC publishes reporting guidelines<sup>3</sup> for Annex I countries, the latest version of which was adopted at the Conference of Parties in Warsaw in 2013 via Decision 24/CP.19, which also specifies that Annex I countries should follow, from 2015 onwards, the most recent GHG monitoring, reporting and verification guidance issued by the Intergovernmental Panel on Climate Change (IPCC), the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (henceforth, the ‘2006 IPCC Guidelines’). Within the 2006 IPCC Guidelines, there is flexibility with respect to approaches to establishing relevant GHG data, known as tiers. The use of a 2013 supplement to the 2006 IPCC Guidelines, on wetlands, is recommended but not mandatory. All of the countries in this study – including Mexico – are now preparing their UNFCCC national greenhouse gas inventories according to the 2006 IPCC Guidelines.

##### 3.1.2. Sectoral and geographic scope

Reporting under the UNFCCC is comprehensive, including all significant non-natural sources of GHG emissions and removals within the national boundary, including from all sub-sectors of the ‘Land use, land-use change and forestry’ (LULUCF) sector. The UNFCCC Guidelines

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<sup>2</sup> See [http://unfccc.int/national\\_reports/non-annex\\_i\\_natcom/items/10124.php](http://unfccc.int/national_reports/non-annex_i_natcom/items/10124.php) (accessed 6 November 2017).

<sup>3</sup> “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories” (included in Decision 24/CP.19).

specify that the inventory should be divided into the following sectors: Energy; Industrial processes and product use; Agriculture; Land use, land-use change and forestry; Waste; and Other (if applicable).

The geographical scope covers all activities taking place within national boundaries, including offshore areas over which the country has jurisdiction. Emissions from international aviation and maritime transport are not included in national totals, but they are still accounted for and reported separately.

### **3.1.3. GHGs and GWPs**

Article 4, paragraph 1 (a) of the UNFCCC requires all Parties to compile a national inventory of anthropogenic emissions and removals of all GHGs not controlled by the Montreal Protocol. The UNFCCC Guidelines specify that the minimum requirement (for Annex I Parties) is that inventories shall cover the following GHGs: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF<sub>6</sub>) and nitrogen trifluoride (NF<sub>3</sub>). All of the countries in this study include all of these gases in their UNFCCC national inventories.

Emissions of carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO<sub>2</sub>), as well as indirect CO<sub>2</sub> and N<sub>2</sub>O emissions from breakdown of these gases, may be included in reporting but not in national emissions totals.

Decision 24/CP.19 specifies that, from 2015 until the COP decides otherwise, Annex I Parties should apply the 100-year GWPs as set out in the IPCC Fourth Assessment Report (AR4) to calculate the carbon dioxide equivalents of all non-carbon dioxide GHGs. All of the countries in this study are now using the AR4 GWPs for their national inventories apart from Mexico, which is using GWPs from the IPCC Fifth Assessment Report (AR5).

### **3.1.4. Flexibility mechanisms**

UNFCCC accounting is not adjusted for any form of flexibility mechanism.

## **3.2. Kyoto Protocol (second commitment period)**

The first commitment period (CP1) under the Kyoto Protocol (KP) ran from 2008-2012 and applied to a set of developed countries listed in Annex B to the Protocol. A second commitment period (CP2) running from 2013-2020 has been agreed via the 2012 Doha Amendment to the KP. At the time of writing (November 2017) this has not yet entered into force, as it has not been ratified by the required three-quarters of KP signatories (144 countries). Currently, of the countries in this study, only Mexico, Norway and New Zealand have ratified the Doha Amendment. The EU officially intends to comply with the Doha Amendment, but the ratification process requires unanimous support from Member States, and is currently blocked by Poland. Nevertheless, all of the countries in this study, except for Mexico, are reporting according to KP CP2 requirements, even though it has not entered into force or been ratified by all of them.

All of the countries in this study have a target for the period 2013-2020 under the Doha Amendment, except for Mexico (as a developing country) and New Zealand (which has not agreed to accept an internationally binding target for the second KP commitment period). The EU has a target of 80% of 1990 KP emissions, taken on behalf of all its Member States (this therefore applies to Ireland, Denmark, Sweden and Estonia), while Norway has a target of 84%.

These targets are converted to fixed ‘budgets’ denominated in ‘Assigned Amount Units’ (AAUs) for the whole of the 2013-2020 period by multiplying base year KP emissions by the target percentage, multiplied by eight. The base year is 1990 for most countries. Exceptions apply only to certain countries outside this study (Bulgaria, Romania, Hungary and Poland) and gases (where 1995 may be used as a base year for HFCs, PFCs and SF<sub>6</sub>, and either 1995 or 2000 may be used for NF<sub>3</sub>).

Countries for which LULUCF constituted a net source of emissions in 1990 include these net emissions in their 1990 baseline. Of the countries in this study, this applies only to Denmark.<sup>4</sup> All of the other countries, for which LULUCF constituted a net sink in 1990, use their gross emissions (excluding LULUCF) for their 1990 baseline.

