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Carbon Budgeting in Selected Countries

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Small Scale Study of carbon budgeting in selected countries

By

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Climate scientists have calculated, subject to important assumptions, estimated ranges of a remaining global carbon budget that is consistent with a given threshold temperature increase, usually the temperature goals specified in the Paris Agreement. The range of global carbon budgets consistent with a 1.5 or 2 degree Centigrade temperature range implicitly apply a level of risk tolerance (understood as the degree of willingness to accept risk of overshooting the temperature target)). Carbon budgets are thus a matter of broad public concern with profound economic, equity and ethical implications, especially when considering the most vulnerable populations to climate impacts and future generations. Furthermore, carbon budgets are shrinking - estimates continue to be revised with new scientific analysis and budgets are also being depleted by the ongoing failure to mitigate, which in turn, could be driving positive feedbacks in the climate system. This study reviews approaches to setting carbon budgets in other jurisdictions to support the development of the second programme of carbon budgets by the Climate Change Advisory Council. The study reviews and describe approaches in Ireland, the UK, New Zealand, the Netherlands, France, Finland, and Denmark and also the EU approach to setting targets and trajectories where relevant, with a particular focus on approaches and lessons which could be applied in an Irish context.

Blind spots

National level carbon budgets are devised by calculating a share of the remaining global carbon budget, and make implicit judgments regarding responsibility for historical emissions based on a given temporal range. Modelling parameters that are used to devise mitigation pathways also include important assumptions about risk, climate feedbacks, the cost of damages and the relative cost of inaction. These choices inevitably determine the scope and temporal range of the chosen carbon budget. Other potential 'blind spots' in carbon budgeting include the inclusion of large-scale negative emissions or carbon dioxide removal technologies, the exclusion of aviation, shipping and non-territorial emissions from carbon budgets, or assumptions about future offshore mitigation potential. If aviation and shipping emissions, along with other non-territorial or consumption emissions, are not properly reported and accounted for in the carbon budgeting process, and strategies put in place to address them, they may evade scrutiny or mitigation planning. Of particular relevance to Ireland is the ongoing debate about whether to use a different metric for methane, a potent greenhouse gas with a shorter lifetime than CO2. If non-CO2 mitigation contributions are not fully implemented in a timely manner, this affects the timing of reaching net-zero CO2 which must occur much sooner. The literature reviewed argues in favour of including all GHGs in carbon budgets as CO2 equivalent.

Equity principles in carbon budgets

Ethics and equity principles in devising carbon budgets have been proposed by many researchers to take account of the role of intergenerational equity, historical responsibility, and global inequality. For example, some principles for sharing the global carbon budget equitably propose equal cumulative per capita emissions or contraction and convergence (Meyer, 2004), grandfathering, greenhouse development rights, cost effectiveness and ability to pay. However, applying these principles could mean that developed countries would be required to reach net zero emissions as soon as 2030 which raises questions about enforceability and political feasibility. These results highlight the challenges of ensuring an equitable global distribution of emission rights, especially where the equity framework is non-prescriptive and voluntary, and where there is a risk of free-riding and carbon leakage. To address this challenge, some analysts suggest putting the emphasis on sinks and land use policies, and increasing levels of support to other countries to enable them to implement mitigation efforts 'that go beyond their responsibilities and capabilities' to transform food and financial systems along with contributing to loss and damage funding, a commensurate climate finance contribution, and the reform of trade policies to ensure that they support sustainable development and climate justice.

Climate communication

Carbon budgeting is an opportunity to communicate the concept of atmospheric limits, planetary boundaries and democratise decision-making with respect to the trade-offs that climate mitigation policies inevitably entail. While opinion polls regularly show strong levels of public support for climate policies, these results should not be confused with forms of public engagement that foster climate literacy and allow for deep listening and learning, as well as opportunities to participate in decision-making processes that channel concern into agency. While citizens' assemblies have proven to be highly effective forms of engagement and for problematizing certain issues, they have important limitations and are no substitute for strong political leadership, societal consensus or for a vibrant civil society and social movements including those using litigation as an instrument for policy change and legal reform.

Comparing climate laws and policies

Comparing climate laws and policies allows for an examination of similarities and differences in a way that enhances our understanding of climate politics and public

policy. What is apparent from reviewing the climate laws and carbon budgeting processes in the selected countries is that regardless of how prescriptive the climate policy planning process is, political choices, public opinion, and the policy preferences of key stakeholders shape the decision-making process in important ways. Many countries in this study have set ambitious targets that are now at risk due to political backsliding, popular resistance to certain measures, or the emergence of new crises such as Russia's invasion of Ukraine. While the UK, for example, was a world leader in introducing a framework climate law in 2008, recent political developments and policy implementation challenges are putting the achievement of the fourth and fifth UK carbon budgets at risk. The Paris Agreement makes the achievement of the temperature goals in article 2 a collective ambition, however it did not resolve the issue of burden sharing. Countries claiming to do their 'fair share' of the global mitigation effort should have transparent and credible targets that correspond to their reasonable shares of what is required if the world as a whole is to achieve the temperature targets of the Paris Agreement.

Case studies

This report analyses the climate policies and laws of Ireland, 6 OECD countries and the EU as a whole against a range of normatively relevant indicators that are chosen to highlight institutional, legal, economic, and political commitments to climate action that, taken together, reflect each country's overall contribution to the temperature goals of the Paris Agreement. The indicators reflect each country's emissions profile, historical contribution, renewable energy shares, international policy performance ranking, committed emissions and recent policy developments. The data tracks legislative initiatives, alongside measures for a Just Transition and public participation. Each country's climate policy planning cycle is described, including accounting and accountability frameworks, the role of expert advisory bodies and carbon budgeting and/or target-setting processes.

Conclusions and lessons learned

Ireland's climate law and the carbon budgeting framework recommended by the Climate Change Advisory Council rank highly among countries with robust climate laws that include science-based targets, accountability mechanisms in the policy cycle and opportunities for public participation. However, a number of important lessons can be learned from studying other countries included in this report.

1. A 'no backsliding' principle should be enshrined in any future revision to the 2021 Climate Act to ensure that no carbon budget programme can be less

ambitious than the previous one, and that overshoot of a carbon budget triggers an emergency process to revise the Climate Action Plan midstream.

2. Carbon budgets should make explicit provision for, or exclude, assumptions about negative emissions technologies and set absolute limits on offshore mitigation.
3. Modelling assumptions that contribute to the making of a carbon budget for any sector should incorporate climate risks, projected damages under various scenarios and positive climate feedbacks.
4. Methane emissions should continue to be reported as CO2e in sectoral targets and carbon budgets.
5. Aviation and shipping emissions should be reported transparently and mitigation strategies for these sectors included in the annual Climate Action Plan. Non-territorial emissions should be reported on an annual basis by the EPA or the Council.
6. The Council should in its carbon budgeting process and/or in its annual review consider how to include the question of fossil fuel lock-in or committed emissions as a result of new fossil fuel infrastructure such as gas pipelines, connections, LNG storage, fossil fuel boilers or gas fired power plants.
7. The Council should consider taking a more active role in climate communications and climate literacy programmes, and make recommendations to government on incorporating the carbon budgets into existing climate communications activities.
8. The Council should recommend to government that it engage with relevant stakeholders to draw up sectoral partnerships or agreements (similar to those in the Netherlands or Denmark) leading to sectoral just transition plans.
9. The Council should commission a review of Ireland's fair share contribution opportunities under the Paris Agreement to consider levels of and approaches to climate finance, support for loss and damage, a review of trade policies and international support for a fossil fuel phase out.
10. The Council should recommend that Ireland's next NDC include an explanation of how Ireland's contribution represents a 'fair share' of its common but differentiated obligations under the Paris Agreement.

2. Introduction

The Climate Action and Low Carbon Development Act 2015, as amended in 2021, makes provision for the adoption of carbon budgets and related sectoral emission ceilings, along with a climate action plan to be updated annually. The Act specifies that the first two carbon budgets covering 5-year periods each should achieve reductions such that the total amount of annual greenhouse gas emissions in the year ending on 31 December 2030 is 51 per cent less than the annual greenhouse gas emissions reported on an economy-wide basis for the year ending on 31 December 2018. The Climate Change Advisory Council's role is to devise and recommend carbon budgets, and the first carbon budget programme was adopted by the Oireachtas in April 2022. This study was commissioned in December 2022 to assist the work of the Council in considering the fourth carbon budget and second carbon budget programme.

While the approach of the Irish 2021 Act is largely consistent with the climate laws of several EU and OECD member states, there is considerable variation across countries in methodological choices (such as whether to 'grandfather' emission rights), the treatment of long-lived vs short-lived greenhouse gases, weighting of feasibility and flexibility, and understandings of fair shares and climate justice. In their 2020 report, researchers Nick Evans and Matthias Duwe highlighted how framework climate laws speak to 'fundamental questions' relating to the organisation of climate policy making and institutional roles and responsibilities (Duwe and Evans, 2020). They note that good practice in climate law design incorporates several key elements, including targets, planning and measures, progress monitoring, institutional arrangements, scientific advice, public participation, and set out a vision for long term transition towards a decarbonised economy. In addition, some laws go further in specifying carbon budgeting mechanisms that break climate targets down into emission budgets periods, which in some cases (notably Germany) are drawn up on a sectoral basis (*ibid*., p.18).

This study reviews approaches to setting carbon budgets in other jurisdictions to support the development of the second programme of carbon budgets by the Climate Change Advisory Council. The study reviews and describe approaches in Ireland, the UK, New Zealand, the Netherlands, France, Finland, and Denmark and also the EU approach to setting targets and trajectories where relevant, with a particular focus on approaches and lessons which could be applied in an Irish context. The criteria against which different modelling approaches will be assessed

will include legal, economic, and institutional contexts, temporal ranges, and treatment of long and short-lived gases.

The study also considers different approaches to determining 'fair share' contributions of effort under the Paris Agreement and how conceptions of climate justice are incorporated into carbon budgeting and emission scenarios in selected countries. While there is a large body of research that now looks at comparative climate policy through the lens of climate laws and litigation (Averchenkova *et al.*, 2017; Setzer and Higham, 2022), there is less information available that compares countries' approach to carbon budgeting, whether that is through the adoption of formal carbon budgets in climate laws (such as the UK, France, Ireland and New Zealand), or budgeting via target-setting (as in Denmark, Finland and the EU).

This report analyses the climate policies and laws of Ireland, 6 OECD countries and the EU as a whole against a range of normatively relevant indicators that are chosen to highlight institutional, legal, economic, and political commitments to climate action that, taken together, reflect each country's overall contribution to the temperature goals of the Paris Agreement. The indicators reflect each country's emissions profile, historical contribution, renewable energy shares, international policy performance ranking, committed emissions and legislative initiatives, alongside measures for a Just Transition and public participation. Each country's climate policy planning cycle is described, including accounting and accountability frameworks, the role of expert advisory bodies and carbon budgeting and/or target-setting processes. Finally, the study will consider what lessons can be gleaned from the legal, policy and budgeting approaches adopted by the selected countries that are relevant to Ireland, in the context of the consideration of the next carbon budget programme due to commence in 2024.

3. Carbon budgets: an overview

Climate science has confirmed since the early 1990s that observed changes in the Earth's climate are due to cumulative anthropogenic emissions of greenhouse gases that drive a near-linear response in temperature increase and subsequent climatic changes (Allen *et al.*, 2009; Meinshausen *et al.*, 2009). The most recent assessment report of the IPCC AR6 Working Group I reaffirmed with high confidence the AR5 finding that there is a near-linear relationship between cumulative anthropogenic CO2 emissions and the global warming they cause (Masson-Delmotte *et al.*, 2021 [D1.1]), and that peak warming is largely insensitive to the pathway of CO2 emissions over time.

Thus the global climate mitigation challenge might be described as one of limiting the cumulative emissions of carbon dioxide (CO2) to a budget consistent with a tolerable temperature rise by a specific date (Matthews *et al.*, 2018). On this basis climate scientists have calculated, subject to important methodological assumptions, probabilistic ranges of a remaining global carbon budget that is consistent with a given threshold temperature increase, usually the temperature goals specified in the Paris Agreement (UNFCCC, 2015; Rogelj *et al.*, 2018; Matthews *et al.*, 2021).

Notwithstanding the high levels of agreement in IPCC reports, there is still a significant range of carbon budgets offered in AR6 for different likelihoods of temperature increases of between 1.5 and 2 degrees which suggests a set of mitigation options many of which may not be consistent with equitable, prudent, or precautionary climate mitigation. For example, a global carbon budget of 300 GtCO2 is estimated for a 83% likelihood of remaining below 1.5 whereas 2300 GtCO2 for a 17% likelihood of remaining below 2 degrees (IPCC, 2021b Table SPM.2, p.29). In addition, when additional factors are included such as non-CO2 gases and forcings, limits to the degree of overshoot permissible, tipping points and geophysical feedbacks in climate scenarios, the carbon budgets are tightened even further (Matthews et al., 2021; Lenton *et al.*, 2019).

The implications of this brief review are that firstly, the adoption of any carbon budget is both a scientific endeavour based on best available information about the climate response to greenhouse gas emissions as well as an implicit decision about risk tolerance. Climate uncertainty, a higher transient climate response to cumulative emissions and a tighter risk tolerance, implies a lower safe carbon budget and indicates that less fossil fuel can be burnt in total, thus requiring a more ambitious climate policy (van der Ploeg, 2018). But while scientists are best placed

to estimate the global carbon budget consistent with a temperature range, the choice of risk tolerance is also a matter of broad public concern with profound equity and ethical implications, especially when considering the most vulnerable populations to climate impacts and future generations, and the largely irreversible nature of large-scale earth system and atmospheric shifts.

Secondly, carbon budgets are not fixed for all time: estimates continue to be revised with new scientific analysis and budgets are also being 'squeezed' and depleted by the ongoing failure to mitigate, which in turn, could be driving positive feedbacks in the climate system (Lenton, 2021). Furthermore, as wealthy and large emitting countries continue to use up the carbon budget, the scope for developing countries to realise their development goals fades in real time (Alcaraz *et al.*, 2018; Ganti *et al.*, 2023).

The lesson here is that carbon budgeting, whether carried out at international, national or sectoral levels, should be viewed as a dynamic and iterative endeavour that in turn will require much greater levels of scientific and climate literacy across decision-making bodies as well as consistent political will to implement the policies necessary to stay within the budgets. However, revisions *per se* should be determined by new scientific information rather than wishful thinking and approached with prudence, risk avoidance, and the precautionary principle as paramount.

3.1 Methodological choices in determining carbon budgets.

In addition to a temperature threshold or goal, a carbon budget requires a temporal range. The global carbon budget estimates the cumulative emissions consistent with 1.5 or 2 degrees of warming, this includes known anthropogenic emissions from the industrial era to the present (i.e., from c.1850).[1] Most countries however, including Ireland, have adopted carbon budgets or targets that implicitly grandfather past emissions by choosing base years that omit historical emissions. How far back in time the budget starting line is chosen reflects once again an implicit ethical decision to grandfather past emissions by simply ignoring them. This is akin to someone electing to wipe their financial slate clean by writing off debts that have not been paid without their creditors' agreement.

[1] Even the precise definition of the 'pre-industrial' period is debated in the literature. Matthews *et al* (2020) include 3 reference periods as options to describe the pre-industrial period: 1850-1900 (average), 1860-1880 (average) and 1720-1800 (average). The quality of the dataset for each varies.

In a practical sense of course, past emissions cannot necessarily be 'undone' (except by large scale carbon removal technologies that do not yet exist at scale) so it is understandable that carbon budgeting tend to cover the *remaining* carbon budget.[2] But by claiming a share of the remaining global carbon budget in a manner that does not acknowledge countries' historical emissions, carbon budgeting risks losing its scientific integrity in the eyes of developing countries whose access to the remaining carbon budget is restricted as a result.

In selecting a temporal range for a global carbon budget, various considerations come into focus, including baseline year and target GHG reductions, whether to 'grandfather' emission rights implicitly, the treatment of different gases, Land use and Land Use Change and Forestry (LULUCF), and how to incorporate emission scenarios into the budgeting process. Matthews et al (2020) recommend that budgets estimate anthropogenic warming only; are defined in relation to policy relevant target (such as the Paris Agreement temperature goals); make explicit any choices about desired level of risk avoidance; define a reference period (pre-industrial baseline); be explicit about temperature change metric; and finally, define the carbon budget as total emissions up to the point of net zero or peak temp (avoiding any assumption re NETS or overshoot).

Integrated assessment models (IAMs) are used to devise pathways for a range of emission scenarios and play an important role in devising mitigation strategies to accompany carbon budgets. IAMs are modelled transformations of the energy and land-use system and rely on the assumed available carbon budgets (Fujimori *et al.*, 2019). Some economists warn that the methodologies employed, which attempt to integrate economic and environmental analysis, have 'serious shortcomings' (Stern *et al.*, 2022). Despite these shortcomings, IAMs (and models generally) have been very influential in shaping policy and have played a major role in IPCC reports, which in turn have played a prominent role in public discussion. While the setting of a carbon budget ideally is entirely separate to an IAM, in reality the two processes often become conflated in public narratives, resulting in a confusion between the agreed 'facts' about the range of carbon budgets consistent with a temperature rise and the policy choices alongside feasibility considerations about these temperature goals might be realised.

[2] See Matthews et al (2020) for a summary of the variants of carbon budgets, which include total carbon budget, remaining carbon budget, threshold avoidance budget, threshold return budget and overshoot budget (Box 1, p.770). See also Rogelj, J., Schaeffer, M., Friedlingstein, P., Gillett, N. P., Van Vuuren, D. P., Riahi, K., Allen, M. and Knutti, R. (2016) 'Differences between carbon budget estimates unravelled', *Nature Climate Change,* 6(3), pp. 245-252

Other critiques of IAMs highlight the normative assumptions that are built into climate models in respect of base years, historical responsibility for climate change, implicit intertemporal trade-offs between generations, the inclusion of carbon capture and storage or negative emission technologies and note that IAMs do not often make explicit how much the current generations should sacrifice in order for future generations to be assured of atmospheric safety (Rivadeneira and Carton, 2022).

IAMs struggle to compare welfare across generations, and disregard the rights of future generations, with high discount rates that weigh the interests of future generations negatively in comparison to the present. Catastrophic risks are in large measure assumed away as are damages, technologies and costs associated with inequitable temporal and spatial distribution of such risks (Wagner and Weitzman, 2016). The optimisation framework embodied in IAMs is often inadequate to capture deep uncertainty and extreme risks. Stern and Stiglitz (2022) recommend an alternative methodological approach to simple maximisation of expected utility which they refer to as the guardrail approach, first outlined in chapter 3 of IPCC AR5 WGIII (Kolstad *et al.*, 2014). This asks what needs to be done to avoid the most extreme damages, what targets to adopt and then assesses whether they are feasible.

Certain modelling assumptions can lead to a narrowing of policy options that whether intentionally or not, support business-as-usual paradigms. For example, van Meijl *et al* (2018) and Hasegawa *et al* (2018) compare impacts of climate change and mitigation on global agriculture by 2050 and find that mitigation has more negative impacts on agriculture production relative to a no-mitigation strategy with stronger climate impacts (RCP6.0). This stands in contrast to most of the IPCC science on the impacts of climate change on crop yields, food insecurity, water availability, pests, drought and soil health (Arora, 2019) but the divergence arises because of the modelling assumptions used and the limits of models in capturing multiple dynamic feedback mechanisms and socio-economic interactions.

On the basis of the above, it is important that policymakers and bodies charged with recommending carbon budgets take stock of the large body of published research that seek to define a global carbon budget consistent with meeting a long term climate objective, and then separately consider the rules or criteria to equitably allocate a national or local/ sectoral budget. Matthews *et al* (2020) note that since remaining carbon budget estimates range widely,

> *'uncertainty can be used to either trivialize the most ambitious mitigation targets by characterizing them as impossible, or to argue that there is ample time to allow for*

a gradual transition to a low-carbon economy. Neither of these extremes is consistent with our best understanding of the policy implications of remaining carbon budgets' (ibid., p.769).

3.2 NETs, non-CO2 gases, and blind spots in carbon budgets

Negative emissions technologies (NETs)

IAMs have come under much scrutiny over the past decade for their reliance on largely speculative and unproven negative emissions technologies (NETs) such as Bioenergy Carbon Capture and Storage (BECCS), Direct Air Capture (DAC) and carbon capture and storage (grouped together here under the term Negative Emission Technologies or NETS) (Anderson *et al.*, 2016). Scientists have been warning for over a decade that NETs are largely unproven at scale and risk becoming 'dangerous distractions' if included in mitigation scenarios (Fuss *et al.*, 2014; McMullin *et al.*, 2020). As Smith *et al* note (2016), NETs could be utilised to offset emissions that were released either in the past or in the near future, or ongoing emissions from difficult-to-mitigate sources of CO2 such as from aviation or steel production (*ibid.*).

The difference to the atmosphere between the two uses of NETs is negligible, but from an ethical perspective however, the difference is significant. In the first case emissions that could be mitigated or eliminated with different technologies or behaviours are allowed to continue, whereas in the second case, only sectors that do not have readily available alternative fuels, but which are essential for some aspects of economic development or human welfare are targeted with offsetting via NETs. Such nuanced ethical considerations are rarely considered in IAMs where NETs are deployed at scale, since economic analyses often assume that an effective economy-wide carbon price will determine the allocation of the most efficient mitigation investments.

NETs also require the utilisation of considerable land, water, and physical resources to be realised which could displace food production or forestry and could result in higher albedo effects due to large-scale land-use change. Non-permanence is a further risk, if captured emissions somehow are released again (Fekete *et al.*, 2022). Smith *et al* (2016) note that without global forest protection, increased bioenergy deployment would likely increase GHG emissions from land-use change (Schueler *et al.*, 2013). In any case, the potential for bioenergy in particular is very unevenly distributed across the planet. NETs are also costly, in many estimates considerably

more costly than mitigation via energy efficiency and the deployment of renewables to replace fossil fuels.

As more and more NETs pilot studies emerge, it is common to see CCS projects coupled with existing sites of fossil fuel extraction and power generation, and also plastics production, often with significant levels of state subsidy (see the UK and Netherlands case studies in this report in this respect). Some experts however have criticised the UK government's supports for CCS on the grounds that it will delay the phase out of fossil fuels, and because it is unnecessary if the transition to renewables takes place as quickly as possible. [3] Many countries are now investing heavily in NETs. However, it is not clear that the technologies are being targeted at residual emissions in a net zero emissions scenario, or at hard-to-abate sectors. The most recent IPCC assessment report (AR6) is nuanced regarding carbon dioxide removal (CDR) which it regards as having considerable potential in principle but notes that CDR methods may have 'wide-ranging side-effects' that could affect the achievement of sustainable development goals (IPCC, 2021a).

Carbon capture and storage does not currently play a role in Ireland's climate mitigation strategies. However, the 2023 Climate Action Plan states the intention to support a CCS strategy during the third carbon budget period (2031-2035).

Non-CO2 emissions

A further blind spot exists in respect of non-CO2 emissions, which are usually expressed as CO2 equivalent in UNFCCC inventories, but which include gases such as methane that are much more potent in terms of their warming potential than CO2, even if they have a shorter atmospheric lifetime. While this is not the place to detail the scientific debates and findings in full, it is important to note that achieving climate neutrality[4] by reaching and then maintaining net zero annual GHG emissions

[3] See https://www.theguardian.com/environment/2023/mar/30/government-gambles-on-carbon-capture-and-storage-tech-despite-scientists-doubts. Bob Ward, head of policy at the Grantham Institute, said CCS technology would be needed for certain industries, but that using it to enable the continued use of fossil fuels was a mistake. "What does not make sense is to carry on with further development of new fossil fuel reserves on the assumption that CCS will be available to mop up all the additional emissions. While the costs of CCS will come down, it will make fossil fuel use even more expensive, and it will not eliminate all the risks resulting from the price volatility and energy insecurity of fossil fuels. A successful and competitive economy in the future will be powered by clean and affordable domestic energy, not unreliable and insecure fossils fuels," he said.

[4] Climate neutrality is most commonly used to mean that a nation achieves and then maintains a target of net zero annual emissions of GHGs, based on use of the GWP100 equivalence metric, so that a low residual quantity of GHG emissions is balanced by the same annual removal of CO2.

requires mitigation of all GHGs. If non-CO2 mitigation contributions are not fully implemented in a timely manner, this affects the timing of net-zero CO2 which must occur about two decades earlier, according to Ou *et al* (2021) taking the 1.5 and 2 degree targets 'out of reach' under high emission scenarios (Harmsen *et al.*, 2023). In particular, a failure to achieve early, deep, and sustained cuts in annual CH4 emissions greatly increases the likely of overshoot and subsequent carbon dioxide removal (CDR) requirements.