### 3.2.1. Methods and guidelines

Decision 4/CMP.7 establishes that GHG accounting for the second KP commitment period should be consistent with the UNFCCC approach, i.e. from 2015 applying the 2006 IPCC Guidelines and revised UNFCCC Annex I inventory reporting guidelines. Decision 2/CMP.7 provides guidance for KP LULUCF accounting. All of the countries in this study except for Mexico (to which it is irrelevant) apply these guidelines to their KP accounting.

### 3.2.2. Sectoral and geographic scope

The sectoral scope of KP accounting is the same as under the UNFCCC, except that coverage within the LULUCF sector is less extensive, including only the following activities:

- Mandatory: net emissions and removals from direct, human-induced afforestation/reforestation (AR), deforestation (D) and forest management (FM) activities; and
- Optional: net emissions and removals from cropland management (CM), grazing land management (GM), revegetation (RV) and/or wetland drainage and rewetting (WDR).

Table 4 below sets out which of the optional LULUCF sectors each country has elected to include in its KP second commitment period accounting (where relevant). New Zealand is included in the table because it voluntarily reports according to KP accounting rules, even though it does not have a target under the Doha Amendment.

**Table 4: Kyoto Protocol second commitment period (2013-2020) optional (Article 3.4) LULUCF sectors**

Country	Optional LULUCF sectors
Ireland	CM, GM
France	None
Denmark	CM, GM
Sweden	None
Estonia	None
Norway	CM, GM
New Zealand	None

The geographical scope of the KP is in principle the same as the UNFCCC, i.e. covering all activities taking place within national boundaries, and therefore not including emissions from international aviation or international maritime transport. Nevertheless, for some countries, there are slight differences between UNFCCC and KP geographic coverage: for example,

<sup>4</sup> Mexico also had net positive emissions from LULUCF in 1990, but this is not relevant as they do not have a KP CP2 target.

Denmark reports for all of mainland Denmark, Greenland and the Faroe Islands under the UNFCCC, but made a reservation for the Faroe Islands when they signed the KP, with the result that Denmark’s KP national totals exclude the latter (however, this makes only a tiny difference to the national inventory).<sup>5</sup>

### 3.2.3. GHGs and GWPs

Decision 4/CMP.7 establishes that KP accounting covers only the minimum set of seven GHGs required under the UNFCCC, i.e. CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, SF<sub>6</sub> and NF<sub>3</sub>, and as per UNFCCC accounting, 100-year GWPs as set out in AR4 should be used to calculate carbon dioxide equivalents.

### 3.2.4. Flexibility mechanisms

The Kyoto Protocol permits the use of three flexibility mechanisms:

- ‘International Emissions Trading’, which permits AAUs and ‘Removal Units’ (RMUs) from net removals from LULUCF activities to be transferred between Annex B countries;
- ‘Joint Implementation’, in which emission reductions at a project level in another Annex B country generate ‘Emission Reduction Units’ (ERUs) which can be transferred to another country, provided that the country generating the ERUs cancels an equivalent number of AAUs first; and
- The ‘Clean Development Mechanism’ or CDM, in which emission reductions at a project level in a non-Annex B (developing) country generate ‘Certified Emission Reductions’ (CERs) which can be added to the Assigned Amount of the purchasing country.

In addition, the Doha Amendment allows for units created under any other mechanism established under the UNFCCC (e.g. under the Paris Agreement) to be used for compliance.

## 3.3. Paris Agreement

The 2015 Paris Agreement entered into force on 4 November 2016 and applies to all of the countries in this study. The Agreement calls for every country to put forward its own ‘nationally determined contributions’ (NDCs), which allow considerable freedom in the choice of base years, target levels, accounting methods, sectoral and geographic scope, GHGs and GWPs, and use of flexibility mechanisms. The NDCs for the countries included in this study are summarised in Table 5 below.

Table 5: Paris NDC targets

Country	Target (2030)	Methods	Sectors	GHGs	GWPs	Flexibility mechanisms
<b>Ireland</b>	40% below 1990	2006 IPCC Guidelines and IPCC 2013 KP Supplement	All	All	100-year AR4	No international credits
<b>France</b>						
<b>Denmark</b>						
<b>Sweden</b>						
<b>Estonia</b>						
<b>Norway</b>	40% below 1990	2006 IPCC Guidelines	All	All	100-year AR4	With EU: no international credits Individually: yes
<b>New Zealand</b>	30% below 2005	2006 IPCC Guidelines and 2013	All	All	100-year AR4	Yes

<sup>5</sup> Denmark’s National Inventory Report 2017.

		IPCC KP Supplement				
<b>Mexico</b>	Unconditional: 25% below BAU (22% GHGs and 51% black carbon) Conditional: 40% below BAU by 2030 (36% GHGs and 70% black carbon)	IPCC guidelines (unclear which)	All	All except NF <sub>3</sub> , plus black carbon	100-year AR5 plus Bond et al (2013) for black carbon	Unconditional: no Conditional: yes

The targets proposed by the EU and Norway appear to be broadly consistent with an extension of KP accounting. They both continue to use 1990 as the base year, although the targets are expressed in the form of levels to be achieved by 2030, as opposed to average emissions for 2021-2030 (however, Norway's NDC notes that the target will need to be converted into such a budget). Although both aim to cover all sectors, the precise way in which the LULUCF sector will be accounted is still unclear. The EU's NDC states that LULUCF coverage will include the KP activities AR, D, FM, CM and GM, or equivalent land-based accounting using UNFCCC categories, plus any other categories or activities elected by the EU and its Member States. Norway intends either to follow the EU approach (in the case of collective delivery with the EU), or a common framework to be developed for all Parties, or an individual approach based on the principle of not reducing the level of ambition of its 2030 target, compared to the case if LULUCF is not included.