A new metric known as GWP* has been developed to compare more accurately the contributions of long- and short-lived GHGs (Cain *et al.*, 2019). Unlike the conventional metrics GWP100 and GWP20, GWP* represents the warming impact of a short-lived GHG such as methane more accurately. The GWP* metric has deployed by some interests to argue that a. methane should be treated *differently* and b. sources of methane emissions should be treated *separately* (i.e. with a different target) to CO2 (some industry experts argue for a stabilisation of methane emissions rather than a steady reduction over time). This is unsatisfactory because the primary usefulness of GWP* is that it enables CH4 to be treated on the same basis as CO2e (for N2O and CO2) making aggregation and comparative scenario assessment possible – especially in meeting a specified Paris target. Furthermore, the use of GWP* outside of its proper context - a Common but Differentiated Responsibility and Respective Capability test that is applied consistently to all nations - deflects attention from the necessity of substantial early CH4 reductions to limit overshoot among high emitting countries.

As Rogelj *et al (ibid.)* point out in respect of GWP*, the deployment of any metric raises questions of equity and fairness when applied at any but the global level. They state that 'the use of GWP* would put most developing counties at a disadvantage compared to developed countries, because when using GWP* countries with high historical emissions of short-lived GHGs are exempted from accounting for avoidable future warming that is caused by sustaining these emissions. Using GWP* instead of GWP100 to capture the effects of methane emissions would risk the 'facilitation of loopholes when emissions based on the GWP* are traded between countries that use different approaches' (Rogelj and Schleussner, 2019). Furthermore, and precisely because of the characteristics of methane, policy choices made now in respect of methane emitting sectors can have

from atmosphere. By contrast, carbon neutrality is most commonly used to refer to reaching net zero annual emissions of CO_2 only.

a substantial effect on the amount of warming increase or decrease on the basis of the methane pathway taken.

The separate target for biogenic methane in the New Zealand climate act has been widely criticised, partly because it is a weak target, but also because the scientific rationale that supports it has also been subject to criticism (Taylor, 2023) . While methane has different characteristics to long-lived GHGs such as CO2, this does not mean that its impact can be ignored, especially as, using GWP*, large reductions in CH4 annual emissions can contribute to temperature reductions. Methane emissions have two main warming effects: a long-term “pulse” or “stock warming” which the science underpinning GWP* usage shows to be equivalent to releasing a CO2 emission of about a quarter of its annual CO2e value; and a “step” or “flow change” effect whereby an increase or decrease in annual CH4 emissions will result in a related increase of decrease in warming impact due to a CH4 source. Therefore, although a sustained stable rate of methane annual emissions will result in a stabilisation of resultant atmospheric concentrations, slow long-term warming would occur due to the persistent CH4 pulse stock effect (Solomon *et al.*, 2010) The mitigation potential of methane is large because a sustained small reduction in methane flow from a source (such as by a reduction in milk and meat production Ireland’s ruminant population) equates in temperature reduction terms to a large one-off removal of CO2 from the atmosphere.

Therefore, determining a ‘fair’ target for methane is not solely a question of stabilising the temperature impact of a gas by a given year: given its potency and short-lived nature, reducing methane flows can contribute to warming reductions. Critics also note that New Zealand’s ‘soft’ target for methane leads to further problems with agriculture’s impact on water quality and soil contamination (Semmelmayer, 2020, p.172). Experience with the UK’s climate change act shows that all sectors and GHGs should be included in one target (Fankhauser *et al.*, 2018). Semmelmayer concludes that ‘New Zealand seems to be following the general trend that the target is following the economy’ instead of vice versa *(ibid*., p.173). ‘Simply attempting to “grandfather” our existing contribution to warming from methane could be seen to be self-serving’, according to the New Zealand Parliamentary Commissioner for the Environment (Muinzer, 2020, p.214). This statement could apply equally well to Ireland, since analyses have shown that it is now virtually impossible to achieve a per capita fair share effort of the 1.5°C target by 2050 without early, deep and sustained reductions in annual methane emissions (McMullin and Price, 2020; Price, 2023), which in turn implies early, deep and

sustained reductions in ruminant annual milk and meat production unless rapid changes in production systems or new technologies are put into effect.

Offshore mitigation in climate strategies

While the expectation is that countries submitting NDCs under the Paris Agreement will adhere to the Agreement's intention that commitments should represent Parties' highest possible ambition, in practice, countries have a number of strategies and flexibilities available to them to assist them in meeting their domestic targets. Article 6 of the Agreement makes provision for a Sustainable Development Mechanism along the lines of the former Clean Development Mechanism under the Kyoto protocol (but significantly strengthened and with COP oversight). Countries may enter into formal agreements under article 6 with other countries to transfer mitigation outcomes (known as ITMOs) under certain circumstances. Switzerland for example has already entered into agreements with developing countries with a view to purchasing credits that it can then use to offset domestic emissions within its NDC.[5]

Using international credits or offsetting to achieve domestic targets is not yet a policy priority for most of the countries in this study, and at time of writing, the article 6 mechanisms are not fully up and running. In practice, the voluntary carbon market has not yet found a way to align itself with the new legal architecture of the Paris Agreement in a 'credible and legitimate way' (Kreibich and Hermwille, 2021). However, it is likely as 2030 approaches that many countries will seek to avail of offshore mitigation strategies in combination with the voluntary carbon market to support the achievement of their NDC. Such measures may not square with domestic climate law obligations, but remain a possibility for Paris Agreement compliance.

Carbon credits have been widely criticised for a lack of environmental integrity and in many cases do not represent real emission reductions. Furthermore, the risk of double counting reductions remains, and if the host party has an unambitious NDC this means that they can afford to sell emission reductions without any great effort. Researchers recommend that countries adopt a 'cautious' approach that guarantees environmental integrity and the use of limits (either relative or absolute) in international transfers as a guardrail against 'hot air' (La Hoz Theuer *et al.*, 2019)

[5] https://www.undp.org/geneva/press-releases/ghana-vanuatu-and-switzerland-launch-worlds-first-projects-under-new-carbon-market-mechanism-set-out-article-62-paris-agreement

Aviation and shipping

Emissions from bunker fuels or international transport have been traditionally omitted from national climate strategies but are accounted for 'below the line' in national UNFCCC inventories. At the moment it is a matter of policy choice whether to address emissions from these sectors in climate action plans under the Paris Agreement or domestic law. It is particularly striking that Ireland, with such a large (international) aviation sector, has no climate policy in respect of aviation emissions, a point which has been criticised by a number of civil society organisations and researchers. As Cormac O Raifeartaigh noted in 2022, the emissions associated with a return flight from Dublin to New York are not counted in the national emissions budget of either country. For this reason, there is little incentive for nations to reduce emissions associated with international flights.[6]

Until aviation and shipping emissions, along with other non-territorial or consumption emissions, are properly reported and accounted for in the carbon budgeting process, and strategies put in place to address them, they will simply evade political scrutiny or mitigation efforts. According to the Climate Action Tracker website, aviation emissions should decrease by 90% by 2050, compared to present.[7] Of the countries considered in this study, only France has implemented a clear policy to reduce aviation emissions by banning short-haul domestic flights if the journey can be completed in less than 2.5 hours by rail. The Dutch government has recently secured a legal ruling allowing it to implement a lower cap on the annual number of flights at Schipol airport from 500,000 to 460,000. By contrast, Ireland's Climate Action Plan 2023 does not include any measures for the aviation sector aside from a *post-2030* commitment to promote sustainable aviation fuels. The Dublin Airport Authority is proceeding with its plans to get planning approval to increase the numbers of passengers it can accommodate annually from 32 million to 40 million.[8]

3.3 Ethics and equity

The required rapid global reductions to ensure that global warming is held below 1.5 degrees can only be achieved by reducing emissions everywhere. However, the

[6] https://www.irishtimes.com/science/2022/09/29/our-growing-aviation-sector-is-a-cause-for-concern/
[7] https://climateactiontracker.org/sectors/aviation/
[8] https://www.irishtimes.com/transport/2023/04/04/daa-set-to-seek-increase-in-capacity-of-dublin-airport-to-40-million-passengers-per-year/

geographical circumstances, capabilities and development status of each country vary. Mitigation potentials are not always captured due to financial and institutional constraints, and furthermore, some countries have contributed a great deal more to increased atmospheric CO2 concentrations than others so far. Taking historical emissions into consideration when calculating a fair and equitable contribution to the temperature goals of the Paris Agreement shifts the focus from what is cost-effective and politically feasible to what is equitable, given the considerable benefits that accrued to developed countries that exploited fossil energy. Taking one specific case, the UK currently emits less than 1% of total global CO2 emissions annually, but is responsible for 4.5% of global cumulative CO2 emissions. When looking at what counts as a fair share, if the UK only claimed responsibility for 1% of global emissions it would be a claim that its historical emissions from over 150 years of industrial development (which are still warming the earth's atmosphere) should somehow be discounted, even though the science is clear that cumulative emissions (the 'stock') are just as important as the annual flow of emissions.

The principle of common but differentiated responsibilities' is enshrined in the 1992 UNFCCC in which Parties agreed that they should protect the climate system 'on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities'. While the Paris Agreement does not provide any guidance or thresholds on what an adequate or fair share effort would look like, countries are supposed to submit their NDCs along with an explanation of why they consider their targets to be a fair contribution. However according to Fekete *et al* (2022) very few countries have offered such an explanation to date (Winkler, 2020).

The Paris Agreement is also clear that equity is a guiding principle: it states that the Agreement -

> *'shall be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances" and national emissions reductions targets shall "reflect [a country's] highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances' (articles 2.2 and 4.3 of the Paris Agreement).*

In contrast to the Kyoto Protocol, the Paris Agreement does place obligations on all Parties to contribute to the goal of keeping the temperature increase below 2 degrees centigrade and pursuing a temperature increase limit of 1.5 degrees. However, developing countries are to receive support from developed countries in

the form of climate finance, technological assistance, and capacity building. The Agreement makes it clear that developed parties are supposed to take the lead in mitigation efforts and providing support to developing countries. The provisions in article 4 relating to mitigation, according to Bodansky *et al* (2017, p.251), are expressly designed to create both obligations and expectations in respect of a Party's contribution to implementing the Agreement in respect of equity.

Various studies have been conducted to describe equity principles that could be used to determine equitable contributions under the Paris Agreement. While the climate justice literature has examined the strength of various normative principles underpinning the concept of fairness in international climate policy (for example, see Caney, 2009; Caney, 2012; Bell, 2011; Shue, 1993; Page, 2011; Page and Heyward, 2017; McKinnon, 2015), more recent studies have attempted to put these principles to work in dividing up the global carbon budget and/or analyse various GHG mitigation pathways (Van den Berg *et al.*, 2020; Höhne *et al.*, 2014; Baer *et al.*, 2008; den Elzen *et al.*, 2013; Holz *et al.*, 2018; Baer *et al.*, 2017; Pan *et al.*, 2014; du Pont *et al.*, 2016; Raupach *et al.*, 2014). Van den Berg *et al* (ibid) select five distributive strategies from this literature, namely equal cumulative per capita emissions, contraction and convergence, grandfathering, greenhouse development rights and ability to pay, and analyse country level emission targets and carbon budgets following these criteria.

Taking grandfathering as an example, using an emission pathway, allocations of emission allowances remain in proportion to current emission shares. Grandfathering leads to allocations of carbon budgets based on current emission shares. Under an immediate per capita equality/ convergence principle, allocations of emissions allowance are immediately distributed in proportion to population shares, and carbon budgets are shed out based on average population shares in the period 2010-2100 (Pan et al., 2014). Equal cumulative per capita budgets incorporate historical cumulative emissions and are also based on the share of the population (den Elzen *et al.*, 2005). Ability to pay means that emission or carbon budget reduction targets from a baseline are allocated based on annual GDP per capita or average GDP per capita between 2010-2100. The greenhouse development rights approach considers both responsibility and capability (Athanasiou *et al.*, 2014). The cost optimal approach distributes allowances based on the least-cost options available and mitigation potential. The national allocation thus is highly dependent on the assumed marginal abatement cost curves and energy investment needs and capacity (McCollum *et al.*, 2018).

Approach	Methodology	Implications for carbon budgets (relative to 2010 levels of emissions)
1. Grandfathering	Allocation of carbon budgets based on current emission shares	This approach favours large emitters with large shares of historical emissions and high per capita emissions.
2. Immediate per capita convergence	Carbon budgets allocation based on average (projected) population shares in the period 2010-2100	The allocation under this principle results in negative budgets for the USA and Russia and near zero budgets for the EU. India and China are allocated c.50% of the total global carbon budget.
3. Per capita convergence	Allocation of carbon budgets based on both current emission shares and population shares.	Combines grandfathering and population shares so results are in the middle of those two approaches.
4. Equal cumulative per capita emissions	Allocation of budgets based on cumulative emissions per capita in a certain period that is equal across countries, incorporates historical cumulative emissions and based on share of population.	Countries with relatively high historical per capita emissions are allocated negative budgets and EU near zero. Countries with low historical emissions are allocated large budgets but lower than the GDR approach.
5. Ability to pay	Carbon budgets allocated on the basis of ability to bear the burden.	As responsibility is not taken into account, there are smaller differences between countries. A country with a GDP per capita income that is twice as high as the global average receives a reduction target that is 26% larger.
6. Greenhouse development rights	Carbon budgets allocated on the basis of both responsibility and capability using a Responsibility-Capacity Index that includes GDP per capita and measures of income distribution.	This approach favours China and India who, combined, are allocated 80% of the global carbon budget.
7. Cost-optimal	Allocation of budgets based on mitigation potential. Emission reductions are allocated on the basis of assumed marginal abatement cost curves.	For most countries the cost-optimal reductions are between the grandfathering and per capita convergence approach. Van den Berg et al state that a uniform global carbon price only leads to an equitable outcome on the basis of the presumption of acquired rights.

Figure 1: Summary of the effort-sharing approaches analysed by Van den Berg et al (2020).

Van den Berg *et al* find that effort sharing approaches that (i) calculate required reduction targets in carbon budgets (relative to baseline budgets) and/or (ii) take into account historical emissions when determining carbon budgets can lead to (large) negative remaining carbon budgets for developed countries. This is the case for the equal cumulative per capita approach and especially the greenhouse development rights approach. Furthermore, for developed countries, all effort-sharing approaches except grandfathering lead to more stringent budgets than cost-

optimal budgets, indicating that cost-optimal approaches do not lead to outcomes that can be regarded as fair according to most effort-sharing approaches (*ibid.*).

These results are important because they highlight the challenges of imposing an equitable regime under the Paris Agreement, in which Nationally Determined Contributions are *de facto* voluntary and self-determined. Countries will not be motivated to take the most equitable budget share if they do not see other Parties to the agreement behaving in a similar manner (the 'freeriding effect'), and different measures of what is equitable could be presented by countries that, when aggregated, blow through the global carbon budget nonetheless. Furthermore, in the absence of a legally enforceable global cap-and-trade regime, where developed countries allocated small or negative carbon budgets could purchase emission allowances from developing countries, the most equitable allocations could not be regarded as politically feasible.

In the current geopolitical context, it is proving next to impossible to get international agreement to formalise a distributive mechanism that includes recognition of historical emissions, and these political differences can also be seen in the ongoing negotiations for a new loss and damage instrument arising from decisions taken at COP27.[9] To address these significant gaps, Fekete *et al* (writing about the Netherlands) suggest focusing on increasing emphasis on sinks (though this would only make a small difference), and increasing levels of support to other countries to enable them to implement mitigation efforts 'that go beyond their responsibilities and capabilities'. If an equity calculation means that countries such as the Netherlands need to be at or below zero emissions by 2030, it is not clear how this could be accomplished in a way that is politically, economically, or technically feasible within a carbon budgeting framework in the absence of an enforceable global agreement that established an equity framework acceptable to all countries.

However, it does point to the opportunities in international climate diplomacy for developed countries to demonstrate their commitment to equity by ramping up their financial contributions to mitigation and adaptation funding and a loss and damage fund for developing and vulnerable countries.[10] Countries with the ability to pay should consider a suite of measures to support developing countries through

[9] The US is one of the biggest obstacles to a recognition of historical responsibility and it rejects the concept of climate reparations – see https://climatechangenews.com/2023/07/14/loss-and-damage-john-kerry-climate-reparations/

[10] The UK has announced that it will drop its commitment to meeting their share of the global $100bn per annum to developing countries. See https://www.theguardian.com/environment/2023/jul/04/revealed-uk-plans-to-drop-flagship-climate-pledge-rishi-sunak.

investments in clean technology and energy access under the Sustainable Development Goals, alongside reforms to the international financial architecture and multilateral development institutions to break the cycle of underdevelopment, poverty and extreme global inequality. Further, developed countries could support new financial instruments at a global level to end the ad hoc nature of development aid and disaster relief so that there is a steady and predictable flow of finance for loss and damage that is directly linked to responsibility for climate damages. Some proposals for innovative sources of finance that should be considered include a tax on international shipping emissions, a climate damages tax levied on coal, oil and gas extraction, a levy on carbon markets, frequent flyer taxes, wealth taxes, special drawing rights and the redirection of fossil fuel subsidies (Carty and Walsh, 2022).

Political obstacles are not a reason to abandon the concept of fair shares: many analysts argue that the roots of the climate crisis are deeply woven into global capitalism. Reforms need to be targeted at the economic structures that are continuing to drive both climate change (Hickel, 2019) and growing carbon inequality (Zheng *et al.*, 2023). At the very least, a carbon budget or mitigation pathway that relies on grandfathering emission rights without any regard for the argument for convergence or global development rights is simply unethical and unfair. Furthermore, a 'just' society would surely avoid extreme risks and burdens that are imposed on future generations (Gosseries, 2014).

Countries that claim to be making an equitable contribution to global climate justice would not just be designing mitigation pathways that are aligned with the Paris Agreement: they should also focus efforts on implementing the scientific recommendations of the IPCC including, for example, transforming food and financial systems (Zurek *et al.*, 2022) in ways that create avenues for contesting unequal balances of power in the international system (Ciplet *et al.*, 2022); supporting the call for loss and damage finance for vulnerable states (Lai *et al.*, 2022), and making climate finance commitments that are commensurate with historical responsibility for climate change and ability to pay; and reforming trade policies to support sustainable development.

3.4 Carbon budgets at the science-policy interface

While the expectation is that scientific analysis and information will directly inform mitigation policy, in practice climate change has always been a difficult issue to communicate to non-expert audiences including policymakers, their voters and other stakeholders (Howarth and Painter, 2016). While Ireland had a successful

citizens' assembly that considered climate change in 2017[11], and a second assembly on biodiversity in 2022[12] that both contributed to important policy debates, absorption of those recommendations into the political and policy agendas has not been without challenges. Climate policy analysis can learn to a significant degree from existing research into the obstacles to effective policy implementation which will be outlined briefly below.

To begin with, just because there is strong scientific evidence to support a policy does not mean it will be implemented rapidly, outside of an emergency such as a global pandemic. For example, it took decades for the tobacco industry to be regulated, in large part due to the influence of the tobacco industry itself which obscured the truth and lobbied successfully against public health measures (Oreskes and Conway, 2011). This pattern of promoting sceptics, obfuscation, denial and confusion by the fossil fuel industry has been a feature of climate discourse since the 1970s also (Lamb *et al.*, 2020) and is probably much more commonplace and 'normal' than is realised. Furthermore, the policy implementation process itself is often derailed by competing priorities, electoral cycles and weak or non-existent advocacy coalitions (Sabatier and Weible, 2007; Béland and Howlett, 2016). John Kingdon's work among others has highlighted the confluence of factors that need to be brought together to implement a new policy successfully: a good evidence base is only one of many aspects swimming in the multiple streams that make up the policy process (Kingdon and Stano, 1984).

In addition, the 'information deficit model' underpinning conventional understandings of science-policy interface underestimates the difficulty and challenge of communicating and acting appropriately on climate science (Suldovsky, 2017). As Rapley *et al* (2014) note, climate science is often unwelcome, inconvenient and contested: the role of scientists therefore is not just to provide impartial information but to fulfil a number of roles within the policy domain including that of 'Pure Scientist', 'Science Communicator', 'Science Arbiter', 'Issue Advocate' and 'Honest Broker of Policy Alternatives' (*ibid*.). Climate science and its interaction with public policy raise important questions about political legitimacy, trust, uncertainty and expertise (Demeritt, 2001), pointing to the need for new forms of deliberative policy-making that engages non-experts and stakeholders in designing policy responses (Suldovsky, 2017; Anderson *et al.*, 2008; Mander *et al.*, 2008; Hobson and Niemeyer, 2013). There is also a need to develop tailored programmes

[11] See https://2016-2018.citizensassembly.ie/en/How-the-State-can-make-Ireland-a-leader-in-tackling-climate-change/
[12] See https://citizensassembly.ie/citizens-assembly-on-biodiversity-loss/

for better public understanding of climate science at all educational levels and in the media to enhance climate literacy across the population (McCaffrey and Buhr, 2008), without which people struggle to make sense of climate discourse or their household carbon footprints. All of these issues and obstacles should rightly be the concern of the Climate Change Advisory Council as it undertakes its activities. There is growing evidence of a 'populist' backlash against climate policies in many of the countries surveyed in this report. For instance, one recent study that looked at Denmark, Finland and Sweden found a growing trend of intense politicisation of climate policies utilising strategies such as denial, nationalism and conservativism to contest or delay policy implementation (Vihma *et al.*, 2021). Other research highlights the tendency of populists to associate climate policies with 'elite' and exclusionary decision-making. Huber *et al* (2022) note that climate change - and carbon budgeting frameworks even more so - are highly abstract and 'cognitively distant phenomen[a] relying on 'democratic norms of political compromise and mediation, oftentimes located on an international level, making them an ideal target for populist criticism'. In addition, the populist critiques emerging in many countries of parliamentary democracy, the courts, public broadcasting and the 'legacy media', drives a deep distrust in political institutions that could potentially spill over into the climate policy and carbon budgeting arena.

While opinion polls regularly show strong and growing levels of public support for climate policies amongst Irish voters, these results should not be confused with forms of public engagement that allow for deep listening and learning, as well as opportunities to participate in decision-making processes i.e. channel concern into agency (Sippel *et al.*, 2022). In Ireland, levels of support for climate policy are stable across all demographics and regions.[13] However there is a significant undercurrent of opposition to climate policy among the farming community, and in conjunction with an emerging pattern of disinformation and climate denial from populist-style groups, this constituency is witnessing a pattern of politicisation that mirrors the emergence of the BBB farmers' protest party in the Netherlands.

In addition, opinion polls tend to test public beliefs and attitudes about climate change rather than ask the public what it wants (Fairbrother, 2022). Many types of opinion polling are also prone to methodological problems such as response bias, where respondents may offer answers that are perceived to be socially acceptable. Given the political challenges of staying within a declining carbon budget, skilling the public to engage effectively with the kinds of choices necessary, along with the

[13] See https://www.irishtimes.com/politics/2023/06/16/climate-action-a-priority-for-voters-but-pace-and-scale-of-changes-still-divide-ireland

scientific basis for them, will be crucial in the years ahead, and in particular, to avoid the kind of polarisation that has been a feature in recent political discourse in the Netherlands, UK and the US (Atkins, 2023; Patterson, 2022).

It might be tempting to think that the answer is a form of grassroots deliberative democracy that allows everyone to participate and learn together, such as citizens' assemblies as proposed by the Extinction Rebellion group when it launched in 2018 (Willis *et al.*, 2022).[14] However, while citizens' assemblies have proven to be highly effective forms of engagement and for problematizing certain issues, they don't reach everybody; nor are the resulting recommendations necessarily followed through in the policy and political streams. Public participation in climate decision-making is best regarded as necessary but not sufficient and citizens' assemblies are no substitute for strong political leadership, parliamentary scrutiny, societal consensus or for a vibrant civil society and social movements. In fact, the countries that have the strongest climate legislation were those that saw climate-focused campaigns with activist groups acting as 'policy entrepreneurs' in support of a climate law, notably the UK, the Netherlands, Denmark, Finland and Ireland (see for example, Carter and Childs, 2018). In practice, litigation by environmental and social actors has often been key to jump-starting more ambitious climate policies (Setzer and Higham, 2022). There is also a growing body of research that highlights the important role of the media in shaping public opinion and support for climate policies (Pringle and Robbins, 2022).

The selection of appropriate communication tools, framings and meta-narratives as well as new forms of decision-making to determine national mitigation responses will thus be critical to their ultimate success and uptake by the public and other stakeholders.

3.5 Carbon budgeting in the comparative public policy literature

Recent climate policy research highlights the potential for socioeconomic, cultural, political and cost barriers to derail mitigation responses and the transition to a net-zero economy as described in IPCC representative pathways (Matthews et al., 2020). In the case of climate change, countries, even within the EU or the OECD, due to the variety of institutional and legal forms that shape public policies, respond differently to the climate challenge. While all of the countries selected for analysis in this study are signatories to the Paris Agreement, each has responded differently to the climate science and the ethical, political, economic and technological

[14] See https://rebellion.global/blog/2021/01/05/citizens-assembly-climate-change/

implications of policies embedded in climate scenarios. Interrogating the reasons for this variation and the advantages vs disadvantages of different approaches is the foundation of comparative climate policy.