An important difference between the EU's Paris target and its KP CP2 target is that the EU no longer intends to make use of any international carbon offsets during the 2021-2030 period.

New Zealand's NDC is likewise broadly consistent with an extension of KP accounting. The choice of 2005 emissions as the base year has the effect of making the target seem more ambitious, as New Zealand's gross emissions (excluding LULUCF) increased by about 28% between 1990 and 2005.<sup>6</sup> An earlier version of the NDC stated that the 30% reduction target was equivalent to an 11% reduction on 1990 levels, but this was removed from the final version.<sup>7</sup> New Zealand's approach to accounting for LULUCF remains provisional, but clearly favours a continuation of existing KP approaches. Furthermore, as non-LULUCF emissions are projected to continue to grow, New Zealand is implicitly relying on substantial use of various flexibility mechanisms.

Mexico, as a non-Annex I country, has historically been allowed much greater flexibility in its GHG accounting, which is also evident in its NDC. The inclusion of black carbon is particularly idiosyncratic, as the uncertainty associated with the climatic effects of black carbon is very high. Mexico proposes using a GWP of 900 for black carbon, drawn from a single literature source. In addition, as black carbon is generally produced by the same processes that produce carbon dioxide, it is already taken into account in global models of the emission reductions

<sup>6</sup> Source: UNFCCC GHG data portal, [http://di.unfccc.int/detailed\\_data\\_by\\_party](http://di.unfccc.int/detailed_data_by_party) (accessed 16 November 2017).

<sup>7</sup> <http://www4.unfccc.int/submissions/INDC/Published%20Documents/New%20Zealand/1/New%20Zealand%20INDC%202015.pdf> (accessed 16 November 2017).

required to keep warming below 2°C globally, therefore to account for it separately could be argued to be a form of double-counting. However, as Mexico has broken down its targets into GHG and black carbon components, this criticism would not apply to the GHG components.

### 3.4. EU accounting frameworks and targets

The EU has an overall target to reduce emissions by 20% below 1990 levels by 2020, as part of the ‘2020 Climate and Energy Package’, which was first agreed by the European Council in 2007, and finalised in 2009. This target includes all sectors except for LULUCF (which across the EU as a whole is a net sink, removing the equivalent of about 7% of the EU’s total GHG emissions per year<sup>8</sup>) and international maritime transport; covers the original ‘basket’ of six Kyoto gases (not including NF<sub>3</sub>) and originally applied GWPs from the IPCC Second Assessment Report. From 2015, GWPs from AR4 have been applied instead (to the entire time-series), consistent with both UNFCCC and KP accounting.

The EU’s 2020 target differs from its KP second commitment target in the following ways, as set out in Table 6 below.

**Table 6: EU 2020 target compared with KP second commitment period target**

		EU 2020 target	EU KP CP2 target
<b>Sectoral coverage</b>	LULUCF	Excluded	Includes compulsory KP LULUCF categories (D, AR and FM) for all countries, and the optional KP LULUCF categories elected by each Member State
	International maritime transport	Excluded	Excluded
	International aviation	European Economic Area (EEA) flights included (via the EU ETS); others excluded	Excluded
<b>Target basis</b>		To be reached by 2020	To be reached on average over 2013-2020
<b>GHGs</b>		Excludes NF <sub>3</sub>	Includes NF <sub>3</sub>

The major instrument for achieving the EU’s 2020 target is the EU Emissions Trading System (EU ETS), which covers around 45% of EU emissions from large stationary sources in a variety of sectors, plus domestic and international aviation (between EEA countries only). Installations and aviation operators covered by the scheme may only emit greenhouse gases if they subsequently surrender an EU ETS allowance (EUA) or certain other types of approved credit. EU ETS emissions are controlled by an EU-wide cap on allowances which reduces by 1.74% (of 2010 emissions) per year, increasing to 2.2% per year from 2021. Because of this, it would not make much sense for an individual country to have a specific target for its EU ETS emissions: the EU-wide cap ensures that EU ETS emissions are reducing in aggregate, and unrestricted trading means that countries have effectively agreed not to control where those

<sup>8</sup> <https://www.eea.europa.eu/themes/climate/trends-and-projections-in-europe/trends-and-projections-in-europe-2017/progress-of-the-eu-towards#2-1-progress-in-reducing-total-greenhouse-gas-emissions-in-the-european-union> (accessed 14 November 2017).

emissions take place. Hence, the scope for further targets is effectively limited to non-ETS emissions.

All EU countries (in this study, Ireland, France, Denmark, Sweden and Estonia) have targets for non-ETS emissions each year from 2013 to 2020 under EU legislation – Decision 406/2009/EC – known as the Effort Sharing Decision (ESD). These are expressed as target reductions on 2005 emissions to be achieved by 2020, which are then converted into a fixed ‘annual emission allocation’ (AEA) for each year 2013-2020.

In October 2014, the European Council agreed on the 2030 Climate and Energy Framework, which includes a collective target of a 40% reduction on 1990 levels by 2030, with reductions for the ETS and non-ETS sectors of 43% and 30% on 2005 levels, respectively. In July 2016 the Commission published proposed targets for individual Member States to give effect to the non-ETS target. At the time of writing, negotiations on this proposed ‘Effort Sharing Regulation’ (ESR) were still on-going.

**Table 7: EU ESD and proposed ESR targets by country (as % of 2005 emissions)**

Country	ESD target (by 2020)	Proposed target (by 2030)	ESR Proposed ETS flexibility	EU Proposed land use flexibility <sup>9</sup> (MtCO <sub>2</sub> e)
Ireland	-20%	-30%	4%	5.6% (26.8)
France	-14%	-37%	N/A	1.5% (58.2)
Denmark	-20%	-39%	2%	4.0% (14.6)
Sweden	-17%	-40%	2%	1.1% (4.9)
Estonia	+11%	-13%	N/A	1.7% (0.9)

### 3.4.1. Sectoral and geographic scope

Both the ESD and proposed ESR targets apply to all sectors except for LULUCF, and exclude emissions which are covered by the EU ETS. They also exclude aviation and international maritime transport.

Both targets apply only to territories which are part of the European Union, and therefore exclude certain overseas territories. For example, Greenland and the Faroe Islands are excluded from Denmark’s ESD target, as are France’s overseas territories (which made up 1.4% of France’s total emissions in 2014).<sup>10</sup>

### 3.4.2. GHGs and GWPs

The EU ESD targets apply to all of the KP gases except for NF<sub>3</sub>, and apply 100-year GWPs as set out in AR4. The proposed ESR is the same, except for adding coverage of NF<sub>3</sub>.

## 3.5. Methods and guidelines

EU monitoring and reporting requirements are defined under Regulation 525/2013 (the ‘Monitoring Mechanism Regulation or MMR), which specifies that the 2006 IPCC Guidelines shall be followed.

<sup>9</sup> The limits are expressed in absolute terms (MtCO<sub>2</sub>e, in brackets); these percentages are an estimate. Source: [https://ec.europa.eu/clima/policies/effort/proposal\\_en#tab-0-0](https://ec.europa.eu/clima/policies/effort/proposal_en#tab-0-0) (accessed 13 November 2017).

<sup>10</sup> France’s NDC submission, 2016.

In addition, Decision 529/2013 covers accounting rules for LULUCF and Regulation 2016/757 provides accounting rules for maritime transport; these sectors are therefore reported on by all EU Member States, but not included in the ESD or proposed ESR targets.

### 3.5.1. Flexibility mechanisms

The ESD allows Member States to use a number of different flexibility mechanisms, including:

- Banking unused AEs from one year into the next;
- Borrowing up to 5% of the following year's AEs;
- Trading up to 5% of its annual AEs, if surplus to requirements in that year, with other Member States;
- Various international credits (CERs and ERUs), subject to a range of restrictions, conditions and caps (see ESD Article 5 for further details); and
- Credits from domestic EU emission reduction projects approved for use in the EU ETS under Article 24a of the amended EU ETS Directive 2003/87/EC (without quantitative restriction).<sup>11</sup>

The ESR proposal includes similar banking, borrowing and trading flexibility, plus two additional options: the ability for certain Member States effectively to transfer some EU ETS allowances (which would otherwise have been auctioned to EU ETS sectors) to non-EU ETS sectors, up to an EU-wide cap of 100 MtCO<sub>2e</sub> over 2021-2030 and subject to the individual country caps set out in Table 7 above; and the ability for certain MS (again subject to individual country limits, as set out in Table 7 above) to use up to 280 MtCO<sub>2e</sub> of credits from certain LULUCF categories. However, the ESR proposal does not allow any use of international credits.

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<sup>11</sup> Article 24a of 2003/87/EC requires that any such credits shall not result in double-counting of emission reductions.

## 4. Domestic targets and GHG accounting frameworks

### 4.1. Ireland

Currently, the most relevant national target for Ireland is its EU Effort Sharing Decision target (20% below 2005 levels for non-ETS sectors by 2020). Ireland uses its UNFCCC inventory data to report against this target. It is consistent with UNFCCC reporting with regard to all non-ETS sectors except LULUCF, maritime transport and civil aviation (which are excluded), as well as with respect to GHGs (except for NF<sub>3</sub>)<sup>12</sup>, GWPs, and methods. Ireland is currently (to 2015) meeting its ESD budgets and therefore has not yet made use of any of the ESD flexibility mechanisms. However, it expects to exceed its target and therefore to make use of these mechanisms (including banking of excess allowances from previous years, and trading with other Member States) in later years, towards 2020.

In 2014, Ireland adopted the National Policy Position on Climate Action and Low Carbon Development, which includes two national targets for 2050: an 80% reduction (in carbon dioxide emissions only) on 1990 levels by 2050 across electricity generation, the built environment and transport; and a parallel target to achieve carbon neutrality in agriculture and LULUCF. The Climate Action and Low Carbon Development Act 2015 provides the statutory basis for achieving these objectives, including through the development and submission to Government of a series of National Mitigation Plans, the first of which was finalised in July 2017.