Comparative approaches in public policy aims to explain differences in country responses by isolating key indicators or mechanisms that are regarded as critical to explanations for policy change within a given policy paradigm (Dodds, 2018; Hall, 1993). Why do some countries experience barriers differently to others? What makes a climate policy more likely to succeed? Taking public policy as the unit of analysis of comparison across different systems and institutions allows for an examination of similarities and differences in a way that enhances our understanding of climate politics and public policy (Purdon, 2015).

In this field, institutions, interests and ideas are regarded as the three key variables against which policies can be described and compared, as is the relationship between the state, markets and society (Dodds, 2018). 'Institutions' refer to legal and statutory frameworks and government agencies, 'interests' include market actors, consumers and social movements, whilst 'ideas' refers to the different policy or political paradigms that shape the policy discourse. Understanding the interactions between these variables and how they play out differently in different countries may be key to identifying 'opportunities for intervention and remediation' (Purdon, 2015, p.2).

When carbon budgeting is considered from this perspective, what is involved is the creation of new institutions and legal frameworks to regulate a set of economic activities that have an unprecedented environmental impact. Greenhouse gas emissions are by their nature diffuse and locked-in to energy systems and socio-technical paradigms that have co-evolved for over a hundred years. Like many externalities, the benefits of emission reductions accrue to society at large while the costs fall to individual households or businesses, with vast spatial and temporal inequalities, hence climate change is viewed as a notoriously 'wicked' collective action problem (Gardiner, 2011). Abatement and transition costs vary significantly across different sectors, and in countries with fossil fuel resources there can be major social disruption if these industries are wound down.

Climate policy research stresses the need for policy durability to align investment strategies with decarbonisation goals, which in turn demand political commitments that are regarded as credible over a long timeframe (Riahi *et al.*, 2021; Helm *et al.*, 2003; Kolstad et al., 2014). For this reason, climate policy regimes at the national level tend to be more effective when accompanied by robust legislation and the

delegation of decision-making to independent expert and advisory bodies such as climate councils (Dubash *et al.*, 2021; Duwe and Evans, 2020; Lockwood, 2021).

The UK Climate Change Act of 2008 was the first legislative initiative to *institutionalise* a carbon budget framework by putting a cap on emissions over a specified time frame. It established an expert scientific body to provide advice and recommend the budgets to Parliament. This legislation might be fairly described as a watershed moment in climate policy as it offered an institutional innovation to a novel policy problem. The UK Act, by establishing a mechanism for carbon budgets that are set 12 years in advance, created a signal for long-term, credible commitments to climate mitigation, to create policy stability and put decarbonisation measures on a pathway that is consistent with the policy target (now - the temperature goals of the Paris Agreement). Since the UK Act was adopted, many countries have followed suit and climate laws are commonplace across the developed and developing world.[15]

However recent political developments in the UK underscore the challenge of maintaining the commitment to decarbonisation once the 'lower hanging fruit' is successfully picked. Despite being an early global leader in decarbonisation, the UK is now on course to miss compliance with the fourth (2023-27) and fifth (2028-32) carbon budgets unless additional measures are taken.[16]

Other countries face similar challenges. Many countries have set ambitious targets that are now at risk due to political backsliding, popular resistance to certain measures, or the emergence of new crises such as Russia's invasion of Ukraine. Russia's act of aggression led to soaring energy prices and raised new fears about energy security across Europe. Identifying which climate policy measures are most likely to contribute to energy independence, develop resilience and which are politically feasible in turbulent times is thus a timely endeavour. Viewing such policy instruments through the lens of carbon budget frameworks may provide crucial policy insights to Irish decision-makers, who face the additional challenges of managing ongoing high economic growth rates, growth in population and energy demand against a backdrop of challenging mitigation targets for 2030.

[15] See https://climate-laws.org/ a database of climate change laws of the world maintained by the Grantham research Institute on Climate Change and the Environment at the LSE.
[16] See the UK's Climate Change Committee 2023 Progress report to Parliament at https://www.theccc.org.uk/publication/2023-progress-report-to-parliament/.

3.6 The communicative potential of carbon budgets

At the national level, a carbon budget defines contribution a country should make to the global goals set out in the Paris Agreement, and by extension, the trajectory should it take to meet its own domestic decarbonisation targets (Smith, 2021). The use of a budget, as opposed to a temperature goal, has an important communicative appeal: it signals the finite constraints to the Earth's capacity to absorb greenhouse gas emissions (Price, 2021) and by focusing on cumulative emissions, i.e., a total global carbon budget, makes the gap between the countries' short-term proposals and the required long-term abatement efforts alarmingly obvious (Roser *et al.*, 2015). Carbon budgets have certain advantages over fixed year targets. They give countries a degree of flexibility over the mitigation pathway and render the political choices and trade-offs clear, in the same way that financial budgeting achieves (Van den Berg et al., 2020). Greenhouse gas emission budgets are policy instruments that do not merely require reaching a specific level of emissions reduction in a given year, they also require that total emissions for a given period are kept below a specific level. This approach is used in the United Kingdom, for example, and has been replicated in the Irish, French and New Zealand climate legislation.

According to the Danish Council on Climate Change ('Klimaradet', 2019) which considered the issue in 2019 in advance of the new Danish climate law, in theory, greenhouse gas emission budgets provide a greater incentive for short-term action than a normal single year target. Under a greenhouse gas emission budget, greenhouse gas emission reductions must be achieved within the first year. If reductions do not occur, the budget deficit will have to be compensated through overachievement in later years during the budget period. Greenhouse gas emission budgets therefore help secure immediate action in the green transition.

Another benefit of greenhouse gas emission budgets is the ability to cap total emissions, which is what in the end affects temperatures. However, the Council noted that experiences with greenhouse gas emission budgets from the United Kingdom and the EU 'have not been convincing'. The Council noted:

> *'In principle, the EU ETS and non-ETS are defined as greenhouse gas emission budgets, and at the moment, both systems are facing difficulties in connection with large surpluses of emissions allowances. Random factors have contributed to the United Kingdom remaining within its budget without experiencing any significant forward movement in the green transition. On the other hand, the budgets can complicate how efforts are handled. A specific system must be established, and a number of challenges arise at the end of each budget period that could result in sub-*

optimisation or diminution of efforts (e.g., the transfer of emissions rights between periods).'

The Council noted that single year targets 'have different dynamics', and allow for greater flexibility. In the end, the Danish government adopt the recommendation to set targets rather than carbon budgets, and the Danish law was adopted with a framework of single year targets every five years. Interestingly the council also recommended against including any sector-specific targets in legislation, on the grounds that these generate the risk of sub-optimisation and higher than necessary mitigation costs.

The Irish Climate Action and Low Carbon Development Act 2015, as amended in 2021, followed the UK model and makes provision for the adoption of carbon budgets and related sectoral emission ceilings, along with a climate action plan to be updated annually that is to be consistent with the carbon budget programme. The Act specifies that the first two carbon budgets covering 5-year periods each should achieve reductions such that the total amount of annual greenhouse gas emissions in the year ending on 31 December 2030 is 51 per cent less than the annual greenhouse gas emissions reported on an economy-wide basis for the year ending on 31 December 2018. The Climate Change Advisory Council's role is to devise and recommend carbon budgets, and the first carbon budget programme was adopted by the Oireachtas in April 2022.

However, it is probably fair to say that carbon budgets, and the budgeting process, remain nested within the discourses of policy 'elites' and are not widely understood by the public. Nor can it be assumed that the process and even the methodology behind carbon budgeting is immune from sectoral influence given Ireland's unique greenhouse gas emission profile.[17]

Unlike Denmark and the Netherlands, Ireland has, to date, not copied the model of sectoral climate dialogues or partnerships, which by their nature, include more direct participation by those actors that are directly affected by climate policies. Here, media debates, especially in relation to agricultural emissions, have tended to frame carbon budgeting as arbitrary, punitive and unfair.[18] Howarth (2017) recommends the deployment of narratives that could enable positive engagement with a low carbon future by showcasing investment opportunities, maintaining independence

[17] However, the CCAC publishes all the minutes and reports from its carbon budgeting working group online at https://www.climatecouncil.ie/aboutthecouncil/transparency/carbonbudgetsworkinggroup/.
[18] See for example, https://www.ifa.ie/campaigns/carbon-budget-will-have-serious-impact-on-rural-economy/

and freedom of choice, guiding audiences to visualise a low carbon future, demonstrating the impact of not doing anything, supporting transitions and change, and highlighting the benefits to quality of life.

In addition, efforts are needed to combat disinformation on social media platforms, where climate denial or misrepresentation of climate science is rampant but not countered easily by official communications. Social media platforms make the diffusion of misinformation both easier and faster. Given the speed and reach offered by online social media platforms, effective measures to counter misinformation are difficult to find. Furthermore, while the era of 'false balance' in the mainstream media is largely over, contrarians still get substantial media attention in some media quarters, particularly in right-leaning media outlets in countries with 'elite voices' and lobbyists who back denial of climate change (Treen *et al.*, 2020). Actively altering the algorithmic filtering that shapes peoples' engagement with climate change topics on social media is one option, but this remedy is controversial as this kind of intervention could impede the free circulation of content (*ibid*., p.10).

Research from the psychological sciences recommends communication strategies that reduce psychological distance between people and climate change 'events' (Jones *et al.*, 2017), arguing that policymakers should (a) emphasize climate change as a present, local, and personal risk; (b) facilitate more affective and experiential engagement; (c) leverage relevant social group norms; (d) frame policy solutions in terms of what can be gained from immediate action; and (e) appeal to intrinsically valued long-term environmental goals and outcomes (Van der Linden *et al.*, 2015).

In the Irish Climate Action Plan 2023,[19] there are numerous commitments relating to climate communications, EPA research into public attitudes, the National Dialogue on Climate Action and climate conversations. However, none of these interventions address the communicative potential of carbon budgets specifically, and focus in the main on embedding climate action in everyday life and personal behaviour changes. As long as carbon budgets are kept at a distance from public engagement with climate policy there is a risk that the choices and limits they entail can be simply evaded or ignored in favour of more popular policies. This is an issue that could be addressed by the CCAC in its communications as well as the National Climate Communications Coordination Committee.

[19] Climate Action Plan 2023 https://www.gov.ie/en/publication/7bd8c-climate-action-plan-2023/

4. National carbon budgets consistent with the Paris Agreement

4.1 National obligations under the Paris Agreement

When assessing whether a country's climate policies are consistent with the temperature target in the Paris Agreement, it is important to bear in mind that the Agreement requires parties to commit to a target by submitting a Nationally Determined Contribution (NDC). This means that the countries define themselves how ambitious their targets should be, but countries are not legally bound to comply with the targets they submit.[20] Bodansky *et al* (2017) categorise the provisions in the Agreement and distinguish between binding obligations and provisions that generate expectations, or that recommend or encourage. Some provisions set aspirations and others 'capture understandings'. The Agreement's provisions are a carefully negotiated mix of hard and soft law and while the obligation to prepare and communicate successively more ambitious NDCs is emphatic, the requirement that the successive NDC 'will' represent a progression is impossible to enforce in practice (Bodansky *et al.*, 2017, chapter 7; Young, 2016). While the Agreement makes the achievement of a temperature goal in article 2 a collective ambition, it did not resolve the issue of burden sharing (Doelle, 2017). Bodansky *et al* (2017, p.250) note that:

> *'the design of the Paris Agreement, with its focus on progression and highest possible ambition of successive NDCs, aspires to depth of mitigation commitments over time. But it is uncertain whether such an incremental and iterative approach will produce sufficiently rapid change to meet the global temperature limit agreed to in Paris, in particular the 1.5°C aspirational goal.'*

As a result of these features in the Agreement and the abandonment of the Annex 1/ non-Annex 1 lists under the UNFCCC, assessing whether a country's climate policy is consistent with the Paris Agreement is open to a number of possible interpretive possibilities. The most stringent interpretation means assessing whether a country has targets that correspond to its reasonable share of what is required if the world as a whole is to achieve the temperature targets of the Paris Agreement. McMullin *et al* (2020) take this principle a step further arguing that a 'good faith' effort requires doing not just what parties believe is *feasible* but instead doing

[20] However, commitments under domestic and EU law are binding and failure to achieve targets may result in excess emissions being carried forward into the next budget period, which will be reduced accordingly, and EU compliance costs.

collectively what is *physically necessary* to achieve these limits, with or without recourse to negative emissions. Given Ireland's high CO2 per capita emissions rate, they conclude that this would correspond to sustained year-on-year reductions in nett emissions of over -11% per year.

Using the Climate Action Tracker methodology, the Climate Analytics think tank estimates that Ireland's target of reducing its emissions by 44% below 1990 levels (excluding LULUCF emissions) by 2030 would result in warming between 2 and 3°C (with a 66% probability) by 2100 if all countries were to set targets of an equivalent fair share level of mitigation ambition.[21] If all countries were to achieve emissions reductions of similar ambition to Ireland's projected emissions reductions by 2030 (based on the latest EEA projections), this would result in warming above 4°C (with a 66% probability) by 2100. According to its analysis, Climate Analytics estimates that Ireland needs to achieve emissions reductions globally equivalent to at least 83% below 1990 levels (excluding LULUCF emissions) by 2030 to achieve a level of ambition consistent with the long term temperature goal of the Paris Agreement. This fair share target they suggest can be achieved through a combination of domestic emissions reductions and funding or support for climate action in developing countries.

However, it is important to stress that a fair contribution to the global mitigation effort, however this is calculated, is only one of many obligations on parties to the Agreement. Parties are also urged, for example, to strengthen cooperation in many areas such as loss and damage, capacity building and technology transfer. In relation to finance, the obligations on developed country parties are very clear: under article 9, developed country parties 'shall provide financial resources to assist developing country Parties with respect to the mitigation and adaptation in continuation of their existing obligations under the Convention' and under 9.3, 'as part of a global effort, developed country Parties should continue to take the lead in mobilising climate finance from a wide variety of sources'. Developed country parties are also required under article 13.9 to provide transparent information on the financial, technology transfer and capacity-building support provided to developing country Parties.

[21] See https://climateanalytics.org/publications/2022/an-assessment-of-the-adequacy-of-the-mitigation-measures-and-targets-of-the-respondent-states-in-duarte-agostinho-v-portugal-and-32-other-states/

4.2 The EU effort sharing regulation

While this study does not analyse EU climate and energy policy in detail outside of considering the EU as a case study in section 5.7, it is important to note that the EU has an extensive range of legally binding instruments to support its NDC that compliment both domestic law and carbon budgets in national policy frameworks. The EU's initial NDC under the Paris Agreement was the commitment to reduce greenhouse gas emissions by at least 40% by 2030 compared to 1990, under its wider 2030 climate and energy framework. All key EU legislation for implementing this target was adopted by the end of 2018.

In December 2020, the EU submitted its updated and enhanced NDC the target to reduce emissions by at least 55% by 2030 from 1990 levels. The EU and its Member States, acting jointly, are committed to a binding target of a net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990.

The Effort Sharing Regulation (Regulation EU 2023/857) establishes for each EU Member State a binding national target for the reduction of greenhouse gas emission by 2030 in the following sectors: domestic transport (excluding aviation), buildings, agriculture, small industry and waste. In total, the emissions covered by the Effort Sharing Regulation account for almost 60% of total domestic EU emissions.

Initially adopted in 2018, the Regulation was amended in 2023. With their new national targets Member States will collectively contribute to an emission reduction at EU level, in the Effort Sharing sectors (which excludes sectors covered by the EU ETS), of 40% compared to 2005 levels. The revision was adopted as part of a package of proposals aimed at reducing the EU's emissions by 55% by 2030 (compared to 1990 levels) and deliver the European Green Deal. In addition to establishing targets for the reduction of emissions in the Member States by 2030, the Effort Sharing Regulation also defines annual emission limits for the years 2021 to 2030. For that purpose, Member States are provided with a number of emission allocations (each corresponding to a tonne of CO_2 equivalent) for each of the years in the period, and the number of allowances decreases every year. The annual emission limits per year per Member State are calculated on the basis of a trajectory system (leading to the 2030 emission reduction targets) and a set of adjustments established in articles 4 and 10 of the Effort Sharing Regulation.

Where a Member State still does not meet its annual obligation in any year, taking into account the use of flexibilities, the shortfall is multiplied by a factor of 1.08 and this penalty is added to the following year's obligation. Flexibilities can be utilised to

meet the targets by accessing credits from the land use sector, ETS allowances, banking, borrowing buying and selling. This is what is meant by ‘compliance costs’.

The EU’s 2030 climate and energy framework for 2030 has been criticised for its incrementalist approach by Kulovesi and Oberthür (2020) who remark that it ‘puts the EU on a path towards an incremental transition to a low-carbon society rather than responding to calls in climate science for a radical transformation’. They specifically criticise the continued availability of borrowing between annual carbon budgets (annual emissions allocations) which allow member states to delay action instead of urgently mitigating climate change.

Member States’ targets under the ESR:[22]

Country	2018 target	2023 target
Denmark	-39%	-50%
Ireland	-30%	-42%
France	-37%	-47.5%
Netherlands	-36%	-48%
Finland	-39%	-50%

4.3 Comparative approaches to climate policy

While the approach of the Irish 2021 Act is consistent with the climate laws of several EU and OECD member states, there is considerable variation across countries in methodological choices (such as whether to ‘grandfather’ emission rights), the treatment of long-lived vs short-lived greenhouse gases, whether to include emissions from land use, the weighting of feasibility and flexibility, and understandings of fair shares and climate justice. Consideration of each of these criteria requires careful judgement as decisions made may result in quite different budgets and mitigation policies. In addition, there is a range of potential global carbon budgets that are consistent with different temperature increases and associated likelihoods under IPCC AR6 scenarios meaning that the selection of any carbon budget implies the adoption of an explicit level of climate risk tolerance and intergenerational burden distribution.

[22] Selected EU member states included in this study only.

This study review approaches to setting carbon budgets in other jurisdictions to support the preparation of the next carbon budget programme, specifically the approaches taken in the UK, New Zealand, the Netherlands, France, Finland, Denmark and the EU as a whole. These countries share some normatively relevant features as high-income OECD member states, yet with a range of per capita emissions, institutional and political features, historical/ cumulative emissions and emission intensity rates. Each country has a climate law in place and some approach to target setting (a net zero target) combined with a budgeting framework. The focus of this analysis will be on ways to integrate normative (ethical) dimensions to carbon budgeting alongside economic, legal, and scientific criteria. To do this, I have analysed the climate commitments of each country according to a range of indicators as follows:

- **Emissions profile:** this indicator captures information about a country's emission profile, its per capita CO2 and all-GHG emissions, its ranking by the two most common climate performance tracking projects; renewables as a share of total final energy consumption and its share of historical emissions.
- **Committed emissions:** this indicator is mostly descriptive of the country's current policy (where available) towards fossil fuel exploration and new infrastructure. While only territorial emissions are reported under UNFCCC accounting rules, the scientific consensus is clear that fossil fuels must be phased out entirely. According to the IEA Net Zero report (2021), there is no requirement for further investment in fossil fuel supply in its net zero pathway. It is increasingly important to focus on the specific commitments countries have made to limit further oil and gas exploration and fossil energy infrastructure such as pipelines, new power generation or connections.
- **National policy and legislation:** Under this heading I describe the climate and policy frameworks in place that are legally binding, and the institutions set up by climate laws, including special scientific advisory bodies, obligations on ministers, review mechanisms and targets.
- **Carbon budgeting:** While most countries do not have formal carbon budgeting mechanisms set out in law, in practice, science-based policy requires some form of budgeting whether that is done with target-setting for particular years, accounting rules or even compliance with the EU effort sharing regulation. It is notable that even the most prescriptive carbon budgeting systems (such as those in the UK and Ireland) provide no guarantee that they will be adhered to and lack an enforcement mechanism outside of judicial review.

- **Aviation and Shipping:** While the UNFCCC accounting rules do not require the inclusion of international bunker fuels in a country's territorial emissions inventory, they are an important area for policy frameworks to consider, nonetheless. Some countries such as Denmark are actively engaged in stakeholder dialogue and mitigation planning. The UK Climate Change Committee has recommended that aviation is considered in the next round of carbon budgets. Ireland has not addressed aviation or shipping in its climate policy planning or in the most recent Climate Action Plan 2023.
- **Offshore mitigation:** some countries have specific limits on the degree to which international credits may be used to meet domestic targets. Although it is not included as a case study, Sweden's climate law for instance states that a maximum of 2 percentage points of the emissions reduction goals for 2030 and 2040 may be achieved by 'supplementary measures' that involve investments in various climate projects abroad. Most countries do not specify such limits on offshore mitigation, but some laws make it explicit in other ways that domestic emission reductions are intended.
- **Just transition:** most climate laws under consideration in this study do not make reference to or commit explicitly to a just transition. However, just transition does feature more often in practice within the climate policy frameworks and political dialogues. Though not covered in this report, Scotland's climate law for instance includes just transition principles which are to guide the policy process.
- **Public participation:** some laws make clear provision for public participation throughout the policy planning cycle, which may include carbon budgeting. The Irish act for instance is quite prescriptive in this regard, however in other countries with strong traditions of stakeholder dialogue and public engagement (e.g., Denmark and the Netherlands) there are other non-statutory processes that are nonetheless very influential in goal-setting.

5. Country case studies

5.1 Ireland

Topic	Country	Notes
1. Emissions profile	**Ireland**	All emissions data from https://ourworldindata.org/co2/country unless otherwise stated
1.1 CO2 emissions per capita (2021)	7.5 tCO2 per capita	All fossil fuels from energy and industry exc. Land use
1.2 All GHGs per capita (2019)	11.65 tCO2e	Including land use
1.3 Carbon intensity of energy production (2021)	0.21 kg CO2 per kW/hr	Ireland relies heavily on imported fossil fuels for energy and has limited indigenous gas supplies. Hydro potential has largely been exploited already, and Ireland has a legal ban on nuclear generation in place. Ireland ranked eight highest of the 27 Member States at 80% in terms of import dependency in 2020, the latest year in which full data are available. Historically Ireland relied heavily on peat as a fuel for power generation and for domestic heating, but recent policy changes by both the government and by Bord na Móna (the semi-state company that owns bogs and runs power stations) have dramatically reduced the harvesting and burning of peat. Though only one peat burning power station is still operational, peat still supplies 2% of Ireland's primary energy, gas supplying 32%, oil 46% and renewables 12%. With Bord na Móna announcing a formal ending of peat harvesting on its lands in January 2021, industrial peat production of milled peat for energy purposes has all but ceased in Ireland, and the only peat production was turf cutting to produce sod peat, almost exclusively for residential consumption. Existing stockpiles of milled peat were used to create peat briquettes. The Edenderry Bord na Móna power plant in the Midlands, which is due to cease burning peat at the end of the year, is drawing criticism for transporting the fossil fuel from bogs more than 80km away for use in the facility. The Edenderry power plant received planning permission in 2016 to burn peat along with biomass until the end of December, when it must switch entirely to

		biomass. According to an Irish Times article published in January 2023, the indigenous wood materials are transported to Edenderry from unnamed forests all over Ireland involving distances of hundreds of kilometres in some cases. The plant also sources wood materials from Santana in Brazil, which is transported by tanker to Ireland and then by truck to Edenderry, a distance of some 7,500km. Aside from the controversy over peat burning, Ireland still relies on burning oil and coal for power generation, though mostly as a back-up to gas and for security of supply reasons. The ESB has recently indicated that it intends to apply for permission to extend the life of the 900 MW coal burning plant at Moneypoint, Co. Clare and convert it to oil.
1.4 Historical contribution of cumulative CO2 (1750-2021)	0.13%	Land use not included
1.5 Share of renewables in electricity (2021)	36.4%	Ireland has a target of 80% renewable electricity by 2030, however that does not appear to be on track, with no new planning permissions issued in 2023 for onshore wind and considerable delays in establishing the planning and consent regimes for offshore wind. Electricity on the grid is a mix of renewable electricity from wind and hydro generation, and non-renewable electricity from gas-, coal-, oil-, and peat-fired thermal plants. Notwithstanding this reliance on fossil energy overall, Ireland has an impressive rate of renewables penetration in power generation, where onshore wind contributes 84% of renewable electricity generated in 2021, with 4339 MW of installed capacity and a further 78 MW installed in 2022. Due to a low wind year for renewable generation in 2021, more coal and oil for electricity generation was used, which increased the carbon intensity of electricity by 12.5%. According to a September 2023 article in the Irish Times, the European Household Energy Index data shows a high Irish dependence on gas, with about half the electricity generated here last year coming from the fuel, compared with a European Union average of less than 20 per cent. Bord Gáis is investing €250 million in two new gas-fired power plants. This increases the risk of fossil fuel infrastructure “lock-in” for decades, but the company insists it can run on a natural gas and hydrogen mix, with ability to convert to 100 per cent hydrogen in the future. As part of the 2023 Climate Action Plan, the government has committed to an 80% renewable energy share by 2030, with 9

		GW of onshore wind, 8 GW of solar PV, at least 5 GW of offshore wind and 2 GW of new flexible gas plant.
1.6 Share of renewables in total energy supply (2021)	12.5%	According to the Sustainable Energy Authority of Ireland's 2022 Energy in Ireland report, although Ireland has committed to reducing its CO2 emissions by 4.8% per annum from 2021- 2025 under the first carbon budget, energy related emissions were instead up by 5.4% in 2021. Provisional data from monthly surveys indicate that energy related emissions will increase by a further 6% in 2022. The 35.5 MtCO2 of energy-related CO2 (including international aviation) accounts for over half of all GHG emissions in Ireland. Ireland's overall renewable energy share was 12.5% in 2021 under REDII. The renewable energy share in electricity (RES-E) was 36.4% in 2021, in heat (RES-H) was low at 5.2% in 2021 and in transport (RES-T) was low at 4.3% in 2021.
1.7 Climate action tracker 2022 https://climateactiontracker.org/countries/eu/		Climate Action Tracker treats all 27 EU Member States as one country for the purposes of its analysis. The CAT rates EU's climate targets, policies, and finance as "Insufficient". The "Insufficient" rating indicates that the EU's climate policies and commitments need substantial improvements to be consistent with the Paris Agreement's 1.5°C temperature limit. The EU's 2030 emissions reduction target and its policies and action are consistent with 2°C of warming when compared to modelled domestic pathways. The EU is also not meeting its fair share contributions to climate action.
1.8 Climate Change Performance Index 2022 https://ccpi.org/country/dnk/	37 (up from 46)	The CCPI experts note that significant progress in climate policy in 2022, with the introduction of legally binding carbon budgets and sectoral emissions ceilings. However, government implementation remains weak with necessary actions and measures delayed or ignored in many areas. The country's agricultural policies continue to support intensification of livestock farming, which increases GHG emissions, harms water and air quality, and is a primary contributor to biodiversity loss in Ireland. The experts highlight the need to reduce use of reactive nitrogen in fertiliser and to pay for ecosystem services. The experts note that government plans for offshore wind are substantial, and new schemes have been introduced in transport, microgeneration, and energy efficiency. Use of coal in power generation, however, has increased.