It is not yet clear exactly how progress towards these 2050 targets will be measured. It is evident that the sectors to which these targets apply are slightly different to UNFCCC sectors: the first National Mitigation Plan notes that ‘The Electricity, Built Environment and Transport sectors represented here are based on National Mitigation Plan sectors rather than total emissions in the EPA inventory’ (p. 14). Therefore, for example, energy used in agriculture would be included in Ireland’s carbon-neutral target as part of the agriculture sector, whereas it is reported under the UNFCCC category of ‘Energy’ rather than ‘Agriculture’. Nevertheless, the figures for sectors which should be identical to UNFCCC reporting (such as electricity generation) appear to be consistent, suggesting that this is only a matter of different arrangement of the same GHG data. It is also evident that, unlike the ESD and ESR targets, there is no stripping out of EU ETS emissions: if the EU ETS continues to exist in 2050, then its effects appear to be included in the target. Finally, it is clearly stated that the 80% target applies to CO<sub>2</sub> only.

The carbon-neutrality target for agriculture and forestry implies a potential further departure from UNFCCC accounting. A 2013 report by Teagasc (Ireland’s Agriculture and Food Development Authority) provided much of the thought leadership for the 2050 carbon-neutrality target. This report notes:

“The concept of carbon-neutrality as a horizon point marks a change from the policy conventions used heretofore to frame the discussions on agriculture and GHG emissions, which are largely focussed on the methodologies specified by National Inventory Reports and UNFCCC reporting guidelines. In these inventories, emissions of agricultural GHG’s... are attributed to the agricultural sector, whilst the benefits arising from agriculture in the form of carbon-

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<sup>12</sup> Ireland’s NF<sub>3</sub> emissions in 2015 were approximately 1,000 tCO<sub>2</sub>e, so the effect of excluding these emissions is negligible. Source: Department of Communications, Climate Action & Environment (2016) *Annual Transition Statement 2016*.

sequestration and fossil fuel offsetting are attributed to other sectors of the economy. ...In contrast, the concept of carbon-neutrality as a horizon point changes the emphasis from gross emissions to net emissions (i.e. the difference between gross emissions and offsetting)...<sup>13</sup>

The concept of offsetting used here appears to be constrained by geographical scope (to Ireland, i.e. not relying on international offsets) and largely by sectoral scope (to agriculture and forestry). However, one of the pathways examined in the Teagasc report relied on the use of biomass and biogas offsetting fossil fuel emissions in energy generation, which would obviously risk double-counting if this was also counted as a contribution to the 80% reduction target for the electricity, built environment and transport sectors. Furthermore, the report notes that ideally, the concept of carbon neutrality would be combined with a Life Cycle Assessment (LCA) approach to accounting, which would include imported (and exported) 'embedded emissions' associated with the supply chains of imported (exported) products – while noting that this would be complicated, and inconsistent with UNFCCC accounting.

Agriculture currently accounts for about 33% of Ireland's gross emissions, while the offsetting potential of the forestry sector is estimated at 20-22% of agricultural emissions.<sup>14</sup> The majority of emissions from agriculture derive from methane and nitrous oxide. Ireland's first National Mitigation Plan mentions alternative metrics to GWP, such as Global Temperature Potential (GTP), in its discussion of how progress towards carbon neutrality would be measured, implying that alternative metrics could be considered, although this is not explicitly stated.

## 4.2. France

France's 2020 objective is to meet its ESD target (-14% on 2005 levels in non-ETS sectors by 2020). Its proposed ESR target is -37% on 2005 levels in non-ETS sectors by 2030.

France's Energy Transition and Green Growth Act (No. 2015-992) sets national goals to reduce emissions by 40% on 1990 levels by 2030 and by 75% by 2050. To achieve these targets, carbon budgets have been set for the periods 2015-2018, 2019-2023 and 2024-2028, which are further elaborated in the 2016 National Low-Carbon Strategy. These carbon budgets apply to the EU ETS sectors (excluding international aviation) and non-ETS sectors as per the ESD. In other words, they exclude LULUCF and international maritime transport. However, France intends to incorporate LULUCF removals into the budget for 2029-2033, which is scheduled to be set in mid-2019. The implication is that LULUCF might be counted towards meeting the 2050 target (or even earlier, subject to a review process which should be completed in 2019), but "without significant alterations to the efforts demanded of other sectors".<sup>15</sup> Further sub-targets apply to individual sectors, e.g. to reduce transport emissions by 29%, agricultural emissions by 12% and industrial emissions by 24% by the third carbon budget (2024-2028), compared with 2013 levels.

The geographical scope of these targets is the same as France's KP commitments, i.e. including mainland France, Corsica, Guadeloupe, Guiana, Martinique, Reunion, Saint-Martin and Mayotte as well as transport between these territories.<sup>16</sup>

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<sup>13</sup> Teagasc (2013) *Carbon-neutrality as a horizon point for Irish Agriculture: A qualitative appraisal of potential pathways to 2050*, p. 6.

<sup>14</sup> Department of Communications, Climate Action & Environment (2017) *National Mitigation Plan, July 2017*, p. 123.

<sup>15</sup> France's National Low-Carbon Strategy, 2016, p. 92.

<sup>16</sup> Ibid, pp. 91-92.