		Energy retrofits and solar photovoltaics are not being delivered at the necessary scale and not reaching those most at risk of energy poverty. Fossil gas infrastructure and gas connections are also still being promoted. The government has accelerated the phase-out of peat in power generation and committed to supporting peatland restoration and rehabilitation. The experts, however, criticise that peat extraction from wetlands continues for horticultural use and export. The experts ranked Ireland's performance regarding GHG per capita including LULUCF in 2022 as 'very low' whereas if LULUCF is excluded, the ranking changes to 'high'. Overall Ireland remains in the low-performing countries.
1.9 Committed emissions from existing and new energy installations		Ireland has a legal ban in place against fracking since 2017, and became the first country in the world to divest from fossil fuels in 2018 by passing a law requiring the state to divest its strategic wealth funds from fossil fuels. Ireland currently has no storage facilities for either conventional gas or LNG, and there has been a highly contested debate over a proposal to build an LNG plant in Shannon, Co. Clare which could be used to import US fracked gas. With limited indigenous fossil energy resources and growing energy demand, the owners of Ireland's last remaining gas field in the Corrib are seeking to extend the gas field's life to 2038 by opening an adjacent field. Ireland relies heavily on gas for electricity production, industrial use and heat, and currently imports much of its gas from Britain and Norway via a pipeline from Scotland (Moffat). With the Russian invasion of Ukraine and the resulting spike in gas prices, the government moved to establish a review of energy security. However, the expert technical consultants engaged by the Government ruled out a commercially operated or State-owned LNG import terminal on land. They also warned that additional domestic production of natural gas at Corrib could lock Ireland into a high-gas energy market. Instead, the experts recommended green hydrogen, demand response programmes, electricity interconnection and storage as beneficial energy security measures.
2. Policy and legislation		

2.1 Legislation	The Climate Action and Low Carbon Development Act 2015 as amended by the Climate Action and Low Carbon Development (Amendment) Act 2021.	Ireland's 2021 Climate Law, revising the existing legislation from 2015, created a comprehensive and prescriptive legally binding framework for climate action. It established an obligation to achieve climate neutrality or 'net zero emissions' well before 2050, and set an interim target of reducing economy-wide greenhouse gas emissions by 51% over 2018 levels by 2030. Under the revised law, the Climate Change Advisory Council is required to draft and propose a programme of three 5-year carbon budgets for adoption by the government. These set legally binding limits on emissions for 2021-25, 2026-2030 and a provisional budget for 2031-2035. The original legislation was criticised for lacking any quantitative targets for emissions reductions. The then government (in office 2011-2015) ruled out introducing carbon budgets on the grounds that they would be damaging to the economy and as a result, Torney (2020) described the legislation as largely symbolic in the sense of it having ambitious objectives that are nonetheless designed to be ecologically ineffective. Newig (2013) describes symbolic legislation as instruments for *managing* rather than *resolving* environmental problems. After the adoption of the 2015 Act, emissions began to rise alongside economic recovery after the financial crash of 2008-2012, largely due to the expansion of the dairy herd following the abolition of milk quotas and increased use of synthetic nitrogen-based fertiliser.
2.1 Institutions and functions	3.(1)-(3)	The 2021 Act requires the Minister and the government to carry out their respective functions in relation to the adoption of a carbon budget programme, sectoral emissions ceilings and the climate action plan in a manner that is consistent with the UNFCCC and EU law in response, including the articles 2 and 4(1) of the Paris Agreement, taking account of the most recent national GHG inventory and projections prepared by the EPA. For the purposes of achieving 3.(1) the Act sets up a climate policy planning cycle to include carbon budgets, sectoral emissions ceilings, a climate action plan, a national long term climate action strategy, and a national adaptation framework. It is the duty of the Minister (for climate action) to make and submit the above to the government for approval.

		According to Torney (2021) institutional arrangements and responsibilities under the 2021 Act represent a progression on the 2015 Act, but are still somewhat lacking in clarity. Coordination mechanisms are largely absent from the Act itself but have been significantly strengthened in recent years on a non-legislative basis. The provisions regarding responsibilities of local government have been significantly strengthened.
2.2 Scientific advisory body	6A, 8, 11, 12, 13	The 2015 Act established the Climate Change Advisory Council, which is an expert advisory body modelled loosely on the UK Act, but its functions and membership were revised under the 2021 amended law. The functions of the CCAC are to advise and make recommendations to the Minister in relation to the preparation of climate action plans, the national adaptation framework, the finalisation and revision of a carbon budget programme and compliance with EU or international climate obligations. The Council can also advise Ministers regarding sector specific actions, and the government as a whole regarding mitigation and adaptation policies. The CCAC must report by 30 October every year with its 'annual review' assessing progress in achieving emission reductions and compliance with the carbon budget and sectoral emissions ceiling for that period. The annual review must also include a projection of future greenhouse gas emissions in each sector of the economy to which a sectoral emissions ceiling applies. Following the publication of the annual review, relevant Ministers are required to give account to an Oireachtas Committee on performance both in implementing Climate Action Plan actions and in adhering to their sector's emissions ceiling under the carbon budget period. The CCAC is also empowered under section 13 to conduct a 'periodic review' at any time it considers appropriate in relation to any significant developments in science, law or policy and to review progress made in furthering the achievement of the 'national climate objective' and related climate plans. The Minister may request the Council to conduct a periodic review. According to

		Torney (2021) the Council's role as both an advisor and a watchdog was strengthened considerably in the 2021 Act. However, Torney noted Ireland's expert advisory body remains an outlier in comparison to other EU member states, in having among its membership representatives of state bodies (Teagasc, Met Éireann and the EPA).
2.3 Approach to carbon budgets	6A, 6B, 6D	The Advisory Council shall prepare and submit a proposed carbon budget programme covering all economy-wide greenhouse gas emissions to the Minister as soon as may be after the coming into operation of section 9 of the Climate Action and Low Carbon Development (Amendment) Act 2021. A carbon budget shall be made for three sequential budget periods so that, at any one time, there is a series of three carbon budgets which have effect under section 6B. The first carbon budget programme was adopted on 22nd February 2022 and laid before the houses of the Oireachtas on 24 February. The carbon budgets were approved by both Houses and came into effect on 6 April 2022. The third (provisional) carbon budget proposed for the period 2031-2035 is subject to proposed amendments from the Climate Change Advisory Council (CCAC), no later than 12 months before the expiry of the first carbon budget in 2025. The CCAC used a "bottom up" approach to calculate the carbon budgets, using the 51% target for emission reductions by 2030 to calculate the required level of emission reductions compared to 2018 levels. Modelling and analysis undertaken by University College Cork, Teagasc and University of Limerick informed the CCAC's calculations. This modelling illustrated the quantity of GHGs that would be emitted under different scenarios that ultimately lead to Ireland meeting the overall target of 51% reduction in GHGs by 2030. In recommending a programme of carbon budgets to the government, the Council had very little room to manoeuvre given the 2030 target of reducing

	6C, 6D 4.(1)-(3)	emissions by 51% against a 2018 baseline. However, it determined that a feasible pathway to meeting that target was to 'backload' mitigation to the second budget period, allocating a much more stringent 200MtCO2e for 2026-2030. The 2021 greenhouse gas emission inventory figures indicate that 23.5% of the Carbon Budget for the 5-year period 2021-2025 has already been used, requiring an 8.4% average annual emissions reduction from 2022-2025 to stay within budget. In addition to the 5 year carbon budgets, the Minister is also required to prepare sectoral emissions ceilings which set out the maximum amount of greenhouse gas emissions that are permitted in different sectors of the Irish economy during each budget period. Following the approval of the Carbon Budgets, Ireland's Sectoral Emissions Ceilings were agreed by the Government on 28 July 2022. The ceilings set targets under both carbon budgets for a range of sectors. No allocation has been made yet for the LULUCF sector and there is still 5.25 MtCO2e in unallocated savings in the second carbon budget period. Each year the Minister must prepare a Climate Action Plan that is consistent with the carbon budgets setting out a roadmap of sector specific actions to comply with carbon budget and sectoral emissions ceilings and sector-specific measures to address failures or projected failures. The Minister and Government are obliged to carry out functions in relation to CAP in a manner consistent with art.2 of UNFCCC and art.2 and 4(1) of Paris Agreement (section 3(3)).
2.4 Banking and borrowing	6D(4)-(5)	The Minister may carry forward any surplus from a preceding budget period into the next, and where total GHGs for a preceding budget exceed that budget, the current budget shall be decreased by the same amount.
2.4 Mechanism for review of targets	6D (1)-(9)	While there is no explicit mechanism to rule out 'backsliding' in the 2021 Act, it is clear that the intention is that the carbon budgets may be reviewed in light of new obligations under EU or international law, or significant developments in

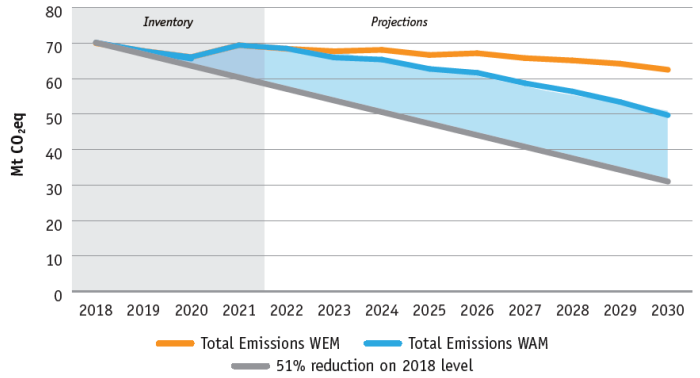
		scientific knowledge. Where banking and borrowing is to take place, the Minister must consult with the CCAC and submit the revised budgets to Government for approval.
2.5 Compliance process	14A.(1)-(6)	Following the publication of the CCAC annual review and the EPA projections, Ministers are required to report on progress under the CAP and SECs to the relevant parliamentary committee. Where Ministers are not in compliance with the targets, they need to outline what corrective measures are envisaged. Ministers will have to respond to any recommendations made by the Committee within 3 months. The 2023 Climate Action Plan (p.64) states that if sectoral targets and carbon budgets are not achieved, 'corrective or additional measures shall be introduced'. It should be noted that as an 'action trigger' this requirement is rather weak in comparison to that of France, Denmark and the Netherlands. There are no specific penalties in the law for a failure to adhere to the carbon budgets. Duwe and Evans (2020) note that reporting provisions can become "a formality without consequences" unless there is a clear and defined sequence of steps that must be undertaken in such circumstances. What is common among other climate laws across Europe is a requirement that the failure to achieve targets triggers a legal requirement for additional policy actions. S.14A(1)(c) and (3)(c) do include a requirement on Ministers to outline 'any measures envisaged to address any failure to so comply' which is a rather weak formulation of this 'trigger'. Nonetheless it is a legal requirement that they do so. It should be noted that Ireland has mandatory obligations under various EU energy and climate directives where failure to meet targets will incur compliance costs and the possibility of legal action by the Commission.
2.6 Fair shares/ ethical consideration of target		The 2021 Act makes no reference to equity and while it refers on three occasions to climate justice it does not define the term. Climate justice is one of many considerations that the Minister and the CCAC must take into account when drawing up plans and carbon budgets. In its technical report underpinning the

		recommended carbon budget programme, the CCAC considered the issue of climate justice in an international and domestic context rather briefly, noting the potential for climate policies to exacerbate inequalities and impact on vulnerable households. It also developed a 'Paris Test' designed to assess the overall temperature impact of the carbon budget scenario and assess any gaps to the 1.5 degree temperature goal (see section 4.2.1 of the technical report). The methodology used grandfathering and a per capita approach which does not consider historical emissions, costs or ability to pay.
2.7 Parliamentary oversight	Sec. 6B, 14A	The carbon budgets must be voted on by parliament once adopted by the government, and the Dáil may refer a carbon budget a joint committee which shall consider the budget and report with recommendations within two months. However the sectoral emissions ceilings are a matter for government to decide. The parliamentary committee tasked with tracking climate policy is empowered to bring in ministers following the publication of the EPA inventory and projections reports, and the CCAC's annual review. S.14A establishes the key political accountability moment in the climate policy cycle where government ministers report on their sectoral efforts to reduce emissions and comply with the carbon budgets. It replaces the 'annual transition statements' that were made to the Dáil under the 2015 Act and thus these appearances before the JOCECA should be regarded as significant opportunities to interrogate responsible Ministers under the categories set out in 14A.
3. Carbon budgeting process		
3.1 Technical criteria		The carbon budget programme as adopted comprises three successive 5-year carbon budgets based on a 2018 baseline as follows: • 2021-2025: 295 MtCO2eq. representing an average reduction in emissions of 4.8% per annum for the first budget period; • 2026-2030: 200 MtCO2eq. representing an average reduction in emissions of 8.3% per annum for the second budget period; • 2031-2035: 151 MtCO2eq. representing an average reduction in emissions of 3.5% per annum for the third provisional budget.

3.2 Offshore mitigation	N/A	There is no reference int the Act to offshore mitigation, international offsetting or other forms of climate contributions.
3.3 Aviation and shipping	N/A	Not covered in the Act. Ireland has a significant aviation sector in the aircraft leasing business, where it is home to over 50 leasing companies and Europe's largest airline group Ryanair Holdings plc. According to IATA, the air transport sector supports 143,000 jobs and contributes $20bn in GVA to Ireland's GDP. The IATA briefing estimates that the air transport market in Ireland is forecast to grow by 55% in the next 20 years resulting in an additional 9.6 million passenger journeys by 2037. However, there is no policy in place to align the growth of this sector with Ireland's obligations under the Paris Agreement, the carbon budgets, sectoral emissions ceilings, long term climate action plan or the net zero climate neutrality target. Ireland imposes no taxes on aviation fuel, tickets or frequent fliers, aside from airport taxes. The Dublin Airport Authority is currently planning to request the removal of a cap imposed in 2008 on passenger numbers which appears to have the support of leading government Ministers and the Taoiseach.
4. Public participation	Sec. 16	The 2021 Act requires the Minister to consult with stakeholders and members of the public in regard to the adoption of the carbon budget programme, the making of a long term climate action strategy and the annual climate action plan. In addition local authorities, when making local climate action plans under the Act, must consult with the public and interested parties including Public Participation Networks.
5. Progress in meeting targets under the Act		According to the latest EPA assessment in the GHG Projections Report 2022-2040, Ireland is not on track to meet the 51 per cent emissions reduction target (by 2030 compared to 2018) based on these projections which include most 2023 Climate Action Plan measures. Further measures still need to be identified and implemented to achieve this goal. The first two carbon budgets (2021-2030), which aim to support achievement of the 51 per cent emissions reduction

goal, are projected to be exceeded by a significant margin of between 24 and 34 per cent. Sectoral emissions ceilings for 2025 and 2030 are projected to be exceeded in almost all cases, including Agriculture, Electricity, Industry, and Transport. Emissions in the Additional Measures scenario are projected to be 29 per cent lower in 2030 (compared with 2018) whereas in the Existing Measures scenario the emissions reduction is projected to be 11 per cent. Faster implementation of measures will be required to meet both National and EU targets.

Figure 3: Total Greenhouse Gas Emissions (including LULUCF) under the *With Existing Measures* and *With Additional Measures* scenarios out to the year 2030



Source: EPA Projections 2022-2040

Table 2: Assessment of Achievement of Sectoral Ceilings under the With Additional Measures Scenario

Sectors	Projected Emissions 2021-2025 (Mt CO_2 eq)	Sectoral Ceiling 2021-2025 (Mt CO_2 eq)	Projected Emissions 2026-2030 (Mt CO_2 eq)	Sectoral Ceiling 2026-2030 (Mt CO_2 eq)
Electricity	45.2	40	28.2	20
Transport	55.1	54	42.4	37
Buildings (Residential)	29.8	29	22.9	23
Buildings (Comm and Public)	7.1	7	5.3	5
Industry	34.4	30	33.5	24
Agriculture	111.6	106	99.5	96
Other[19]	9.7	9	8.9	8
LULUCF (no ceiling currently)	39.1		39.3	
Total with LULUCF	332.1	295	280.0	200

From Table 2, which shows the sectoral ceilings in tonnes of CO_2 equivalent, we can see that none of the sectoral ceilings are projected to be achieved in the first budget period (2021-25) with high (percentage) exceedances projected in Electricity and Industry. For the second budget period the picture is notably worse except for Buildings (Residential) where compliance with the ceiling is being projected.

6. Just transition	Sec.6 (8)(k)	Just transition is one of many criteria that must be considered by the government and the CCAC in drawing up climate policies, plans and the carbon budgets. The reference is ambiguous and weak: it refers to 'the requirement for a just transition to a climate neutral economy which endeavours, in so far as is practicable, to— (i) maximise employment opportunities, and (ii) support persons and communities that may be negatively affected by the transition.' In practice, the initiatives around just transition have been situated in the Climate Action Plan rather than in the Act, the territorial just transition plan under EU post-Covid funding schemes, and in negotiations with stakeholders for the establishment of a statutory Just Transition Commission. The Minister recently

		established a Just Transition Taskforce to aid the implementation of this commitment.
7. **Notable policy developments**		Ireland's climate law as updated performs well in international comparisons in the sense that it is aligned with best practice and the obligations of the Paris Agreement. However progress in reducing emissions in line with the carbon budgets appears to be stymied due to rising energy demand, the slow rollout of sustainable infrastructure such as public transport, renewable electricity and EV charging. Physical planning, low levels of public transport investment over many decades and the preponderance of low density and one-off housing represent major challenges in decarbonising buildings and transport. In particular, policies that seek to attract investment in data centres have come under sharp criticism since these large energy users were already consuming 18% of Ireland's electricity in 2022 (equivalent to all household electricity use), making it almost impossible for the power generation sector to comply with the 2025 and 2030 sectoral emissions ceilings. A recent decision by Fingal County Council to grant planning permission for three new Amazon Web Services data centres in the north of county Dublin included a condition that AWS deploy corporate PPAs to match the electricity demand with renewable energy generation, which must be located in Ireland. However, the 75 data centres already constructed and the 30 additional centres in construction or with planning approval, are putting the stability of the electricity grid and Ireland's climate targets at risk. Agriculture is the other area where Ireland remains a clear outlier. Ireland has a large livestock and dairy processing sector and thus high levels of methane in its emissions profile in comparison to other EU member states. This sector contributed 38% of Ireland's total emissions in 2021 and is projected to rise to 43% by 2030 under the *With Existing Measures* scenario. Notwithstanding its significant climate footprint, the sector received the lowest target under the sectoral emissions ceilings – a 25% reduction over 2018 GHG levels by 2030. The EPA has noted in its 2020 assessment report that the agricultural sector is

		the leading driver of greenhouse gas emissions, ammonia emissions, water quality deterioration and biodiversity loss. However, policies to date, with the exception of changes to nitrate rules and a new fertiliser register, have not had a significant impact on overall emissions as the measures largely rely on voluntary uptake, and yet-to-be-scaled-up technical measures such as feed additives and genomics. There has been fierce resistance among the farming community to any discussion of herd reductions and due to rising land prices and the demand for additional grazing land, tillage production has decreased sharply by 20% in 2023. Ireland imports over 85% of all fruit and vegetables consumed.

5.2 The UK

Topic	Country	Notes
2. Emissions profile	UK	All emissions data from https://ourworldindata.org/co2/country unless otherwise stated
1.1 CO2 emissions per capita (2021)	5.15 tCO2 per cap	All fossil fuels from energy and industry exc. Land use
1.2 All GHGs per capita (2021)	6.35 tCO2e per cap	Including land use
1.3 Carbon intensity of energy production	0.17 kgCO2 per kW/hr	Note: 14.8% of electricity was produced by the UK's 15 nuclear reactors in 2021. Bioenergy produced 12.9% of the UK's electricity in 2021 or 33% of all renewable electricity. 2 sites produce biomass generated electricity, Lynemouth and Drax. The Drax power station in Yorkshire produces 3900 MW or 15 TWh or 12% of all renewable electricity from wood pellets sourced from the US, Canada, Europe and Brazil.
1.4 Historical contribution of cumulative CO2 (1750-2021)	4%	Fossil fuel and industry only. Land use excluded.
1.5 Share of renewables in electricity (2022)	36%	According to UK Energy Trends data 2022, renewable electricity generation was 28.2 TWh in Quarter 3 2022, 18% higher than 2021. After bioenergy (11.9%) the largest shares are from offshore wind (10.1%), onshore wind (7.3%), solar PV (6.2%), and hydroelectricity (0.9%)
1.6 Share of renewables in total energy supply (2021)	17.95%	https://ourworldindata.org/grapher/renewable-share-energy?region=Europe Excluding biofuels.
1.7 Climate action tracker 2022 https://climateactiontracker.org/countries/uk/	Overall rating: almost sufficient	"The UK's climate action is not consistent with the Paris Agreement. While the UK's NDC and long-term targets are broadly aligned with cost-effective domestic pathways, they do not represent a fair share of the global effort to address climate change. … The UK's climate finance contributions have fallen short of its fair share contribution to the USD 100bn goal and have decreased in the past five years. While the UK has doubled its commitment post-2020, this

		is not new funding but is taken from the existing aid budget…Without a steep increase in UK climate finance contributions, it will not be possible for the UK to improve its overall CAT rating to 1.5°C compatible…The UK's targets are far below what would represent a fair contribution. There is also a significant gap between the UK's targets and UK policy."
1.8 Climate Change Performance Index 2022	11th place (↓ 4)	The United Kingdom falls four spots but still ranks 11th in this year's CCPI edition, placing it among the ***high*** performers. The UK earns a medium in the Renewable Energy and Climate Policy categories and high ratings in GHG Emissions and Energy Use.
1.9 Committed emissions from existing and new energy installations		Coal power is to be phased out by 2025. However the UK government approved a new coal mine for steel production at Whitehaven, Cumbria which would add 17,500 tCH4 per annum. Over 100 new oil and gas licence applications have been submitted recently to government. After Norway, the UK is Europe's second-largest oil and gas producer. The UK met 42% of its own gas demand and most of its oil demand in 2021 from indigenous production. There is no planned date for the end of fossil fuel boilers not connected to the gas grid. There is no policy framework to phase out oil and gas extraction. No petrol- and diesel-powered vehicles are to be sold after 2030. The government provides fossil fuel subsidies via financial supports to households and a tax break for new oil and gas production as part of the windfall tax on energy producers introduced in May 2022. The UK Prime Minister reinstated a ban on fracking in October 2022.
2. Policy and legislation		
2.2 Legislation	The Climate Change Act 2008 and The Climate Change Act 2008 (2050 Target	The UK climate act sets an emission reduction target of 100% (updated in 2019 from previously 80%) by the year 2050 compared to a base year of 1990. The framework applied by the Act is to set milestone targets with a 34% reduction required by 2020. According to Macrory and Muinzer (2020), the 2050 duty in the CCA 2008 is unusual in that it is expressed in absolute terms with no qualifications. The Act requires the government to implement five-year emission budgets or "carbon budgets" (which cover all six main greenhouse gases). The emission budget determines how many tonnes of GHG emissions are allowed

	Amendment) Order 2019 Also: The Climate Change (Scotland) Act 2009 and The Climate Change (Emission Reduction Targets) (Scotland) Act 2019 The Climate Change Act (Northern Ireland) 2022	within each five-year period. The budget levels are determined 12 years before the beginning of each period; these are drawn up by the government on the basis of advice from the Climate Change Committee and then submitted to parliament for decision. If the government deviates from the committee's recommendations it must justify the decision thoroughly. Concrete measures to reduce emissions must then be planned and implemented to stay within the budget.
2.1 Institutions and functions		The Secretary of State (SoS) is the government member charged with the duty of achieving the (now 100%) emissions reduction target. In practice, the Secretary of State is a Cabinet Minister from the UK government who is in charge of the relevant government department dealing with climate change (Macrory and Muinzer, 2020). The carbon budgets or any proposed target revision must be proposed by the Secretary of State as draft statutory instrument and laid before Parliament for approval. The Secretary of State must keep Parliament appraised of progress via annual reports. Once a carbon budget has been set, the Secretary of State then has a duty to prepare

		proposals and policies for meeting the budget in question and to lay before Parliament a report setting these out. Section 15 of the Act makes it clear that the Secretary of State must have regard to "the need for domestic UK action" to reduce GHG emissions. The 2008 Act establishes the Climate Change Committee (CCC) (see below) which has an advisory role in relation to target setting and carbon budgeting.
2.2 Scientific advisory body	Schedule 1 1.(3)	The Committee on Climate Change is established as an independent advisory body with a chair and not be fewer than 5 or more than 8 members. Taken as a whole the committee must have expertise in a range of areas including business, economic analysis, climate and environmental science, technology and climate policy. The Committee must have an adaptation committee. The Secretary of State must seek the advice of the CCC before initiating the process to change the target, or before adopting a carbon budget. Averchenkova et al (2021) note the crucial role of the CCC, particularly in defining the ambition of climate action in the UK, and describe the CCC as 'an incredibly powerful voice' with an internal culture of 'absolutely ruthless interrogation'. This has introduced into parliamentary debate 'a new degree of analytical honesty and rigour'. The CCC produces a range of influential studies and reports and must lay before Parliament (and the devolved assemblies) an annual report setting out progress made under the Act to date.
2.3 Approach to carbon budgets	Part 1	Carbon budgets are devised by the CCC 12 years ahead of time for five-year periods. Setting targets this far in advance also makes them easier to approve politically, by parliamentarians concerned about the immediate costs of climate policy to their constituents (Finnegan, 2018; 2019, quoted in Averchenkova et al 2021). The Act establishes a 'net UK emissions' level, which represents the total amount of targeted greenhouse gases released by the UK over a particular period of time after the deduction of targeted greenhouse gas removals over that time. The milestone reduction targets of 34 per cent and 100 per cent for 2020 and 2050, respectively, serve to sketch out a minimum

		reductions-level pathway that the carbon budgets are required to reflect so that the targets can be met.
2.4 Banking and borrowing	Section 17	Amounts from one budget period can be carried over into another period in certain circumstances. In the event that a set carbon budget is exceeded over the course of one of the mandatory budgeting periods, the Secretary of State is required to lay a report before Parliament that contains proposals designed to compensate over the future period(s) for the excesses; this report must be produced as 'soon as is reasonably practicable'. There are powers under section 17 of the *Climate Change Act 2008* to "borrow" or "bank" amounts from one budgetary period to another. This allows the government to increase the budget by borrowing up to 1% from the succeeding period, which is consequently reduced by the amount borrowed. Conversely, if it has a surplus in a budgetary period, it can carry all or some of it forward to the next period. These powers are subject to consulting with the other national authorities and subject to obtaining and taking account of the advice of the CCC (Priestley, 2019). There were protracted communications between Parliament, the SoS and the CCC over the use of flexibilities to meet the 3rd and 4th carbon budgets. The Secretary indicated it might use surplus emissions from budget 2 however the CCC advised the SoS that the surplus was not due to policy but accounting changes in the EU ETS and therefore shouldn't be used (Priestley, 2019).
2.7 Mechanism for review of targets	Sec. 6 Sec. 7.(6)	The Secretary of State can amend these targets by secondary legislation, but he or she can only do so where there have been significant developments in scientific knowledge on climate change or European or international law or policy. Economic challenges, for example, would not be a legal justification for amending the targets (Macrory and Muinzer, 2020). If the order [to change the percentages in sec.5 – carbon budgets] deviates from that recommended by the Committee, the Secretary of State must also publish a statement setting out the reasons for that decision.

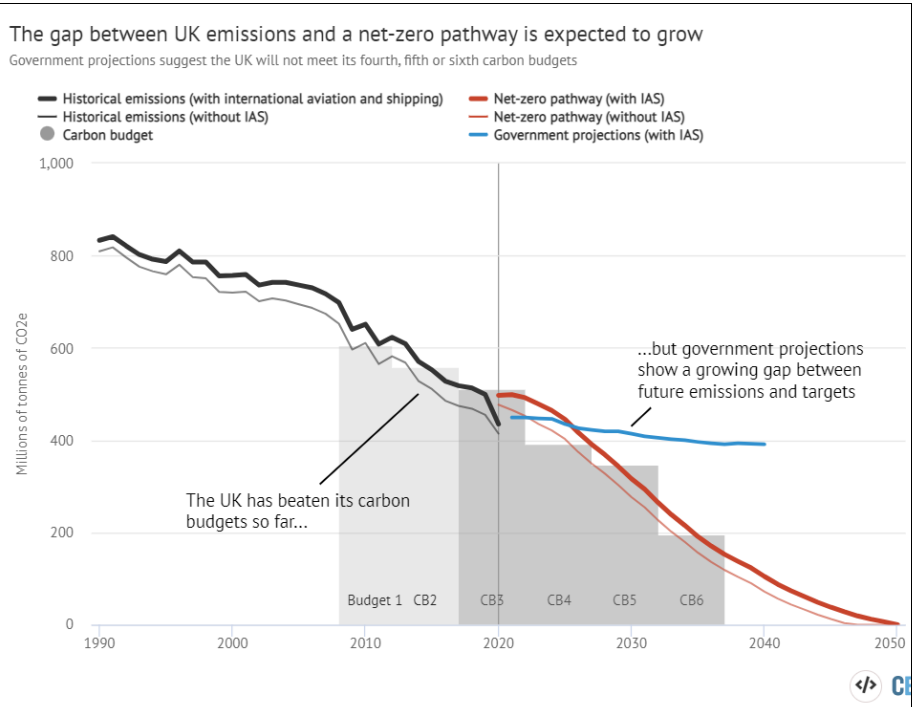
2.8 Compliance process	Section 18. (8) and Sec.19.(1)	If the carbon budget for the period has not been met, the statement [by the SoS to parliament] must explain why it has not been met. As soon as is reasonably practicable after laying a statement before Parliament under section 18 in respect of a period for which the net UK carbon account exceeds the carbon budget, the Secretary of State must lay before Parliament a report setting out proposals and policies to compensate in future periods for the excess emissions. Macrory and Muinzer (2020) note: "The existence of legal duties inevitably raises the question of their enforceability in the courts. In principle, judicial review is available in the UK as a legal mechanism for allowing the courts to enforce duties on government and other public authorities…While *substantive* duties of this sort may be difficult to enforce in the courts in a conventional way, the CCA contains many important procedural duties imposed on government, and here legal action – or simply the prospective threat of such action – is likely to achieve more concrete outcomes; for example, if a reporting duty has been ignored, in determining the breach a court is unlikely to feel inhibited in ordering that the reporting obligation is carried out." The UK Institute for Government noted in a 2020 blogpost that the courts have also shown they are willing to intervene where they do not think the government has taken proper account of its climate change commitments. This happened in February 2020, for example, when the UK Court of Appeal ruled that the government's policy statement in favour of Heathrow expansion was unlawful.
2.9 Fair shares/ ethical consideration of target	Sec. 2 and 10	There is no reference to international equity in the 2008 Act. Sec. 2.(2) sets out the criteria for amending the targeted reductions in GHGs. The power of the SoS to amend the target may only be exercised— (a) if it appears to the Secretary of State that there have been significant developments in— (i) scientific knowledge about climate change, or (ii) European or international law or policy,

		that make it appropriate to do so. When recommending carbon budgets, the SoS and CCC are obliged to consider the following matters under sec.10. (a) scientific knowledge about climate change; (b) technology relevant to climate change; (c) economic circumstances, and in particular the likely impact of the decision on the economy and the competitiveness of particular sectors of the economy; (d) fiscal circumstances, and in particular the likely impact of the decision on taxation, public spending and public borrowing; (e) social circumstances, and in particular the likely impact of the decision on fuel poverty; (f) energy policy, and in particular the likely impact of the decision on energy supplies and the carbon and energy intensity of the economy; (g) differences in circumstances between England, Wales, Scotland and Northern Ireland; (h) circumstances at European and international level; (i) the estimated amount of reportable emissions from international aviation and international shipping for the budgetary period or periods in question. Laes, Gorissen and Nevens (cited by Macrory and Muinzer, 2020) have pointed out that: '[The] long-term goal does include … a moral judgement on the "right" amount of responsibility (i.e., a burden-sharing obligation based on the principle of common but differentiated responsibilities) to be taken by an industrialized country.' In other words, the framework cannot be disconnected from moral underpinnings that, reduced to their essentials, recognise that emissions reduction is a just action where individual state responsibilities are situated in the context of international responsibilities (here the responsibility to redress climate change in the common interest).
2.7 Parliamentary oversight		The Committee that has oversight on energy and climate change matters is the BEIS commons committee

		https://committees.parliament.uk/committee/365/business-energy-and-industrial-strategy-committee/
8. Carbon budgeting process		In determining the appropriate level for the first three carbon budgets covering the period 2008-22 the CCC considered three factors in its report https://www.theccc.org.uk/publication/building-a-low-carbon-economy-the-uks-contribution-to-tackling-climate-change-2/: 1. The implications of the 2050 target [then 80% below 1990 levels] for the appropriate trajectory over the next fifteen years, and appropriate contributions by the UK to required global emissions reductions in 2020. 2. The implications of EU targets for emissions reductions to which the UK is already committed. 3. A bottom-up sector by sector analysis of feasible emissions reductions, likely costs, and the policies required to ensure that they are achieved.
3.1 Technical criteria	Sec.29 Removals Sec. 92-3 measurement of all GHGs Sec.89 Territorial emissions Sec.56 Risk analysis	The Act defines 'removals' of a greenhouse gas as 'removals of that gas from the atmosphere due to land use, land-use change or forestry activities in the United Kingdom'. Base year: The reference year for all 6 Kyoto gases is 1990 (although in practice this refers to carbon dioxide, methane and nitrous oxide, and in respect of the remaining industrial gases it is 1995). All gases are treated in accordance with their equivalence in carbon dioxide as per international practice. A "tonne of carbon dioxide equivalent" means one metric tonne of carbon dioxide or an amount of any other greenhouse gas with an equivalent global warming potential (calculated consistently with international carbon reporting practice). The Act makes clear that the emissions that are relevant for the purposes of carbon budgets relate to activities carried out on the territory or coastal waters of the UK. However, the CCC does report on consumption emissions. It is the duty of the Secretary of State to lay reports before Parliament containing an assessment of the risks for the United Kingdom of the current

		and predicted impact of climate change. In 2016, the CCC wrote to the SoS Amber Rudd advising against the reliance on up to 200MtCO2e emissions that could be affordably reduced as a contingency in case of policy under-delivery or higher energy demand, and with the expectation that EU policies would be strengthened following the adoption of the Paris Agreement.
3.2 Offshore mitigation		In its first set of recommended carbon budgets, the CCC recommended that up to a maximum of 20% of required emissions reductions would come from purchase of offset credits. Subsequently the CCC wrote to the SoS Amber Rudd MP in 2016 advising against the use of any offset credits apart from EUAs from the EU ETS to meet the 3rd carbon budget. This budget was met without the use of any crediting mechanism outside of the ETS allowances assigned to the UK. The CCC has warned that the UK was not on track to meeting the 4th (current) and 5th carbon budget. The CCC advised in 2016 that the UK should meet the 5th carbon budget through domestic actions and without borrowing from other carbon budgets.
3.3 Aviation and shipping		Emissions from aviation and shipping, though measured, are not included in the first 5 carbon budgets. In April 2021 the government announced that aviation and shipping emissions will be included in the 6th carbon budget (2033-37).
9. Public participation		Despite extensive public consultation (Childs and Carter, 2016) prior to the adoption of the Act in 2008, the legislation does not allow for a public consultation period prior to the adoption of carbon budgets, though the national authorities and other government agencies are consulted in advance. The UK held its first citizens' assembly in 2020 on climate change https://www.climateassembly.uk/. While the UK Climate Assembly is considered a success by select committees of the houses of Parliament, its impact had been limited and it "has had an agenda-setting influence at best" (Elstub, 2021).
10. Progress in meeting targets under the Act		The UK's policy framework to achieve net zero is set out in this strategy: https://www.gov.uk/government/publications/net-zero-strategy

		UK greenhouse gas emissions were 447 MtCO2e in 2021, including the UK's share of international aviation and shipping emissions. This is 47% below 1990, a decrease of 10% on 2019 emissions but an increase of 4% on 2020 emissions, which were low due to the effects of the COVID-19 pandemic. UK consumption emissions, which include emissions embedded in imports, fell by 29% from 1990 to 2018. The CCC's annual progress reports can be found online at https://www.theccc.org.uk and the 2023 progress report is available here: https://www.theccc.org.uk/publication/2023-progress-report-to-parliament/. The CCC has been increasingly critical of the government in recent years for inadequate and/or tardy policy responses to align with the carbon budgets. See the country profile by Carbon Brief here: https://www.carbonbrief.org/ccc-uk-will-miss-climate-goals-by-huge-margin-without-new-policies/.

		 Source: Josh Gabattis *Carbon Brief 2021* https://www.carbonbrief.org/ccc-uk-will-miss-climate-goals-by-huge-margin-without-new-policies/
11. Just transition	Sec.81	The UK CCA makes no reference to a just transition, inequality or social justice. Over 30,000 people are directly employed by the oil and gas industry in the UK in 2022, although the numbers employed in coal mining is now fewer than 1,000. Section 81 which refers to climate action reporting in Wales, requires local authorities to report measures addressing the number of households in which one or more persons are living in fuel poverty.

		There are extensive references to just transition in The Climate Change (Emission Reduction Targets) (Scotland) Act 2019
12. **Notable policy developments**		• The UK is one of the world's largest markets for offshore wind, with more than 10GW of cumulative installed capacity across 38 sites. However, efforts to expand the UK's offshore wind sector have hit a setback recently due to rising costs and low market prices. • The Tyndall Institute at the University of Manchester has developed a carbon budgeting tool for UK local authorities: https://carbonbudget.manchester.ac.uk/reports/ • Nuclear energy provides 15% of the UK's electricity at the moment. See here for an analysis of the potential role for nuclear power in the UK's climate and energy policies. The UK government has committed to progressing 8 new nuclear installations by 2030 to replace retiring plants as part of its energy security strategy. See: https://www.lse.ac.uk/granthaminstitute/explainers/role-nuclear-power-energy-mix-reducing-greenhouse-gas-emissions/

5.3 Finland

Topic	Country	Notes
3. Emissions profile	**Finland**	All emissions data from https://ourworldindata.org/co2/country unless otherwise stated
1.1 CO2 emissions per capita (2021)	6.79 tCO2 per capita	All fossil fuels from energy and industry exc. Land use
1.2 All GHGs per capita (2019)	10.56 tCO2e	Including land use
1.3 Carbon intensity of energy production (2021)	0.12kg CO2 per kW/hr	The carbon intensity of energy production in Finland has declined from a peak of 0.23 kg CO2 per kW/hr in 1969 as consumption of coal, oil and gas declined. The country has 5 nuclear plants generating 33.58% of electricity in 2021. A new nuclear plant opened in 2021 and should increase the share of nuclear in to 40% of total electricity production. Another nuclear plant is planned that would take the nuclear share of electricity generation to 60%.
1.4 Historical contribution of cumulative CO2 (1750-2021)	0.19%	Land use not included
1.5 Share of renewables in electricity (2021)	43%	Source: Energy in Finland 2022 It is notable that Finland increased wind power's contribution to power generation by 75% in 2022 and added 427 turbines with an installed capacity of 2430 MW.
1.6 Share of renewables in total energy supply (2021)	33.58%	Wood fuels made up 41% of total energy supply in 2021 including wood fuels in industry and small combustion. Finland met its 2020 target under the EU RE Directive of 22% renewables share in final consumption of energy supply.
1.7 Climate action tracker 2022 https://climateactiontracker.org/countries/uk/	Overall rating: insufficient Policies and action: Almost sufficient	Climate Action Tracker treats all 27 EU Member States as one country for the purposes of its analysis. The CAT rates EU's climate targets, policies, and finance as "Insufficient". The "Insufficient" rating indicates that the EU's climate policies and commitments need substantial improvements to be consistent with the Paris Agreement's 1.5°C temperature limit. The EU's 2030 emissions reduction target and its policies and action are consistent with 2°C of warming when compared to

	Domestic target: Almost sufficient	modelled domestic pathways. The EU is also not meeting its fair share contributions to climate action. https://climateactiontracker.org/countries/eu/
1.8 Climate Change Performance Index 2022	15th place (↓1)	Finland receives a high rating for the GHG Emissions and Renewables categories, but only a medium for Climate Policy and a very low for Energy Use. Actual emissions have been falling along a trajectory that is broadly compatible with the Paris Agreement targets. However Finland was criticised sharply by Germanwatch for the recent drastic decline in forest carbon sinks in recent years and the role that Finland has played in international negotiations on LULUCF/ AFOLU. For the first time in 2022, Finland was a net emitter of CO2 from the entire LULUCF sector due to unprecedented logging and deforestation in some parts of the country that exceeded maximum sustainable yields. According to the Finnish Climate Panel this puts the country's new target of achieving climate neutrality by 2035 in doubt.
1.9 Committed emissions from existing and new energy installations		Finland has no domestic sources of fossil energy. As mentioned above, peat production for energy and horticulture has been declining rapidly and the transition is being supported by EU funding. The Ministry of Agriculture and Forestry decided in 2022 to lease state-owned water resources for offshore wind generation with two projects currently under development with installed capacity of c.3.3GW. Finland has an extensive coastline and excellent wind resources. In 2021 the Global Wind Energy Council estimated that Finland had a potential offshore wind resource (including fixed and floating turbines) of 302 GW. Finland is a supporting member of the Beyond Oil and Gas Alliance.
2. Policy and legislation	Finland	
2.3 Legislation	Climate Law: Act 609/2015 amended by Act 423/2022	According to Torney (2019), the 2011 general election result and the resulting complicated coalition negotiations provided the Green Party and NGOs who had been campaigning for a climate law since 2008 with an opportunity to put a climate law on the political agenda. Extensive industry lobbying resulted in a compromise climate law that resembled the UK Act only in very general terms, but without short or medium term climate targets or budgets, and with a relatively weak role for the

		Finnish Climate Panel which had been established on a non-statutory basis in 2012. There was considerable opposition to the UK carbon budgeting model and the inclusion of the ETS sectors in the Bill's long-term target. It was agreed to include a long-term GHG reduction target of 80% reductions below 1990 levels by 2050. The Finnish parliament adopted the climate law in 2015 a week before new elections were called. As a result of these compromises, Torney (2019) argues that the Finnish 2015 Act, alongside the Irish 2015 climate law, is an example of 'symbolic' legislation, designed to demonstrate and signal adherence to international norms (Cass 2009) rather than a case of policy diffusion per se. The 2015 Act was subsequently updated in 2022 following the election of a coalition government now led by Sanna Marin. Climate change was a hotly debated topic in the public debates leading up to the 2019 election, in which there was cross-party support (apart from the right-wing nationalist Finns Party) for stronger action on climate change. Following the recommendation of the independent advisory body the Finnish Climate Change Panel, it was decided to strengthen the country's climate targets and amend the existing 2015 Act.
	Section 2	The revised law commits the country to achieve net zero emissions or climate neutrality by 2035, and economy wide GHG reductions of 60% by 2030, 80% by 2040 and 90-95% by 2050. This combination of a target year for climate neutrality (where emissions are balanced by removals) and a target year for zero (or close to) emissions is an interesting feature of the Finnish law, which captures the desire to distinguish between the goal of balancing removals and emissions and the goal of decarbonisation, highlighting the important role of the land-use sector and forestry in Finland.[23] Other objectives of the law include the goal of contributing to sustainable development and 'justice of climate measures'[24] alongside supporting the Sami people to maintain their language and culture.