France's domestic 2030 target appears to be roughly consistent with its proposed ESR target, although they have different base years (1990 and 2005, respectively – however, France's gross emissions were similar in these two years) and coverage (the domestic target including ETS emissions).

The GHG data used to calculate France's carbon budgets appears to be identical to UNFCCC and EU accounting, i.e. currently applying IPCC 2006 Guidelines, including all KP CP2 gases and using 100-year GWPs from AR4. However, France also uses complementary consumption-based LCA accounting to consider emissions impacts occurring outside the national boundary as a result of specific policies.<sup>17</sup>

As France's domestic targets include the ETS sectors, they therefore indirectly benefit from the EU ETS as a flexibility mechanism. However, the accounting seems to be based purely on the ETS sector emissions that occur within the national boundary, without any offsetting provision for imports of credits from other countries. Likewise, there is no mention in the National Low-Carbon Strategy of counting any credits from other countries as offsets against non-ETS sector emissions.

### 4.3. Denmark

Denmark's ESD target for 2020 is to reduce emissions from non-ETS sectors by 20% from 2005 levels. Denmark's proposed target under the ESR is a reduction of 39% on 2005 levels by 2030.

The Danish Climate Policy Plan of 2013 announced a target to reduce Danish GHG emissions by 40% on 1990 levels by 2020, plus longer-term goals to base all of Denmark's energy supply (including transport energy) on renewables by 2050, to phase out oil for heating purposes and coal by 2030, and for electricity and heating supply to be 100% covered by renewable energy by 2035. The 40% target includes both ETS and non-ETS sectors, and excludes international aviation and maritime transport. Notably, however, it also includes removals from LULUCF, calculated according to KP accounting. The geographical scope is consistent with EU targets, i.e. the Danish mainland, excluding Greenland and the Faroe Islands. The Plan appears to be based on GHG data that is consistent with UNFCCC and EU accounting, i.e. applying the 2006 IPCC Guidelines and 100-year GWPs from AR4 to the basket of seven KP CP2 GHGs.

The Danish Climate Change Act (No. 716 of 2014) states the ambition for Denmark to be a low emission society by 2050 and requires the government to provide annual updates on climate policy to the parliament. The latest (2016) update notes that emissions as calculated according to the Danish Climate Policy Plan are expected to be 35-44% below 1990 levels by 2020.<sup>18</sup>

There is no mention in the Danish Climate Policy Plan of making any use of international credits to meet any shortfall in achieving domestic targets. As with France, the fact that the target includes the ETS sectors means that it benefits indirectly from the EU ETS as a flexibility mechanism, but the accounting appears to be based on emissions only, without any offsetting provision for imported credits.

### 4.4. Sweden

Sweden's ESD target for 2020 is to reduce emissions from non-ETS sectors by 17% from 2005 levels. Sweden's proposed target under the ESR is a reduction of 40% on 2005 levels by 2030.

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<sup>17</sup> Ibid, p. 10.

<sup>18</sup> Energi-, Forsynings- og Klimaministeriet (2016) *Klimapolitisk redegørelse 2016*.

In 2009, the Swedish parliament approved an integrated climate and energy policy including a target to reduce non-ETS emissions (defined in the same way as under the ESD) by 40% on 1990 levels by 2020 (Government Bills 2008/09:162 and 2008/09:163). One-third of the emission reductions were expected to be provided from KP flexibility mechanisms (no specific limit was placed on this).

In June 2017 the Swedish parliament approved a new climate policy framework, including a Climate Act which will enter into force on 1 January 2018 and establishes the legal basis for supporting long-term climate targets, which were established by the parliament at the same time. The Act also requires the government to report annually to parliament on implementation of the framework and to draw up climate policy action plans every four years. The long-term goals include:

- To reduce non-ETS emissions to 63% below 1990 levels by 2030 and 75% below 1990 levels by 2040; and
- To achieve national net zero non-ETS GHG emissions by 2045, and thereafter to achieve negative emissions.

In both cases, the targets are based on emissions to be calculated in accordance with UNFCCC and EU accounting, excluding LULUCF, international aviation and international maritime transport. The 2030 and 2040 targets cover only non-ETS sectors, while the 2045 targets include both ETS and non-ETS sectors. Consumption-based LCA accounting was considered, but rejected because of the potential uncertainties, and limited ability of the Swedish Government to affect emissions in other countries.

Flexibility mechanisms are permitted to provide up to 8% of the emission reductions in 2030 and 2% in 2040 (which may include removals from LULUCF, international offsets or biomass carbon capture and storage). The 2045 carbon neutrality target may also include the use of flexibility mechanisms (as per 2030 and 2040, plus fossil fuel carbon capture and storage); however, there is a requirement for non-ETS emissions from activities on Swedish territory to be at least 85% below 1990 levels by 2045 (i.e. not including international offsets).

A further target is to reduce emissions from domestic transport (excluding domestic aviation) by at least 70% below 2010 levels by 2030.<sup>19</sup>

#### 4.5. Estonia

Estonia's ESD target for 2020 is to contain increases in emissions from non-ETS sectors to no more than 11% above 2005 levels. Estonia's proposed target under the ESR is a reduction of 13% on 2005 levels by 2030.

In 2016, the Government of Estonia approved a domestic target of reducing emissions by 80% on 1990 levels by 2050, with interim goals of around 70% by 2030 and 72% by 2040.<sup>20</sup> It is not yet clear exactly how this target would be accounted, although it appears to include both ETS and non-ETS sectors, including LULUCF (but presumably excluding international aviation and international maritime transport). It is unclear to what extent flexibility mechanisms (such as carrying forward surplus credits from earlier years) are envisaged as contributing to these targets. The first report on implementation of the 2050 climate policy is due to be presented to the Estonian Government in 2019.

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<sup>19</sup> <http://www.government.se/articles/2017/06/the-climate-policy-framework/> (accessed 9 November 2017).

<sup>20</sup> Resolution of the Riigikogu: General Principles of Climate Policy until 2050, 5 April 2017. [https://www.envir.ee/sites/default/files/low\\_carbon\\_strategy\\_until\\_2050.pdf](https://www.envir.ee/sites/default/files/low_carbon_strategy_until_2050.pdf) (accessed 13 November 2017).

## 4.6. Norway

Norway has the following national targets:

- A KP CP2 target to reduce average 2013-2020 emissions by 16% from 1990 levels;
- A national target to reduce emissions by 30% below 1990 levels by 2020 (agreed by the Norwegian parliament in 2008 as Recommendation 145 (2007-2008));
- A Paris Agreement NDC of 40% below 1990 by 2030; and
- A long-term goal to be carbon neutral by 2050. In June 2016, the Norwegian Parliament approved a motion asking the government to bring this target forward to 2030, using a variety of offsetting mechanism including via the EU ETS, international cooperation, emissions trading and project-based offsetting.<sup>21</sup>

The domestic 2020 target covers both ETS and non-ETS sectors, including KP LULUCF, and depends on the use of international credits. It appears to have been overtaken by Norway's KP CP2 target, which Climate Action Tracker estimates is equivalent to about a 41% reduction on 1990 levels by 2020, assuming linear reductions from 2012 to 2020 and taking reported emissions in 2013 and 2014 into account.<sup>22</sup> Norway's accounting appears to be consistent with both UNFCCC and EU accounting, following the 2006 IPCC Guidelines, covering all seven KP CP2 gases and applying 100-year GWPs from AR4.

As of 2013, around 50% of Norway's emissions are included in the EU ETS, including aviation. If there is an agreement with the EU on collective achievement, Norway's NDC target of a 40% reduction by 2030 will be converted into a target for non-ETS sectors in the same way as the ESR targets for EU countries, assuming that the ETS sectors collectively achieve the EU ETS target of a 43% reduction on 2005 levels by 2030. Otherwise, if there is no agreement with the EU, Norway's target will be economy-wide.

Norway plans to use flexibility mechanisms in accounting towards all of its targets. Only approved KP flexibility mechanisms would be used in accounting for the KP target, and under any agreement with the EU, only ESR-approved mechanisms would be counted towards achieving the 2030 target (i.e. no use of international offsets).

## 4.7. New Zealand

New Zealand has three national targets:

- 5% below 1990 by 2020;
- 30% below 2005 (equivalent to 11% below 1990) by 2030; and
- 50% below 1990 by 2050.

As previously noted, New Zealand does not have a KP target under the Doha Amendment. Its domestic 2020 target differs from other 2020 KP targets in several ways. First of all, the target is not converted to a budget for 2013-2020 in the same way as a KP target, which would be equivalent to a budget of 8x(95% of 1990 emissions). New Zealand's target is only to reach 95% of 1990 emissions by 2020, therefore its budget is the average of the trajectory from average 2008-2012 levels (taken as 2010) to 95% of 1990 emissions by 2020, which is equivalent to a KP CP2 budget of 8x(96.8% of 1990 emissions). In other words, in KP terms this is a target of 96.8%, not 95%.

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<sup>21</sup> Norwegian Government (2016) Sett. 407 S (2015-2016).

<sup>22</sup> See <http://climateactiontracker.org/countries/norway.html> (accessed 17 November 2017).

New Zealand's 2020 target covers the same sectors as would have been included in a KP CP2 target: namely, all UNFCCC sectors apart from LULUCF, where New Zealand accounts only for the mandatory activities (AR, D and FM). All KP CP2 GHGs are included, with 100-year GWPs as set out in AR4, and 2006 IPCC Guidelines are followed. In terms of flexibility mechanisms, New Zealand intends to use its carried-forward surplus from KP CP1.

New Zealand's 2030 national target is the same as its Paris Agreement target. Current indications are that this will be converted into a budget according to a similar trajectory calculation as the 2020 target, and will cover the same sectors, GHGs, GWPs and methods. With respect to flexibility mechanisms, New Zealand has stated that it intends to use a variety of international market mechanisms, cooperative approaches and carbon markets.<sup>23</sup>

In October 2017, a new coalition government was officially sworn in. The new government is preparing to introduce a new, stronger climate change regime, aiming for carbon neutrality by 2050, including legally binding targets and budgets. At the time of writing, there were no further details available on how this might change the targets and accounting methods outlined above.