[23] Recall that the Irish Act requires emissions to be balanced by removals in 2050.
[24] Google Translate

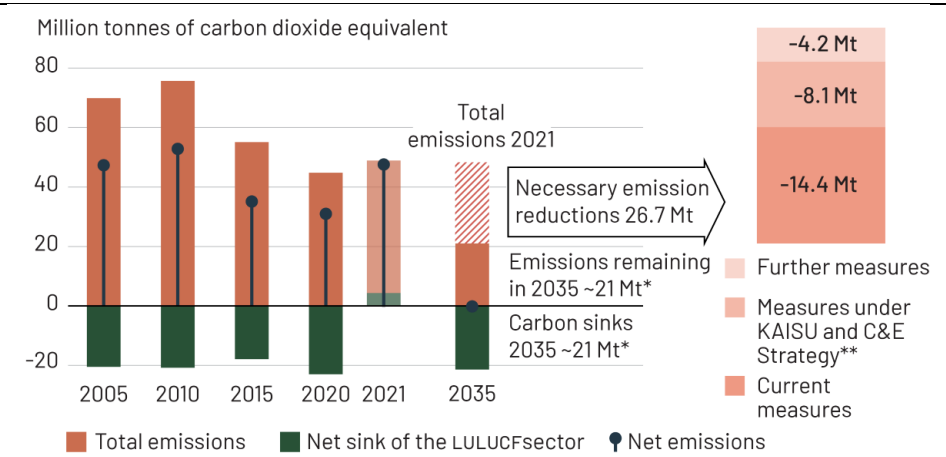
		Professor of International Law at the University of Eastern Finland Kati Kulovesi comments that in effect the law requires Finland to go carbon negative: “the country [must] be carbon neutral by 2035 and for its greenhouse gas emissions to continue decreasing and removals increasing thereafter, meaning that Finland must become carbon negative.” The Panel's initial recommendation assumed a gross emission reduction of 90% by 2050 and that Finland maintains and increases its net carbon sink in the land-use sector. When recommending the 2035 carbon neutrality target, the Panel also presented early results of a study on a possible emission pathway for Finland and possible mitigation actions for key economic sectors to reach carbon neutrality by 2035, illustrating that the proposed target was ambitious but achievable.
2.1 Institutions and functions	Section 3, 7 Sections 9-12	The law establishes a climate policy planning system with specific roles identified for different Ministries and institutions. The purpose of the Act is to enhance and coordinate the planning of the measures aimed at climate change mitigation and adaptation and the monitoring of the implementation of measures. Section 3 specifies that the act shall apply to the tasks of central government authorities in the preparation of climate policy plans and in ensuring their implementation. The 2022 Act puts the obligation on government to update its long term climate plan every 10 years, a national climate change adaptation plan every X years, a medium term climate plan once every parliamentary term and a climate and land use plan at least once every second term. The government must report to parliament on the plans. Monitoring and implementation provisions require the government to introduce additional measures if required however there is a considerable degree of discretion available. Curiously, different ministries have responsibility for different plans: the Long term plan is the responsibility of the Ministry for Economic Affairs and Employment, the national adaptation plan is the responsibility of the Ministry of Agriculture and Forestry, the medium term plan is the responsibility of the Ministry of

	Section 8	the Environment and the land use plan is the responsibility of the Ministry of Agriculture and Forestry. The following shall be taken into account in the preparation of the plans: 1) information produced in the national greenhouse gas inventory system and in the national system for reporting on policy measures; 2) estimates of the development of the international and European Union climate policy; 3) environmental, economic and social factors in line with the principle of sustainable development; 4) cost-effectiveness of the measures concerning climate change mitigation and adaptation; 5) level and development of the technology concerning the reduction of greenhouse gases, strengthening of sinks and climate change adaptation; 6) coordination of the plans with energy and transport policy planning, where necessary; 7) any impacts of the plans on domestic food security; 8) any impacts of the plans on biodiversity; 9) factors other than those referred to in paragraphs 1–8 that are essential in terms of the development of society.
2.2 Scientific advisory body	Section 20	The 2022 Act creates two advisory bodies, the Finnish Climate Change Panel and the Sami Climate Council who both have advisory and stakeholder functions in relation to climate policy. The law emphasises the need for diversity across scientific disciplines in the Climate Panel. Each member is appointed for a 4 year term.
2.3 Approach to carbon budgets		The Finnish law puts emphasis on the climate policy planning framework to achieve the targets set down in Section 2, and does not set out a carbon budgeting framework per se. The weakness of this approach is that it does not set limits on cumulative emissions but relies instead on emission reduction targets to be achieved via the 4 climate policy frameworks, which in turn are the responsibility of

		different ministries. Section 8 does require the climate policy plans to be based on up to date scientific knowledge.
2.4 Banking and borrowing		There is no mechanism to bank or borrow from different budgetary periods as carbon budgets do not apply.
5.3 Mechanism for review of targets	Section 17	There is no specific process set out for changing the targets set out in section 2, however the Act does state that international and EU targets take precedence over those defined in the Act. Section 17 sets out the requirement for the government to revise the climate policy plans subject to the provisions of section 16 which give the government discretion over whether to require additional measures. As the Climate Panel noted prior to the adoption of the Act, one of the weaknesses they identified with the original legislation was the absence of a specific threshold which would trigger the review mechanism.
5.4 Compliance process	Section 16	The Government shall monitor the implementation of the climate policy plans referred to in sections 9–12 adequately to determine whether the targets concerning climate change mitigation and adaptation set out in the plans and the objectives referred to in section 2 will be achieved. The Government can at its discretion introduce additional measures required to achieve the targets. The Government shall monitor the adequacy of the objectives referred to in section 2 on the basis of up-to-date scientific knowledge concerning the progress of climate change and to ensure that the objectives meet the obligations laid down in the international treaties binding on Finland and in the European Union legislation. Kulovesi notes that it is hard to see a legal challenge under the Climate Law other than an administrative law proceeding going ahead in Finland due to the restrictive formulation of government obligations.
5.5 Fair shares/ ethical consideration of target		The domestic 2035 carbon neutrality target was based on scientific analysis by the Finnish Climate Change Panel on the country's fair share of the global carbon budget to limit the global average temperature increase to 1.5 degrees Celsius from pre-industrial times. In 2018-2019, the Panel analysed Finland's long-term climate targets and the country's fair contribution to the implementation of the Paris Agreement and the 1.5 degree target. The Panel assumed a global carbon budget

		of 378 gigatonnes for 2019-2050 to maintain the global average temperature increase at 1.5 degrees. It studied ways to divide the global carbon budget based on equity, ability to pay and historical responsibility, concluding that Finland's fair share of the budget for 2020-2050 amounted to 79 million tonnes of carbon dioxide equivalent.
2.7 Parliamentary oversight	Section 15, 19	Section 15 requires the government to report annually on the implementation of the climate policy planning frameworks. The Government shall submit an Annual Climate Report to Parliament each calendar year setting out emission trends and projections, along with an assessment of the adequacy of existing plans.
13. Carbon budgeting process		
3.1 Technical criteria		Finland is an interesting case, because while the Act does not specify the use of carbon budgets and instead requires the government to devise and implement climate policies, in effect, the cumulative impact of these policies, if aligned with the 2030, 2035, 2040 and 2050 targets amount to a form of carbon budgeting. The budgets are not part of the legislation but the policy planning process. According to the 2035legitimacy blog, the Finnish Climate Change Act does not define the share of removals needed to achieve carbon neutrality, which is legally binding upon the government to achieve by 2035. However, Finland's Medium-term Climate Plan and the LULUCF Sector Climate Plan are based on the assumption that the LULUCF sector remains a carbon sink of 21 million tons of carbon dioxide equivalent. Thus, the gap in Finland's forest carbon sink presently stands at nearly 22 million tons of carbon dioxide equivalent. To illustrate the significance of the gap, Finland's total emissions in 2021 were 48.9 million tons of carbon dioxide equivalent, including LULUCF. On this basis two environmental NGOs have launched a legal challenge against the government on the basis that it has not introduced sufficiently strong additional measures to bridge the gap. The applicants in the Finnish climate case argue that the Government breached the Climate Change Act by failing both to properly assess the need for additional measures and to take a decision on the need to adopt such measures.

3.2 Offshore mitigation		There is no mention in the 2022 Act of any limits to offshore mitigation for the purposes of achieving the targets set out in Section 2.
3.3 Aviation and shipping	Section 3,9	Section 9 specifies that all emissions are to be covered by the new Act but the treatment of aviation and shipping emissions (international bunker fuels) does not get a specific mention.
4. Public participation		The strengthening of public participation is cited as one of the objectives of the 2022 Act. In addition, the government is required to make its emissions reporting and monitoring publicly available.
5. Progress in meeting targets under the Act		Total emissions have decreased by 32% compared to 2005 levels, according to the 2022 Climate Report. GHG Emissions have declined steadily in Finland due to what the chair of the Climate Panel Markku Ollikainen describes as the success of carbon pricing via the EU emissions trading system which has promoted the electrification of industry and supported innovations such as hydrogen-based solutions. However, emissions from the traded sector rose in 2021 by 4% due to the increased use of coal. From 2020 to 2021 emissions from transport decreased by about 4%. The electrification of transport has progressed faster in Finland than was expected. While emissions from the agricultural sector have remained stable, biogas production on farms increased by 50% between 2020 and 2021. According to the Climate Report 2022, efforts are also being made to influence emission trends in agriculture through dietary habits. The measures include a National Climate Food Programme to be prepared during 2022.

		 From the Annual Climate Report 2022 https://valtioneuvosto.fi/en/-/1410903/annual-climate-report-2022-total-emissions-about-same-as-before-land-use-sector-turned-from-sink-into-source-of-emissions The figure of 26.7Mt refers to the reduction that will be required to achieve climate neutrality by 2035.
6. Just transition		The Finnish climate law makes no direct reference to just transition. Section 2 of the Act states that it does however seek to: 1) contribute to ensuring sustainable development and justice of the climate measures; 2) contribute to ensuring the prerequisites for the Sámi people to maintain and develop their own language and culture. In 2021 the Finnish Climate Change Panel published a report on justice in climate policy, which made a number of recommendations as to how climate justice could be incorporated into climate policy in distributive, procedural and recognition terms, alongside human rights and rights of the Sami people. It concluded that effort would

		need to be invested in negotiating conflicts of principles, rights over the utilisation of natural resources: “New evaluation criteria and methods are needed to resolve situations, where evaluating climate policy justice causes conflicts. Such situations may emerge, when climate policy strengthens the basic rights connected to nature, the environment, and health while concurrently restricting the rights to practising a livelihood, occupation, or subsistence, or when promoting justice in Finland causes injustice elsewhere in the world.”
7. **Notable policy developments**		• The country is the first in the world to develop a deep geological repository for spent nuclear waste. Finland lacks indigenous fossil energy resources and imports petroleum, gas and uranium for energy production. Over half of all primary energy is consumed by industry, and a further 25% for heating (Finland has a cold climate). • Finland is also one of the last countries to burn peat for electricity production. In 2021 the country burned 2 million tonnes of peat for electricity generation. However this was a marked decline from previous years, and as a result, peat is no longer regarded as paying a role in the country’s energy security. • Until 2022 Finland imported most of its gas from Russia, however gas makes up just 10% of the country’s energy supply. Following the invasion of Ukraine and Russia’s demand that it receives payment for gas in Roubles, it cut off supplies to Finland entirely. In March 2022 Russia also cut off electricity supplies to Finland. Finland never used the gas for heating purposes, for which electricity, oil and district heating was more common. Arising from the standoff with Russia, sales of heat pumps in 2022 rose dramatically in Finland. • Finland enjoyed the largest growth figures of heat pump sales in 2022 compared with other EU member states in relative numbers.

		• Over 70% of the land area of Finland is forested, with less than 7% old-growth forest. According to a 2018 study by IRENA, typically, wood energy resources are used in highly efficient district heating (DH) • systems and combined heat and power (CHP) plants. According to this study, the annual growth of Finnish forests has nearly doubled since the 1950s, and so has the amount of wood that can be sustainably extracted. However excessive deforestation has led to a collapse in the forest carbon sink in 2021 which makes the achievement of carbon neutrality by 2035 a very challenging target. • Environmental organisations in Finland launched an appeal in November 2022 to the Supreme Administrative Court regarding the Finnish government's decision to submit to the Parliament the Annual Climate Report 2022 without properly evaluating the need for additional action and launching a procedure to decide on additional measures and update sectoral climate plans. According to the NGOs, the collapse of Finland's carbon sinks in 2021 has created a situation where the government's climate policy plans are insufficient for meeting the Climate Act's targets. • In April 2023, the left-leaning government of Sanna Marin collapsed and elections were held. While the new government, which was formed with the National Coalition Party, the Swedish People's Party, the Christian Democrats and the right-wing Finns party, has not (yet) formally changed the 2035 climate neutrality target, it has reduced the financing for nature protection is reduced by one-third from the previous Marin government and reports suggest that the new government's policy priorities will not achieve the 2035 target. In addition, the new government plans to reduce tax on petrol by €100 million, and reduce vehicle taxes by €50 million.

5.4 France

Topic	Country	Notes
8. Emissions profile	**France**	All emissions data from https://ourworldindata.org/co2/country unless otherwise stated
1.1 CO2 emissions per capita (2021)	4.74 tCO2 per capita	All fossil fuels from energy and industry exc. Land use
1.2 All GHGs per capita (2021)	6.06 tCO2eq per capita	Including land use
1.3 Carbon intensity of energy production (2021)	0.21 kg CO2 per kW/hr	The carbon intensity of energy production in France has declined from a peak of 0.28 kg CO2 per kW/hr in 1967 to 0.21 in 2021 as consumption of coal, oil and gas declined. The country has 56 nuclear reactors in operation in 2023 generating 69% of the country's electricity in 2021. A new nuclear plant is currently under construction. The IEA notes that France plans to reduce the share of nuclear from 70% to 50% in its electricity mix by 2035 and to close its last coal plants by 2022.
1.4 Historical contribution of cumulative CO2 (1750-2021)	39.11 billion tCO2 ~2.06% percentage share	Land use not included
1.5 Share of renewables in electricity (2020)	23.8%	Source: France Energy Policy Review 2021 It is notable that an increase in wind and solar photovoltaic (PV) electricity generation has driven up the share of renewables in electricity with hydropower representing half of renewable electricity generation.
1.6 Share of renewables in total energy supply (2021)	13.67%	https://ourworldindata.org/grapher/renewable-share-energy?tab=chart&region=Europe&country=~FRA Excluding biofuels.
1.7 Climate action tracker 2022 https://climateactiontracker.org/countries/eu/	Overall rating: insufficient Policies and action: Almost sufficient	Climate Action Tracker treats all 27 EU Member States as one country for the purposes of its analysis. The CAT rates EU's climate targets, policies, and finance as "Insufficient". The "Insufficient" rating indicates that the EU's climate policies and commitments need substantial improvements to be consistent with the Paris Agreement's 1.5°C temperature limit. The EU's 2030 emissions reduction target and its policies and action are consistent

		with 2°C of warming when compared to modelled domestic pathways. The EU is also not meeting its fair share contributions to climate action.
1.8 Climate Change Performance Index 2023	28th place (↓11)	France receives a medium rating for the GHG Emissions, Energy Use, and Climate Policy categories, but a low rating for Renewable Energy. The strong dependency on nuclear energy has meant the renewable energy target has not been implemented and France is not on the trajectory to achieve well-below-2°C in global warming.
1.9 Committed emissions from existing and new energy installations	Article L100-4 of the Energy Code.	Renewable energy (wind, solar, hydro): one of the objectives contained in the Energy Code is to increase the share of renewable energy to 33% of gross final energy consumption by 2030. (See policy development section below on reinvigorated attempts to develop RE sources in the country) Offshore wind sites at Saint-Nazaire, Fécamp, and Courseulles-sur-Mer have been already constructed with a combined capacity of more than 2 GW. In 2022, the French government committed to invest €1 billion in renewable energy innovation including the launch of two floating wind farm projects in the Mediterranean coast (combined capacity of 500MW): https://www.iea.org/policies/15025-france-2030-investment-plan-investment-in-renewable-energy-innovation Solar projects: Cestas solar power plant, 300 MW capacity. Nuclear: France is developing its first European Pressurised reactor at the Flamanville site in Normandy, with a capacity of 1.65 GW. On the whole, it aims to reduce the share of nuclear power in electricity generation from 70% to 50% by 2035 so as to increase the share of renewable energy: https://www.ecologie.gouv.fr/sites/default/files/PPE-Executive%20summary.pdf https://www.iea.org/reports/france-2021/executive-summary https://www.connaissancedesenergies.org/fiche-pedagogique/parc-nucleaire-francais
2. Policy and legislation		As a civil law system, laws enacted in France for purposes of climate change adaptation and mitigation have amended either their Energy Code or the Environmental Code.
2.4 Legislation	Law no. 2015-992 on Energy	The 2015 Law ("*loi relative à la transition énergétique pour la croissance verte*") provides a framework for decarbonisation without hampering economic growth. The act purports

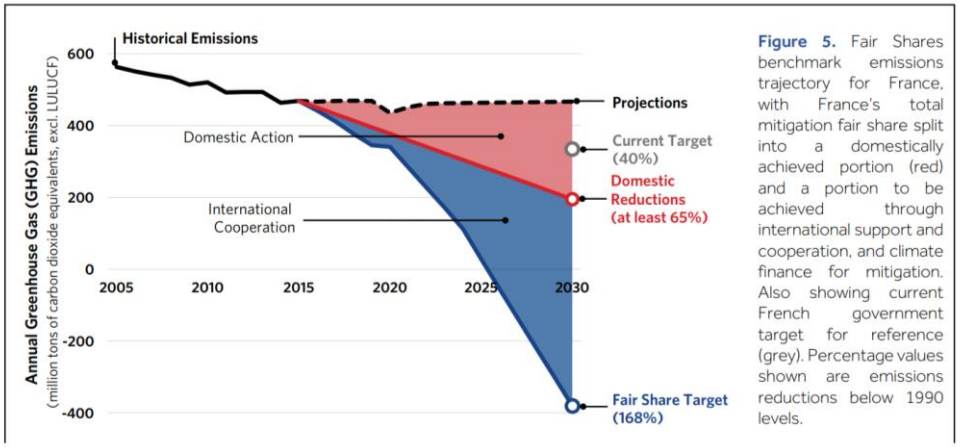
	Transition for Green Growth (Energy Transition Law) Act No. 2019-1147 dated 8 November 2019 on energy and climate Law No 2021-1104 on the fight on climate change and the reinforcement of resilience in the face of its effects Article L.100-4 of the Energy Code (as	to increase the share of renewables and diversify the energy mix and develop methods of tackling climate change i.e. by reducing consumption and taxing emissions. See: https://climate-laws.org/document/law-no-2015-992-on-energy-transition-for-green-growth-energy-transition-law_aea3 https://www.planete-energies.com/en/media/article/frances-energy-transition-green-growth-act The 2019 Law ("*loi relative à l'énergie et au climat*") places the goal of carbon neutrality by 2050 on a legislative footing. It was enacted to strengthen the long term GHG reductions targets and align them with developments made at EU level. It amends several pieces of legislation to increase the emphasis on adaptation to climate change and resilience, alongside mitigation efforts. The 2021 Law ("*loi portant lutte contre le dérèglement climatique et renforcement de la résilience face à ses effets"*) resulted from the work of the French Citizen's Climate Convention. In their presentation to the President in June 2020, they recommended that approaches to climate change adaptation and mitigation should be strengthened, and environmentalism anchored in all aspects of society. The law received significant backlash from climate activists, and criticism from the High Climate Council and policy analysists for its failure to enact significant enough measures to achieve the reductions in carbon emissions necessary to achieve 2050 goals: https://www.nytimes.com/2021/07/20/world/europe/france-climate-law.html https://www.euronews.com/green/2021/07/20/france-s-new-climate-law-has-just-been-approved-so-why-are-activists-so-unimpressed Lists the 11 objectives of the national energy policy, inter alia, i. Reduce greenhouse gas emissions by 40% between 1990 and 2030, and reach carbon neutrality by 2050. ii. Reach a 40% share for renewable energies in electricity production by 2030, and reduce the share of nuclear electricity production to 50% by 2035. iii. Cut down primary fossil fuel consumption by 40% between 2012 and 2030.

	amended by the 2019 Law).	iv. Cut down final energy consumption by 20% between 2012 and 2030, and by 50% between 2012 and 2050.
2.1 Institutions and functions		French law does not assign a specific ministry to the task of climate policy but rather identifies the government as generally responsible for climate policy and indicates how various ministries and agencies are involved in the policy-proposal and policymaking process. The Ministry of the Ecological Transition and Territorial Cohesion is tasked with integrating ecological objectives into cities and housing policies, transport and regional/departmental plans at central and decentralised levels. The Ministry of Energy Transition performs functions related to preparing and implementing the Government's policy in the areas of energy transition and energy, particularly in industrial and tariff matters. It prepares and implements the policy for reducing greenhouse gas emissions and promotes sustainable management of rare mining resources. The 2019 Law created the High Climate Council (see below) with an advisory role in relation to carbon budgeting, implementation and effectiveness.
2.2 Scientific advisory body	Art. L. 132-4 of the Environmental Code (as amended by Article 10 of Law n° 2019-1147)	Establishes the High Climate Council ("*Haut Conseil pour le Climat*") as a permanent independent scientific advisory body tasked with evaluating the relevance and effectiveness of French energy policy and produces an annual report, delivered to the Prime Minister government and to which the government is obliged to officially respond. The previous expert committee created under the 2015 Law had not been given dedicated resources and so had been unable to carry out meaningful work. LesFurets identifies that the HCC was modelled after the British "Committee on Climate Change" https://www.lesfurets.com/energie/guide/loi-energie-climat.

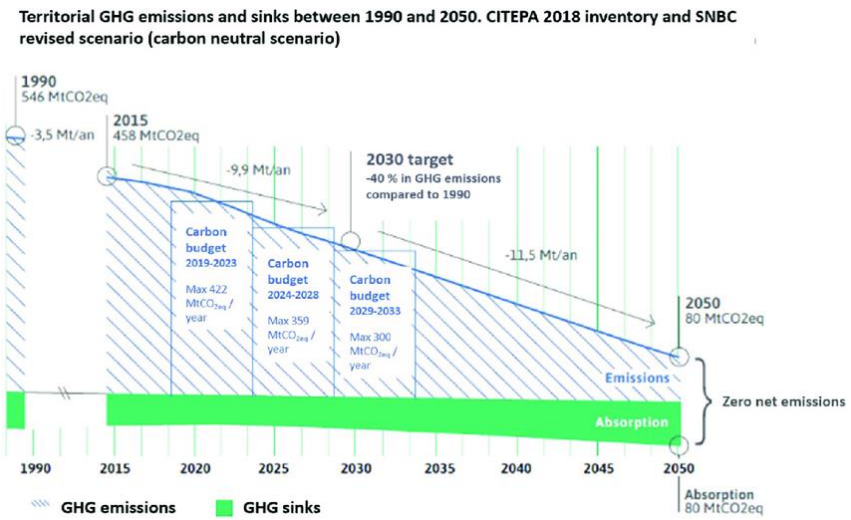
		The HCC consists of a president and twelve members chosen for their scientific, technical and economic expertise in the fields of climate science and ecosystems, the reduction of greenhouse gas emissions as well as adaptation and resilience to climate change. The HCC provides an opinion on compliance with the carbon budgets already set and on the implementation of the current low-carbon strategy one year prior to the next 5-year low carbon strategy being published. The government is obliged to respond to this report.
2.3 Approach to carbon budgets	Code de l'énergie: Art. L.100-4 and Code de l'environnement: Art. L. 222-1 A ; SNBCv 2 p. 37 et seq. Article L. 141-1 of the Energy Code Article L. 222-1 A et seq of the	France adopted a Climate Policy Carbon Budgets approach modelled on that used in the UK (McGuire et al). The system operates by means of successive 5-year target periods, set 10-12 years in advance, with quantitative limits on emissions and an interim target of 30% reduction in GHG emissions by 2030. The budgets are set internally by the Ministry for Ecology and Inclusive Transition with comments and advice on proposed drafts provided by the HCC. This approach provides certainty in the quantitative upper limit for a clearly defined period, and some flexibility from year to year to account for slight variations in emissions production. The 2019 Law connects with both the long-term emissions reductions plan and the medium-term energy planning process (https://www.ecologic.eu/sites/default/files/publication/2020/climatelawsineurope_fullreport_0.pdf). French law employs two major cross-sector approaches to reduce its energy consumption: the multi-annual energy plan, and the low-carbon strategy pertaining to the carbon budgets. Commits the French government to set a multi-annual energy plan (Programmation pluriannuelle de l'énergie) in order to achieve the objectives. The law creates a national "low-carbon strategy" ("stratégie bas-carbone" - SNBC) which provides the policy roadmap to achieve the interim and long-term objectives in the Energy Code by 2050. The SNBC is only binding for multi-year energy planning (PPE).

	Environment Code	The SNBC was recently revised in accordance with the updated objectives contained in the 2019 Law. The National Climate Change Adaptation Plan (PNACC) expresses the national 5-year strategy for adaptation to climate change based on these budgets. The State, local authorities and their respective public establishments must take the low-carbon strategy into account in their planning and programming documents, which have a significant impact on greenhouse gas emissions. https://outil2amenagement.cerema.fr/les-budgets-carbone-et-la-strategie-nationale-bas-r1616.html https://www.ecologie.gouv.fr/strategie-nationale-bas-carbone-snbc
2.4 Banking and borrowing		Banking is allowed without restriction while borrowing is subject to limitations (e.g. less than 1% of emissions of that later budgetary period): CCAC. France overran its first carbon budget (2015-2018) of 441 megatons of carbon dioxide equivalent (Mt CO2eq) by 62 MtCO2eq or 14% and had to revise upwards its second carbon budget (2019-2023) in order to take into account the “structural” difficulties in reducing emissions from the transport and building sectors. The HCC found that at the national level, the SNBC is isolated and is marginally operational. The first SNBC failed to meet the first carbon budget that France set itself and as such is legally and politically too weak to move France towards carbon neutrality by 2050.
5.4 Mechanism for review of targets	Article L. 100-1 A of the Energy Code (as amended by the 2019 Law)	At a national level, there is a general review clause on the long-term targets in the 2019 law which is connected to the independent HCC progress reports at the end of every five-year policy programming period. France amended its 2015 legislation by means of the 2019 Law to account for the decision to increase the target to climate neutrality by 2050 (from a 75% reduction previously).
5.5 Compliance process	Art. L. 132-4.-II. of the Environmental	The HCC produces a report on the implementation and compliance with the previous carbon budget a year prior to the creation of the next 5-year strategy, which is sent to government who are obliged to respond. The government provides an explanation of any

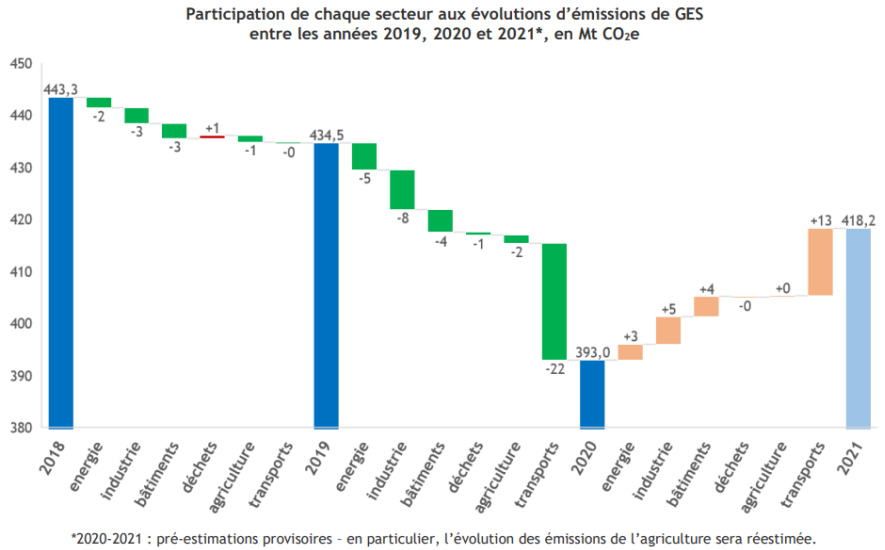
	Code (as amended by the 2019 Law)	gaps and provide information on future actions in their response. This form of progress monitoring is linked in law to taking additional measures, if it becomes clear that reductions being made are not in line with the targets. Annual progress monitoring and reporting is an integral and long-standing element of France's international legal obligations under the 2015 Paris Agreement. EU law also mandates regular reviews of targets and their progress thereunder. The Environmental and Energy codes provide for climate mainstreaming and connects the climate policy cycle with the annual budget process. Administrative review of progress: judicial review proceedings were taken by the municipality of Grande-Synthe in 2019 on the basis that measures taken by government to achieve the 2030 targets contained in the Energy Code were insufficient. In July 2021, the Conseil d'Etat ordered that the government were to take "all the necessary steps" within 9 months to reach its emission reduction targets or face possible financial penalties: https://www.conseil-etat.fr/en/news/greenhouse-gas-emissions-the-conseil-d-etat-annuls-the-government-s-refusal-to-take-additional-measures-and-orders-it-to-take-these-measures-befor
5.6 Fair shares/ ethical consideration of target		Analysis by Holz, Athanasiou and Kartha (2022) of the French GHG reductions targets from the perspectives of historical responsibility for global warming and present capacity indicates that the country should aim for a reduction of 65% from 1990 levels by 2030, whereas present French targets aim for a relatively weak 40% reduction by 2030.