#### 4.8. Mexico

In 2009, Mexico made a non-binding pledge as part of the Copenhagen Accord to reduce emissions by 30% below BAU by 2020, including LULUCF (equivalent to 58% above 1990 emissions by 2020, excluding LULUCF).<sup>24</sup>

This appears to have been superseded by Mexico's Paris Agreement NDC, which includes an unconditional target to reduce combined GHG and black carbon emissions by 25% on business-as-usual (BAU) levels by 2030, with emissions projected to peak in 2026. This translates to a 22% reduction below BAU levels for GHGs (the Kyoto basket, excluding NF<sub>3</sub>) and a 51% reduction below BAU levels for black carbon. Furthermore, if certain conditions are met (including an international carbon price, carbon border adjustments, technical and financial support and technology transfer) Mexico has also proposed adopting a conditional target of 40% below BAU (36% for GHGs and 70% for black carbon). The unconditional 22% below BAU target for 2030 equates to an increase of about 72% above 1990 levels (excluding LULUCF).<sup>25</sup>

Mexico's NDC target is economy-wide, including LULUCF.

Unlike all of the other countries in this study, Mexico plans to apply more recent 100-year GWPs from the IPCC Fifth Assessment Report, rather than from AR4. It is also unique in accounting for black carbon, using a GWP of 900 from a single literature source. This source notes that there are very large uncertainties in this estimate, and it does not include the cooling effects of air pollutants emitted by the same sources.

Mexico's General Law on Climate Change (2012, as amended 2014) provides the legal basis for the National Climate Change Strategy and includes the aspirational target to reduce emissions by 30% by 2020 with respect to BAU levels (as per the Copenhagen Accord pledge), as well as a long-term goal to reduce emissions by 50% on 2000 levels by 2050.

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<sup>23</sup> Submission under the Paris Agreement: New Zealand's Nationally Determined Contribution.

<sup>24</sup> <http://climateactiontracker.org/countries/mexico.html> (accessed 14 November 2017).

<sup>25</sup> <http://climateactiontracker.org/countries/mexico.html> (accessed 14 November 2017).

## 5. Conclusions

This study was motivated by the problem that countries report in different ways against different targets, making both cross-country and within-country comparisons difficult. This is indeed the case: the report provides many examples of countries using, in particular: different base years, sectoral coverage and degrees of reliance on flexibility mechanisms, which make their efforts difficult to compare. In addition, targets which are expressed as objectives to be met by a certain year, rather than as a cumulative budget over a period of years, are subject to considerable uncertainty depending on the trajectory towards the target year. Two countries with identical targets and identical emissions in the same base year could have very different impacts on the global climate if their trajectories towards the target were different.

On the other hand, there is substantial convergence on the use of comparable methodologies to estimate GHG emissions and removals (as called for and promoted by the UNFCCC). The study found no evidence of countries deliberately using different methodologies to calculate underlying GHG data for different purposes, other than in the case of UNFCCC and KP accounting for LULUCF.<sup>26</sup> Rather, it appears that the same underlying GHG data is typically adapted for accounting against different targets. UNFCCC and KP accounting provides the core comprehensive dataset, from which certain elements can be removed or recalculated as required. For example, emissions data for certain territories which are not covered by a particular target may be removed; likewise emissions data from certain sectors or activities (such as EU ETS emissions), or certain gases which are not included in the scope of a given target.

LULUCF is the one sector that is actually subject to two different standardised calculation methodologies, where UNFCCC and KP accounting can result in quite different quantities of stated emissions or removals for the same country. In addition, variation in the adoption of optional KP LULUCF reporting categories, as well as in underlying assumptions and models, make this sector a particular challenge to cross-country comparability.

The historical differences between Annex I and non-Annex I countries, and the associated accounting flexibility given to the latter, means that while there is substantial consistency in underlying methods used by Annex I countries, more variation is to be expected with respect to non-Annex I countries. For example, in this study, Mexico is the only country not applying AR4 GWPs, and also the only country proposing to account for black carbon in its domestic target.

Finally, while substantial convergence can be seen in targets for 2020 (the KP CP2 and ESD time-frames), there is more variation seen in targets for 2030 (the Paris Agreement and proposed ESR time-frames), and generally not a great deal of clarity about accounting for targets beyond 2030. This suggests that the international accounting frameworks are critically important in driving consistency between countries, which otherwise have a strong incentive to pursue more idiosyncratic accounting that suits national circumstances, at the expense of cross-country comparability.

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<sup>26</sup> The absence of something is always difficult to prove, however, and the study did not systematically test for quantitative equivalence between different accounts produced for different purposes.

## Annex 1: Further references

<http://climateobserver.org> (climate policy monitoring)

<http://columbiaclimatelaw.com/resources/climate-change-laws-of-the-world-2/climate-change-laws-of-the-world-database/> (climate legislation monitoring)

<http://climateactiontracker.org> (climate action monitoring)

<http://www4.unfccc.int/ndcregistry> (interim NDC registry)

[http://unfccc.int/national\\_reports/national\\_communications\\_and\\_biennial\\_reports/submissions/items/7742.php](http://unfccc.int/national_reports/national_communications_and_biennial_reports/submissions/items/7742.php) (UNFCCC Annex I country National Communications)

[http://unfccc.int/focus/long-term\\_strategies/items/9971.php](http://unfccc.int/focus/long-term_strategies/items/9971.php) (National long-term strategies submitted under the Paris Agreement).

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