	Law n° 2021-1031 of 4th August 2021	 **Figure 5.** Fair Shares benchmark emissions trajectory for France, with France's total mitigation fair share split into a domestically achieved portion (red) and a portion to be achieved through international support and cooperation, and climate finance for mitigation. Also showing current French government target for reference (grey). Percentage values shown are emissions reductions below 1990 levels. The French government have left a large fraction of the country's overall fair share to be achieved by means of international cooperation. The researchers estimate that France should pay €70 billion between 2021 and 2025 in financing of international climate change mitigation, adaptation and loss and damage costs. At COP27 the French government pledged €30 billion in international financing for that 5-year period. €6.1 billion was mobilised in 2021. The law on programming relating to solidarity development and the fight against global inequalities ("*loi de programmation relative au développement solidaire et à la lutte contre les inégalités mondiales"*) contains the objectives and principles of France's official development assistance ('ODA') and commits the government to spending 0.61% of its Gross National Income on ODA in 2023, 0.66% in 2024 and 0.7% in 2025. France is the third largest climate change donor globally and places second in terms of the greatest relative prioritization of climate change-related projects in the spending of its bilateral allocable ODA. Paulus has identified that French law and the SNBC has defined "carbon neutrality" territorially and does not link to the broader concept of "carbon footprint".

2.7 Parliamentary oversight	Article L222-1 D of the Environmental Code (as amended by the 2019 Law)	The HCC produces advisory reports which it then submits to government for a response. The government responds to these reports in public through parliament which creates an opportunity for public debate. The Government presents to Parliament the new carbon budgets and the national low-carbon strategy as soon as they are published.
9. Carbon budgeting process	Article L222-1 B of the Environmental Code	France's carbon budgets contained in the 2015 Law were explained by means of the SNBC of 2015 which identified the first carbon budget for 2020 as geared towards achieving domestic commitments, whereas the second and third budget levels were mindful of 2030 objective to reduce GHGs by 40% and EU obligations under the 2015 Paris Agreement. The carbon budget trajectory was technically adjusted by the 2019 Law to account for the more ambitious GHG reductions target at EU level, i.e. carbon neutrality by 2050. The revised SNBC for the 2019-2024 period instigated more stringent measures to curtail French consumption and production of GHG emissions.
3.1 Technical criteria	SNBC (March, 2020) v 2 p. 37 et seq.	The carbon budgets were determined on the basis of capacity and responsibility to create a realistic and linear development trajectory towards achieving carbon neutrality by 2050.

		
3.2 Offshore mitigation		The Energy and Environmental Codes do not mention the availability of using offshore mitigation measures to achieve domestic GHG reductions targets.
3.3 Aviation and shipping		France has formally banned domestic flights on short routes that can be covered by train to cut the carbon footprint of the aviation sector. The French government has also introduced higher climate charges for private jets from 2024.
4. Public participation		French law builds in avenues for public participation into climate policy making and requires the responsible governmental agency or body to directly engage the citizen body in climate policymaking. The National Council for Ecological Transition (NCET) was established by Decree n° 2013-753 in 2013 to institutionalize stakeholder participation in the policy-making process in France. NCET is composed of 50 members representing six stakeholder groups and is tasked with reviewing all French policy related to sustainability. President Macron created the French Citizens' Convention for Ecological Transition ("the Convention") inspired by the Irish Citizen's Assembly to quell public protests against a hike in fuel taxes. The Convention's was composed of 150 citizens who met over the

		course of 9 months to make proposals for measures to achieve the national objective of a 40% reduction in GHG emissions by 2030 compared to 1990 level “in a spirit of social justice”. https://www.ecologic.eu/sites/default/files/publication/2020/climatelawsineurope_fullreport_0.pdf https://www.cep.eu/fileadmin/user_upload/cep.eu/Studien/cepInput_Franzoesisches_Klima-_und_Resilienzgesetz/cepInput_The_French_Climate_and_Resilience_Law.pdf
5. Progress in meeting targets under the Act		Citepa, the French organisation monitoring carbon emissions, reported in 2022 that the first carbon budget (2015-2018) had not been respected. However, under the revised SNBC which required emissions of no more than 422 MtCO2e/year on average, the objectives of second carbon budget (2019-2023) were being met for the time being, as the average yearly emissions amounted to 415 Mt CO2e between 2019 and 2021. 2020 represented an exceptional year due to the pandemic-induced lockdown and there was a rebound in emissions levels in 2021 after the lockdown was lifted. See: https://www.euractiv.com/section/emissions-trading-scheme/news/france-saw-8-5-drop-in-co2-last-year-not-enough-to-meet-eu-goals/

		 *2020-2021 : pré-estimations provisoires - en particulier, l'évolution des émissions de l'agriculture sera réestimée. In its 2021 annual report, the HCC stressed that "current efforts are insufficient to ensure that the 2030 targets will be met, especially in the context of the new European Climate Law: HCC, Rapport annuel 2021, Renforcer l'atténuation, engager l'adaptation, p. 5.
6. Just transition		The Ecological Transition Contracts (CTEs) scheme was launched by the French government in 2018 to support fossil fuel-dependent regions in shifting to low-carbon industries and resource-efficient development. They are agreements between the local communities, companies and the State. For example, in the phasing out of domestic coal production and offering of proactive support for the affected workforce. https://www.iea.org/reports/france-2021/executive-summary https://www.ecologie.gouv.fr/sites/default/files/18007-2_CTE_4p_A4%20light.pdf

7. **Notable policy developments**	LAW n° 2023-175 of March 10, 2023 relating to the acceleration of the production of renewable energies (“loi relative à l'accélération de la production d'énergies renouvelables”)	France is lagging far behind other EU countries in terms of the share of Renewable Energy in its energy mix and failed to achieve the target of 23% renewables by 2020 due to its dependence on nuclear electricity generation. The 2019 Law elongated by a decade the previous target to reduce nuclear energy to 50% of the energy mix by 2025. Le Monde reported in January 2023 that many express doubts as to whether the nuclear target will remain in law at all. To accelerate the countries progress towards achieving a 33% share in renewable energy target by 2030, the government recently enacted a new law which is hoped will multiply by ten the production of solar energy to exceed 100 gigawatts (GW), to deploy 50 wind farms in sea to reach 40 GW and to double the production of onshore wind turbines to reach 40 GW. The 2023 Law provides for territorial planning for renewable energies, simplifies and accelerates project procedures, mobilises land with low environmental value to deploy renewable energies and better sharing with municipalities the value generated by these energies. See: *France trailing behind EU renewable energy goals*, in Euractiv 06/05/2021, and https://www.vie-publique.fr/loi/286391-energies-renouvelables-loi-du-10-mars-2023. • It has been difficult for the French government to find the right balance between over and under regulation for climate change in the past decade: NYT article Liz Alderman 19 May 2021 https://www.nytimes.com/2021/05/19/business/macron-france-climate-bill.html • And another NYT article after the bill was passed. https://www.nytimes.com/2021/07/20/world/europe/france-climate-law.html

5.5 The Netherlands

Topic	Netherlands	Notes
1. Emissions profile		All emissions data from https://ourworldindata.org/co2/country unless otherwise stated.
1.1 CO2 emissions per capita (2021)	8.06 tCO2	All fossil fuels from energy and industry exc. Land use
1.2 All GHGs per capita (2019)	10.15 tCO2e	Including land use
1.3 Carbon intensity of energy production (2021)	0.15 kg CO2 per kWhr	According to the IAEA, the Netherlands has one nuclear power reactor in operation, one plant in safe enclosure, two research reactors, one enrichment plant (Urenco) and one central storage facility for radioactive waste. Nuclear energy provides 1% of the Netherlands' Total Energy Supply, with oil (35%), gas (45%) and coal (11%) making up the majority of the country's energy supply. Renewables in 2019 made up 8% of total energy supply but this figure has been rising considerably since IRENA published its profile of the Netherlands and especially in 2022.
1.4 Historical contribution of cumulative CO2 (1750-2021)	0.68%	The Netherlands is one of the countries for which emissions data goes back to 1846 in the Our World in Data GHG series. The country's cumulative emissions from fossil fuels and industry by 2021 are 11.74 billion tonnes of CO2 (compared with Ireland 2.23 billion tonnes CO2).

1.5 Share of renewables in electricity (2022) Source: Statistics NL https://www.cbs.nl/en-gb/figures/detail/82610ENG	33.36%	According to a recent article in *Euroactiv*, the Netherlands is the leader in solar power production in the EU and has seen a huge increase of solar power in its electricity mix, increasing the share of solar from 1% in 2015 to 14% in 2022. In 2022 the country added 1.8 gigawatts (GW) of rooftop solar capacity, 38% more than in 2021. According to the article, a million consumers are now taking part in energy cooperatives. According to the Ember European Electricity Review 2023, the invasion of Ukraine and the EU's REPowerEU plan to accelerate decarbonisation and end the EU's reliance on gas imports from Russia had some notable consequences but did not lead to a rise in coal burning to replace gas. In the Netherlands, a law was passed in June 2022 revoking an order from December 2021 that limited coal plants to 35% capacity. Since then, the four remaining Dutch coal plants have generated at 45% capacity, lower than the 65% capacity over the same period in 2021. The Netherlands has indicated that it will not be amending its phase out date of 2029 for coal use in power generation.
1.6 Share of renewables in total energy supply (2021)	12%	In 2021, renewable energy accounted for 12 percent of total energy consumption in the Netherlands. This share was 14 percent in 2020. Compared to 2020, less biomass was counted towards the share of renewable energy and there was no renewable energy imports. In 2021, wind energy consumption increased by 36 percent and solar energy consumption by 28 percent year on year, based on provisional figures released by Statistics Netherlands (CBS).

1.7 Climate action tracker 2022 https://climateactiontracker.org/countries/eu/	Overall rating: insufficient Policies and action: Almost sufficient Domestic target: Almost sufficient	Climate Action Tracker treats all 27 EU Member States as one country for the purposes of its analysis. The CAT rates EU's climate targets, policies, and finance as "Insufficient". The "Insufficient" rating indicates that the EU's climate policies and commitments need substantial improvements to be consistent with the Paris Agreement's 1.5°C temperature limit. The EU's 2030 emissions reduction target and its policies and action are consistent with 2°C of warming when compared to modelled domestic pathways. The EU is also not meeting its fair share contributions to climate action. https://climateactiontracker.org/countries/eu/
1.8 Climate Change Performance Index 2022	Rank: 13th (up 6)	The Netherlands' CCPI ranking continues to rise, now up six places to 13th. This puts it among the high-performing countries. While the Netherlands receives a high rating in the Renewable Energy and Climate Policy categories, its performance in GHG Emissions and Energy Use earn a medium. The Netherlands generally performs well in the trend indicators, and this time receives a very high rating in the renewable energy current trend indicator as well as a high in the GHG emissions current trend indicator. https://ccpi.org/country/nld/

1.9 Committed emissions from existing and new energy installations		The Netherlands has had extensive oil and gas resources in the North Sea, upon which its rapidly industrialising economy was built during the post-WWII years. The Netherlands was one of Europe's main gas suppliers for decades through the massive Groningen field in the north of the country. But gas production there has been cut to a minimum in recent years to limit seismic risks in the region and drilling is planned to end next year. The government recently announced that no new areas will be opened up for exploration or drilling except for gas fields in the North Sea that currently have exploration licences, a decision that was driven by the climate policy agenda. However, with a strong oil and gas sector, the government's climate policy is supportive of Carbon Capture and Storage or Utilisation (CCS and CCU) with regular CfD auctions now offering subsidies for CCS projects up to a maximum ceiling of permitted removals. A 2021 review article by Akerboom et al (Akerboom *et al.*, 2021) in the journal Frontiers of Energy Research found that while CCS has been accorded an important place in the current Dutch climate policies, being expected to contribute up to 7 Megatonnes of CO2 reduction, these plans have a long way to go from the drawing board to actual operations due to the technical, economic, legal and societal challenges ahead. The authors of the article conclude: "The question it raises is to what extent its deployment gives fossil fuels a new lease [of] life, thereby standing in the way of renewables deployment, or slowing it down, in other words, maintaining the status quo. All agree that this should not be so; but, those in favour of CCS say it will not do so and those against say it will. In so far as CCS is accepted, it is as a transition measure, but how large the role for CCS is in the transition and how long the transition will be is still a matter of debate." Milieudefensie and others vs Royal Dutch Shell (RDS): in 2019, a group of environmental NGOs launched a legal action against RDS building on the landmark Urgenda decision which found that the Dutch government's inadequate action on

		climate change violated a duty of care to its citizens. In the suit against Shell, plaintiffs extend this argument to private companies, arguing that given the Paris Agreement's goals and the scientific evidence regarding the dangers of climate change, Shell has a duty of care to take action to reduce its greenhouse gas emissions. Plaintiffs' argument outlines how Shell's long knowledge of climate change, misleading statements on climate change, and inadequate action to reduce climate change help support a finding of Shell's unlawful endangerment of Dutch citizens and actions constituting hazardous negligence. In 2021 the Hague District Court ordered Shell to reduce its emissions by 45% by 2030, relative to 2019, across all activities including both its own emissions and end-use emissions. The Court ordered Shell to reduce emissions by a net 45% across both emissions from its own operations and emissions from the use of the oil it produces. The Court made its decision provisionally enforceable, meaning Shell will be required to meet its reduction obligations even as the case is appealed. Shell have appealed the decision. On April 25, 2022, Milieudefensie sent a letter to Shell's Board of Directors calling for urgent action to comply with the verdict of May 26th 2021 and warning for personal liability risks towards third parties resulting from a failure to act.

2.1 Legislation	Climate Act 2019 Article 2.1	The Dutch climate law was adopted by parliament in 2019 after a prolonged public debate leading to a multi-sectoral National Climate Agreement[25] which recommended increasing the Netherlands ambition on climate change in accordance with the Paris Agreement. Ultimately the government adopted an emission reduction target of 49% by 2030 but agreed that the target could be revised in line with EU policy. After elections in 2021, the coalition government led by Mark Rutte agreed to a new accord which sets out the climate and energy objectives of the government to 2040. The EU's 55% reduction by 2030 has been increased by the Dutch government with a goal of a 60% reduction in emissions, followed by further cuts of 10% every five years. The Act itself is quite short at 6 pages and quite general in its prescriptions. It sets a target of 49% emissions reduction by 2030 (but see above) and 95% reduction by 2050 against a 1990 baseline. It also stipulates that all electricity production should be climate neutral by 2050. The government is required to prepare a medium term climate plan at least every 5 years covering a 10-year period, in line with EU reporting and the Paris Agreement. The government must prepare a medium-term climate plan once every 5 years that covers a 10-year span. Parliament must approve the climate plans. The Climate Plan must also contain a list of concrete measures that need to be taken in order to achieve these objectives. It must estimate the expected share of renewable energy and the expected saving on primary energy use. An overview of the most recent scientific insights must also be provided in the Plan. The government must further provide an update on global and European developments in the field of climate change mitigation and offer an honest assessment of the consequences of the government's climate policy for the financial position of households, businesses and governments. The responsible Minister has a good deal of discretion over whether to make changes to the Plan based on the advice of the Council of State or the PBL. Annual progress reports (the 'climate memo') are to be prepared for presentation to parliament. The

		Advisory Division of the Council of State must be consulted on the Climate Plan and on the Climate Memo. The independent advisory body, the Dutch Environmental Assessment Agency or PBL is required to submit an annual climate and energy report to the Minister.
2.1 Institutions and functions		The Act delegates responsibility for climate policy planning to the Minister for Economic Affairs and Climate Policy. The Act is weak in the sense of not imposing strong legal obligations on the government to achieve the targets; despite being rather informal legal structures, Duwe and Evans (Duwe and Evans, 2020, p.22) describe the accountability mechanisms and level of detail in actual climate policy planning as significantly stronger in practice. They also note that while the Dutch law does not establish an internal coordinating or advisory body, although each exists separately in the Dutch governance system (separate sector-specific implementing committees were established under the supervision of the relevant Ministers and the government-financed environmental advisory body PBL is consulted on climate action planning and has a monitoring role).

[25]An agreement between various stakeholders along the lines of the social partnership agreements in Ireland.

2.2 Scientific advisory body		Unlike many other countries, the Dutch climate law does not establish a new climate advisory body. The Dutch Act names the PBL or the Netherlands Environmental Agency ('Planbureau voor de Leefomgeving') as the main body tasked with providing expert advice to the government on climate policy. The Netherlands PBL was established in 2008 and conducts independent research on the environmental policies of the Dutch government. It is an independent agency but is formally part of the Netherlands Ministry of Infrastructure and Water Management. Instead of creating a brand-new agency, the PBL was seen as the obvious institute to carry out this new task under the Climate Act.
2.3 Approach to carbon budgets		Following the adoption of the Paris Agreement, PBL scientists drafted a report setting out implications of the temperature goals in article 2, and the latest IPCC science, for Dutch climate policy (Van Vuuren *et al.*, 2017). The report estimated the relevant carbon budgets for the Netherlands and the EU based on scenarios assuming an equal per capita global distribution of emissions in 2050: a maximum temperature increase of 2 degrees with and without negative emissions, and 1.5 using negative emissions. From these scenarios the researchers calculated that for 2030 the Netherlands would have to reduce CO2 emissions by between 40-50% or 50-55% for all GHGs. This study strongly influenced both the Climate Agreement (see above) and subsequent Dutch policy. However, the principle of carbon budgeting per se was not included in the Dutch climate act. According to the analysis of Spijkers and Oosterhuis in Muinzer (2020), earlier drafts of the climate law envisaged that the government would also draw up an annual Climate Budget ('klimaatbegroting'), indicating which concrete policy measures the government expected to take. The Climate Budget was supposed to set how much greenhouse gas is emitted that year and how this relates to achieving the targets in the Climate Plan. In the revised version of the Climate Act, the provisions relating to the Climate Budget were replaced with a provision on a so-called Climate Memo ('klimaatnota'). It should be noted also that the *Urgenda* decision by the Supreme Court required the Dutch government to reduce emissions by 25% by 2020 against

		1990 levels. In effect, this decision brought the specific number of tonnes of additional reductions – 5 MtCO2e into sharp relief.
2.4 Banking and borrowing		There is no mechanism for banking and borrowing under the climate law.
2.4 Mechanism for review of targets	Article 4.(1) Article 5. (1)	The Climate law makes provision under article 4 for a review of progress every two years after the adoption of the climate plan, following which additional measures may be introduced. Under article 5 the Minister has discretion to amend the climate plan if in his opinion this is necessary to achieve the objectives set out in article 2 of the law.
2.5 Compliance process		The Dutch climate law does not include any provisions relating to compliance. However, the policy process is strongly coordinated across government and the various stakeholders.
2.6 Fair shares/ ethical consideration of target		Dutch climate policy and its climate law is strongly influenced by the (non-statutory) Climate Agreement arrived at between government and a variety of stakeholders, submitted to the government in 2018 and formally adopted in 2019. In the course of the negotiations leading to the agreement, the participants conducted a sectoral analysis of 5 areas based on a 49% emission reduction target against 1990 levels.

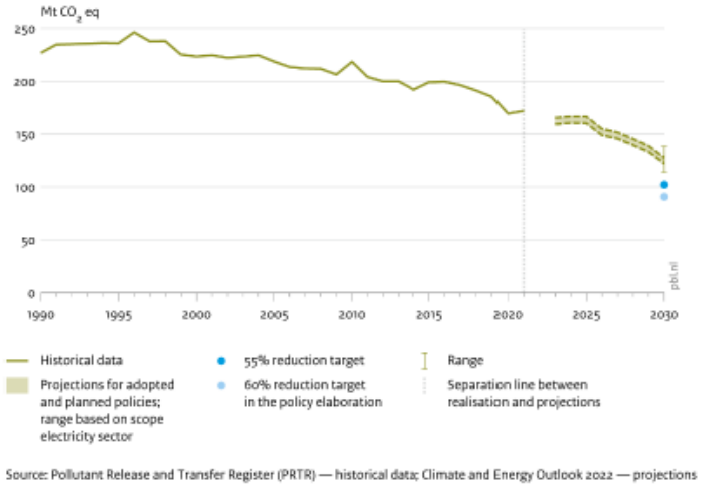
		However, the analysis and discussions did not address questions of fairness or equity and the agreement makes no mention of the principle of common but differentiated responsibilities and respective capabilities. It noted the prospect of a higher EU target of 55% which was already on the horizon but did not consider the ethical underpinnings of either the 49% or 55% targets. In 2017, the Dutch Environmental Assessment Agency PBL published a report (van Vuuren et al, 2017) setting out a framework for responding to the Paris Agreement with a national carbon budget which looked at the choices available to policymakers in the Netherlands based on different levels of risk tolerance and likelihood of achieving the targets based on IPCC AR5. PBL's calculations were based of the three following scenarios ('Paris scenarios'): a) Achieving the 2 °C target with a likelihood of more than 66% ('well below 2 °C'), assuming the use of negative emissions (for their calculations, they assumed a total of 200 billion tonnes in negative CO2 emissions). b) Achieving the 2 °C target with a likelihood of more than 66% ('well below 2 °C') without the use of negative emissions. Achieving the 1.5 °C target with a likelihood of more than 50%, using negative emissions (for their calculations, they assumed a total of 350 billion tonnes in negative CO2 emissions). The PBL report noted that the policies in place at the time were not consistent with either a 1.5 or 2 degree scenario and that the proposed target of 49% was roughly in line with what would be necessary. However, as Fekete highlights in Nascimento et al (2022) (see below), the PBL modelling does make key assumptions about the viability of global CCS, nor did it consider the Netherlands' historical contribution. Fekete (2022) for the New Climate Institute argues that the Dutch government's proposed target and associated pathway to 2050 does not reflect the country's fair contribution under the Paris Agreement. While the targets are aligned with EU policy and the required global effort as an *average*, the Dutch approach does not take a

		conservative approach to carbon dioxide removal, which they describe as an immature technology that has not been proven to work in large-scale applications. Nor does the current policy reflect the high historical contribution of the Netherlands alongside its capabilities to reduce emissions. The study analysed two approaches to “fair shares” for the Netherlands, one using a grandfathering approach (distributing the remaining carbon budget according to current share of global GHGs) and the second using an equal emissions per capita approach at 2050. This analysis resulted in a 94% reduction in emissions by 2030 under the equal per capita scenario, 0% CO2 by 2037 under a distributed emissions scenario and negative emissions by 2030 under an unambiguously fair scenario. The authors state “under an unambiguously fair trajectory, the Netherlands has already used up its budget. In practice, this means that the Netherlands need to decrease their emissions as fast and deep as possible, and additionally provide substantial support to other countries. Another independent analysis conducted by a team of climate policy experts in July 2021 for CE Delft concluded that Dutch CO_2 emissions need to decline far faster than is currently the case. They proposed the introduction of a national carbon budget, with the government setting an annual cap on the volume of greenhouse gases that can be emitted and lowering this budget each year (similar to the Feasta “Cap and Share” approach). This budget system would be organised as an emissions trading scheme through energy suppliers, who would need to have enough emission allowances for the emissions of the fuels they sell. These allowances would give the right to emit 1 tonne of CO_2 and initially be auctioned by the government or sold for a fixed price. Subsequently, energy suppliers would buy and sell additional allowances on a carbon market, creating a going price. Energy suppliers will pass on the CO_2 price as far as they can to their customers.
2.7 Parliamentary oversight	Article 5 Article 6	The climate plan must be adopted in accordance with the views of the Council of Ministers and after it has been submitted to both chambers of the parliament. The climate and energy outlook, and the climate memorandum, which are published annually must be sent to both chambers.

3. Carbon budgeting process		The act does not specify a carbon budgeting process. However, in its assessment of the Dutch NECP, the European Commission noted that the binding target (then) of 36% for 2030 could be missed. The submitted NECP mentions the commitment to generate no debits in the land use, land use change and forestry (LULUCF) (i.e. accounted emissions should not exceed accounted removals). Several measures are considered to improve the performance of the LULUCF sectors, such as adjustments in the management of peat meadows, agricultural soils and forests, as well as planting new forests. However, both the 'with existing measures' (WEM) and 'with additional measures' (WAM) projections predict net emissions over 2021-2030.
3.1 Technical criteria		According to the European Commission's assessment of the Dutch 2019 NECP: "The Netherlands' binding 2030 non-ETS GHG emission target is -36% compared to 2005. Annual binding national limits have not been provided, but a cumulative amount has been put forward: 891 Mt CO2 equivalent. With existing policies, the final Dutch plan projects 31% emission reductions within effort sharing sectors, which would miss the 2030 target by 5 percentage points. Based on the 2019 National Energy Outlook, which is used for the projections in the plan, the Commission estimates that the non-ETS point target for 2030 will be missed unless additional measures are taken. The Netherlands indicates that it does not intend to apply the flexibility from the LULUCF sector to the effort sharing sectors.
3.2 Offshore mitigation		There is no mention of offshore mitigation in the Dutch law. However according to the 2019 Dutch NECP the country aims to achieve the ESR target domestically, as this is line with the national total GHG emissions reduction target of -49% by 2030 compared to 1990.
3.3 Aviation and shipping		The Act does not mention aviation or shipping emissions, though these are covered to a limited extent in the 2019 NECP under transport. The commitments regarding shipping and aviation do not constitute part of the agreements made by parties at the Mobility Platform of the Climate Agreement. However other processes are looking into national policies for aviation and shipping. The Climate Agreement

		(p.85) concludes: At present, consultation platforms have also been set up in our country for the shipping and aviation sectors, with ambitions, targets and actions being formulated. These are being used to prepare an ambitious approach for sectors that have a major climate impact. The shipping sector is developing an action plan within the Green Deal for Inland Shipping, Maritime Shipping and Ports aimed at realising the target of 40% fewer carbon dioxide emissions by 2030, which was adopted by the International Maritime Organization (IMO). The Sustainable Aviation platform also wishes to make an active contribution via measures that relate to emissions from domestic aviation. The platform will therefore seek alignment with the Mobility Platform in the implementation of the Climate Agreement. Schiphol airport in Amsterdam is the first airport in the world to permanently cut the number of flights from end-2023 in order to reduce noise and air pollution.
4. Public participation	Article 8	The Dutch law includes a provision on public participation, described as a 'guiding principle' and requires the Minister to consult with a variety of agencies and stakeholders. The processes laid down in the Act and in Dutch climate policy generally require a good deal of stakeholder engagement and coordination via the Polder model and the Climate Agreements, however the public at large is given little opportunity to participate by comparison with industry and NGOs. Spijkers and Oosterhuis (2020) note that the Climate Act: "[I]s to a large extent 'empty'. It only sets very generally formulated targets, but it does not say anything about how these targets are to be achieved, what specific measures need to be taken, what the financial and other consequences might be and so on… An often-heard critique is that the Climate Act contains only procedural rules on how to come to an agreement, but does not constitute an agreement itself.' The Dutch Climate Agreement (2019) was negotiated by private and public

		parties together, with over 100 parties were involved in the process. A final version of the Climate Agreement was presented on 28 June 2019, after which the parties had to confirm their commitment to the Climate Agreement with a signature. The agreement is not legally binding or enforceable. However, it provided the main planks of the government's climate policy framework alongside EU obligations and proposals for sectors not covered by the agreement.
5. Progress in meeting targets under the Act		The most recent Climate and Energy Outlook of the PBL from December 2022 shows that the Netherlands is not on track to meet its targets under the Dutch and EU climate laws. Based only on adopted and planned policies, emissions are projected for 2030 to go down by 39% to 50% from 1990 levels (Figure 1, below). This means that, to meet the 55% target, the NL still faces the additional task of reducing emissions by another 5–16 percentage points, or 12–36 megatonnes of CO_2 equivalents. The estimated emission reduction of 39% to 50% by 2030 is slightly larger than projected in the outlook 2021, which stood at 38% to 48% (with both these reduction ranges including land use). The somewhat greater reduction presented in this year's report is mainly due to higher assumed prices for energy and CO2 and various policy effects. The report found that most of the climate policy plans including the Dutch NECP lack sufficient detail, and while much progress is being made to increase the share of renewables in electricity generation, the renewable heat sector is lagging behind. Current targets for energy efficiency are not being met, and the latest revisions to the European EE Directive will require greater effort.

		Figure 1 **Greenhouse gas emissions, including land use**  Source: Pollutant Release and Transfer Register (PRTR) — historical data; Climate and Energy Outlook 2022 — projections
6. Just transition		The Dutch climate law does not refer to just transition. Studies by Milieudefensie have found that households pay a disproportionate share of the costs of energy and climate transition costs in comparison to businesses. Following a successful campaign during the negotiation of the Climate Agreement in 2018, the Agreement was amended to emphasize a more equitable distribution of costs and benefits between citizens and (large) corporations.

7. **Notable policy developments**		Under the last Mark Rutte-led government, which collapsed earlier in 2023, the Netherlands signalled its intention to increase the ambition of its existing climate goals for 2030 from a 49 percent cut below 1990 levels to "at least" a 55 percent cut, according to the coalition deal. To ensure that target is reached, parties agreed "that our policy will focus on a higher target, which will be around 60% by 2030." To become less reliant on gas imports, the life of the existing Borssele nuclear plant will be extended and two new nuclear power plants are to be constructed, as are efforts to increase the adoption of CCS. The Dutch support for CCS projects operates under a SDE++ subsidy scheme and €13 billion will be available at this year's funding announcement, a significant increase from previous years. The scheme is intended for projects developing renewable energy, hydrogen production, CCS and other industrial climate initiatives. The Dutch government had previously set a ceiling on its CCS support of 7.2 million tonnes of CO2 by 2030. This has now increased to 8.7 million tonnes of CO2. Support from SDE++ is provided as a contract for differences and is awarded according to an auction principle. The Rutte government split up the joint climate and economy ministry, creating a minister for climate and energy who will be in charge of a €35 billion Climate and Transition Fund. That money was supposed to be directed to building infrastructure for power, heat, hydrogen and CO2, as well as investments in greening industry, buildings and transport. The Dutch coalition also planned to introduce a floor price for carbon for allowances under the EU Emissions Trading System. The Dutch version will be a rising price, with "any financial gains ... returned to the climate fund for companies to make their operations more sustainable." The government also aimed for all new cars to be zero-emissions by 2030 and will increase its air ticket tax. However, following the collapse of the Rutte government in July this year, new elections are due to take place in November with a new Farmers' party BBB likely

		to take a significant share of the vote. There has been a notable backlash against environmental and climate policies in the Netherlands that are perceived to target farmers and rural livelihoods unfairly.

5.6 New Zealand

Topic	Country	Notes
8. Emissions profile	**New Zealand**	All emissions data from https://ourworldindata.org/co2/country unless otherwise stated
1.1 CO2 emissions per capita (2021)	6.59 tCO2 per capita	All fossil fuels from energy and industry exc. Agriculture and Land use.
1.2 All GHGs per capita (2019)	13.42 tCO2e	Including land use and agriculture. Note, NZ has a large agricultural sector. Annual emissions from the agricultural sector alone were 41.96 tCO2e in 2019.
1.3 Carbon intensity of energy production (2020)	0.149 kg CO2 per kW/hr	NZ has no nuclear energy and relies on a large share (over 80%) of hydropower and geothermal energy for its power generation. The IEA in its most recent energy review for NZ stated that this could 'easily' exceed 90% based on existing policies alone. NZ aims to achieve 100% RE-E by 2030, however this will only be possible if back-up generation in the form of battery storage comes on stream in time.
1.4 Historical contribution of cumulative CO2 (1750-2021)	0.11%	Land use not included
1.5 Share of renewables in electricity (2021)	81%	Out of 45 TWh of total electricity generation in New Zealand in 2021, 36 TWh (81%) came from renewable energy sources. Hydro accounted for 54% of total generation, while geothermal accounted for 19% (Source: IEA country review 2023).
1.6 Share of renewables in total energy supply (2021)	29%	In 2021, renewables provided 60% of energy demand (TFEC) in buildings, 36% in industry and 0.2% in transport. Renewable electricity covered 55% of buildings, 26% of industry and 0.14% of transport. Solid biomass provided 5% of energy in buildings and 9% in industry, and liquid biofuels had a share of 0.06% of transport energy demand. Total share of RE in TFEC was 29%, whereas the IEA average in 2020 was 13%.

1.7 Climate Action Tracker 2023 https://climateactiontracker.org/countries/new-zealand/	Overall rating: Highly insufficient Policies and action: Almost sufficient NDC target: Insufficient Climate finance: Highly insufficient	The CAT rates New Zealand's climate targets, policies and finance as "Highly insufficient". The "Highly insufficient" rating indicates that New Zealand's climate policies and commitments are not stringent enough to limit warming to 1.5°C and need substantial improvements. New Zealand's NDC target is rated "Critically insufficient" when compared with its fair share contribution to climate action and "Insufficient" when compared to modelled domestic pathways. Its policies and action do not put in on track to meet this target and its climate finance is inadequate. New Zealand should increase both its emissions reduction target and climate policies, and provide additional, predictable, finance to others to meet its fair share contribution. CAT calls out in particular the fact that while the agriculture and waste sectors have separate methane targets, there are insufficiently detailed policies in place to ensure that these targets are realised by 2030 or 2050. The CAT assessment states "The government also needs to revisit its target architecture and drop the much discredited "gross-net" approach to target setting. New Zealand is one of only a few countries in the world using this "gross net" accounting system to calculate its 2030 target." The NZ Emissions Trading Scheme continues to exempt the country's largest contributor to greenhouse gas emissions – the agriculture sector – from a price on its methane emissions until 2025, despite original promises that it would cover all sectors. Agricultural methane emission reductions are now being discussed under a proposal released in June 2022. The scheme relies strongly on industry partnerships and trust, with results "yet to be seen".
1.8 Climate Change Performance Index 2022	33rd place (up 2)	New Zealand receives a 'medium' rating for its climate performance in 2022, up two places from 2021. The assessment of NZ was critical of the adopted climate legislation which it deems is not 1.5°C-compatible (despite the commitment to the 1.5°C target) and because it lacks important details. And although agricultural sector emissions (including methane and nitrogen dioxide [NO_2]) account for 50% of New Zealand's overall GHG

		emissions, the agricultural sector is not included in the ETS and does not face adequate emissions reduction regulation. The experts welcomed the announcement of a ban on new offshore oil and gas exploration, as well as a target of 100% renewable electricity by 2035 (with already a relatively high 43% share of renewables in energy use), but they noted that coal mining and onshore oil and gas exploration remain unrestricted. They also criticise a lack of policies to incentivise deployment of new renewables, noting that the high share of renewables is due to hydroelectric power plants, which were built in the last century and which dominate the electricity sector. Additionally, the experts emphasise that electricity only makes up 4% of New Zealand's overall GHG emissions, which means that the 100% renewable electricity commitment will have a limited impact on overall emissions. To become aligned with a well-below-2°C trajectory, New Zealand "needs to include the agricultural sector in the ETS and implement policies to reduce agricultural emissions, along with banning synthetic nitrogen fertiliser."
1.9 Committed emissions from existing and new energy installations		New Zealand has no international gas connections and must be self-sufficient in terms of natural gas supply, so national consumption depends on domestic production levels. According to the IEA (2023), while New Zealand is self-sufficient in terms of gas supply at present, a steep decline in production at existing fields is expected to result in only 75 PJ of output in 2030 (although uncertainty remains as to the exact volumes). In 2018, the NZ government announced that it would no longer issue any new licences for offshore exploration. That year's block offer was limited to Taranaki offshore region only however the government argued that it was "protecting existing exploration and mining rights. No current jobs will be affected by this as we are honouring all agreements with current permit holders. There are 31 oil and gas exploration permits currently active, 22 are offshore. These permits cover an area of 100,000 km^2, nearly the size

		of the North Island, and run as far out as 2030 and could go an additional 40 years under a mining permit." NZ also has a coal mining industry and onshore oil and gas industries which are not covered by the 2018 announcement. The ban also limited new petroleum exploration and mining permits in the onshore Taranaki Region. This announcement did not impact existing rights. New Zealand is an associate member of the Beyond Oil and Gas Alliance, an international alliance of governments and stakeholders working together to facilitate the managed phase-out of oil and gas production.
2. Policy and legislation	**New Zealand**	
a. Legislation	Climate Change Response (Zero Carbon) Amendment Act 2019 Section 5Q	New Zealand adopted a climate law in 2002, amended in 2008 to establish a domestic emissions trading scheme and to set out arrangements for compliance with the Kyoto Protocol. The 2002 Climate Change Response Act (CCRA) was subsequently updated in 2019 as the Climate Change Response (Zero Carbon) Amendment Act 2019 (hereafter CCRA).The then government 2017-2020 was a Labour-Green coalition that introduced the amendments to the CCRA in 2019. The revised law commits the country to achieve net zero emissions or climate neutrality by 2050. The CCRA sets a target of achieving net zero emissions by 2050 by providing 'a framework by which NZ can develop and implement clear and stable climate change policies' that contribute to the global effort under the Paris Agreement. The Act controversially set a separate 'soft' target for biogenic methane reductions only by 2030 (see discussion below): Reductions emissions of biogenic methane in a calendar year—

		(i) are 10% less than 2017 emissions by the calendar year beginning on 1 January 2030; and (ii) are 24% to 47% less than 2017 emissions by the calendar year beginning on 1 January 2050 and for each subsequent calendar year. The CCRA establishes a system of carbon budgets modelled closely on the UK legislation and establishes a new independent Climate Change Commission to provide independent expert advice and monitoring. The separate target for biogenic methane has been widely criticised. While methane has different characteristics to long-lived GHGs such as CO2, does not mean that its impact can be ignored. Additional warming caused by methane in the short term can lead to further warming in the longer term due to positive climate feedbacks. The premise that a stable rate of emissions will not lead to increase in atmospheric concentrations is challenged by climate scientists (Rockström *et al.*, 2017). Furthermore, determining a 'fair' target for methane is not solely a question of stabilising the temperature impact of a gas by a given year: given its potency and short-lived nature, reducing methane can contribute to atmospheric cooling. Critics also note that the 'soft' target for methane leads to further problems with agriculture's impact on water quality and soil contamination (Semmelmayer, 2020, p.172). Experience with the UK's climate change act shows that all sectors and GHGs should be included in one target (Fankhauser et al., 2018). Semmelmayer concludes that 'New Zealand seems to be following the general trend that the target is following the economy' instead of vice versa *(ibid*., p.173). 'Simply attempting to "grandfather" our existing contribution to warming from methane could be seen to be self-serving', according to the NZ Parliamentary Commissioner for the Environment quoted by Taylor (in Muinzer 2020, p.214). Greenpeace New Zealand, in its 2018 submission, criticised the proposed methane measures for relying on yet-to-be-invented vaccines, and remarked as follows: 'If the Government chooses a reduce-and-stabilise

		strategy it must be noted that significant reduction in radiative forcing can be achieved by rapid and steep reduction in methane before stabilisation and this is essential to achieving Paris commitments'. The base for the 2050 target has also been criticised as 'not stringent enough' (Taylor, in Muizner, 2020, p. 212), as it emphasises net accounting emissions rather than gross emissions which may be increased, provided they are offset by removals. There is no mention of the need to go below zero by 2050. Although a net approach provides flexibility, the target should identify an intention from net emissions to a low- or zero-emissions economy. Emphasis on net accounting emissions for another 30 years (and beyond) 'potentially delays the intense transformations needed. There is a significant difference between a low- or zero-emissions economy and a net emissions economy', according to Semmelmayer (p.174). Taylor (p.212) also points out that the target is 'unfair to future generations'.
2.1 Institutions and functions	Section 5X Section 5ZG	The Minister [for climate change] has a duty to set emissions budgets and ensure they are met. Requirement for emissions reduction plan (1) The Minister must prepare and make publicly available a plan setting out the policies and strategies for meeting the next emissions budget, and may include policies and strategies for meeting emissions budgets that have been notified under section 5ZD in accordance with the dates set out in section 5X(3). (2) The plan must be prepared and published— (a) after the relevant emissions budget has been notified under section 5ZD; but (b) before the commencement of the relevant emissions budget period. (3) The plan must include— (a) sector-specific policies to reduce emissions and increase removals; and

		(b) a multi-sector strategy to meet emissions budgets and improve the ability of those sectors to adapt to the effects of climate change; and (c) a strategy to mitigate the impacts that reducing emissions and increasing removals will have on employees and employers, regions, iwi and Māori, and wider communities, including the funding for any mitigation action; and (d) any other policies or strategies that the Minister considers necessary.
	5ZO	There is a requirement for an emissions reduction plan for each budget, however no requirement on the ERP to be aligned with a specific pathway to net zero emissions by 2050. The responsible Minister may issue guidance for departments on how to take the 2050 target or an emissions budget into account in the performance of their functions, powers, and duties (or classes of those functions, powers, and duties).
2.2 Scientific advisory body	Section 5ZA	The CCRA establishes a seven-member Climate Change Commission which advises the minister on emissions budgets. However it does not have any decision-making or enforcement powers. Appointment and required member expertise is tightly prescribed by the Bill. The Commission must advise the Minister on the following matters relevant to setting an emissions budget: (a) the recommended quantity of emissions that will be permitted in each emissions budget period; and (b) the rules that will apply to measure progress towards meeting emissions budgets and the 2050 target; and (c) how the emissions budgets, and ultimately the 2050 target, may realistically be met, including by pricing and policy methods; and (d) the proportions of an emissions budget that will be met by domestic emissions reductions and domestic removals, and the amount by which emissions of each greenhouse gas should be reduced to meet the relevant emissions budget and the 2050 target; and

		(e) the appropriate limit on offshore mitigation that may be used to meet an emissions budget, and an explanation of the circumstances that justify the use of offshore mitigation (*see* section 5Z). Before the Commission provides advice to the Minister on an emissions budget, it must— (a) make the proposed advice publicly available and invite comments on that advice; and (b) allow adequate time and opportunity for any submissions to be received, heard, and considered by the Commission.
2.3 Approach to carbon budgets	Section 5ZC	The Commission and the Minister must— (a) have particular regard to how the emissions budget and 2050 target may realistically be met, including consideration of— (i) the key opportunities for emissions reductions and removals in New Zealand; and (ii) the principal risks and uncertainties associated with emissions reductions and removals; and (b) have regard to the following matters: (i) the emission and removal of greenhouse gases projected for the emissions budget period: (ii) a broad range of domestic and international scientific advice: (iii) existing technology and anticipated technological developments, including the costs and benefits of early adoption of these in New Zealand: (iv) the need for emissions budgets that are ambitious but likely to be technically and economically achievable: (v) the results of public consultation on an emissions budget: (vi) the likely impact of actions taken to achieve an emissions budget and the 2050 target, including on the ability to adapt to climate change: (vii) the distribution of those impacts across the regions and communities of New Zealand, and from generation to generation:

		(viii) economic circumstances and the likely impact of the Minister's decision on taxation, public spending, and public borrowing: (ix) the implications, or potential implications, of land-use change for communities: (x) responses to climate change taken or planned by parties to the Paris Agreement or to the Convention: (xi) New Zealand's relevant obligations under international agreements. The Act does not specifically require the budgets to be aligned with a 1.5 or 2 degree pathway consistent with the Paris Agreement goal.
2.4 Banking and borrowing	Section 5ZF	If the total emissions in an emissions budget period are lower than the emissions budget for that period, the excess reduction may be carried forward to the next emissions budget period. Borrowing must not exceed 1% of the emissions budget for the next emissions budget period. The Minister must decide whether to bank or borrow and determine the extent to which banking or borrowing is permitted.
5.6 Mechanism for review of targets	Section 5ZE	The Commission may, when providing advice and recommendations on a future emissions budget under section 5ZA, recommend that any emissions budgets notified under section 5ZD be revised if, since the emissions budgets were originally set,— (a) there have been methodological improvements to the way that emissions are measured and reported; or (b) 1 or more significant changes have affected the considerations listed in section 5ZC(2) on which an emissions budget was based. (2) At any time the 2050 target is revised, the Commission may provide advice recommending that the relevant emissions budgets be revised to reflect the change in the 2050 target. (3) An emissions budget notified under section 5ZD may be revised only if the Commission recommends the revision. *Minister's determination*

		(4) After receiving advice from the Commission, the Minister must determine whether to revise an emissions budget. (5) The Minister must— (a) take into account— (i) the Commission's advice; and (ii) the matters set out in section 5ZC(2); and (b) follow the procedure set out in sections 5ZB and 5ZD. (6) However, the Minister must not revise an emissions budget— (a) after an emissions budget period has begun, unless the circumstances are exceptional; or (b) after the end of the emissions budget period to which it relates; or (c) in any way other than that required if any of the circumstances described in subsection (1) or (2) apply. (7) If the Minister determines to revise an emissions budget, the Minister must present to the House of Representatives an explanation of the reasons for revising the original emissions budget, having regard to— (a) the matters described in subsection (1)(a) and (b); and (b) the prohibition on revising an emissions budget (*see* subsection (6)) and any exceptional circumstances that led to the Minister's decision (*see* subsection (6)(a)).
5.7 Compliance process	Section 5ZJ and 5ZK	The Commission is required to monitor progress towards meeting emissions budgets and must report annually on results of monitoring. According to Semmelmayer (2020) however, the current framework is not adequately designed to prevent policies from backsliding (Fankhauser et al., 2018). Effect of failure to meet 2050 target and emissions budgets: (1) No remedy or relief is available for failure to meet the 2050 target or an emissions budget, and the 2050 target and emissions budgets are not enforceable in a court of law, except as set out in this section. (2) If the 2050 target or an emissions budget is not met, a court may make a declaration to that effect, together with an award of costs.

			(3) If a declaration is made and becomes final after all appeals or rights of appeal expire or are disposed of, the Minister must, as soon as practicable, present to the House of Representatives a document that— **(**a) brings the declaration to the attention of the House of Representatives; and (b) contains advice on the Government's response to the declaration. Taylor (in Muinzer, 2020, p.2019) points out in relation to that section: 'A legal analysis suggests that the Bill's privative clause goes too far, potentially offending against: developing climate justice litigation; international law principles; the right to natural justice in New Zealand's Bill of Rights 1990; and constitutional principles. In general terms, the concern is that, given the urgency and existential risks of climate change, media scrutiny, political accountability and parliamentary oversight are important but not sufficient. In this respect, more consideration should be given to timely scrutiny (including through judicial processes if needed) of reductions plans,130 including their capability to meet the target and budget, *before* any failure to meet a budget occurs.' Also, the Act provides that a person or body may, but is not required to take, the 2050 target or an emissions budget into account in the exercise or performance of a public function, power or duty. Greenpeace New Zealand described the Bill as 'toothless' and 'a reasonably ambitious legislation with its teeth ripped out'. The restrictions on legal enforceability have to be read alongside this related clause which makes the targets and budgets non-mandatory.
5.8	Fair shares/ ethical consideration of target		The CCRA has been widely criticised for not including the submitted NZ NDC target of reducing GHG emissions to 30% below 2005 levels by 2030. The only 2030 target mentioned in the Act is the 10% reduction target for methane emissions against 2017 levels (Semmelmayer, 2020, p.161). Semmelmayer also criticises the 2050 target as possibly not

		compatible with international law, and he speculates 'it seems that implementing a 2030 target has been avoided as it would put a much greater burden on non-agricultural emitters of GHGs' (i*bid*., p.170). New Zealand's NDC target is rated "Critically insufficient" by the Climate Action Tracker when compared with its fair share contribution to climate action and "Insufficient" when compared to modelled domestic pathways. Its policies and action do not put in on track to meet this target and its climate finance is inadequate. According to Taylor (in Muinzer 2020, p.204), NZ took advantage of a 'uniquely low' obligation under the Kyoto Protocol's first commitment period, and elected not to make any commitment under the second commitment period (2013-2020). Its NDC commitment to reduce GHGs by 30% by 2030 is regarded as 'modest' by Taylor, and 'inadequate' by the CCPI. Taylor criticises the Bill's failure to use a global carbon budgeting approach. This requires: (a) determination of New Zealand's share of the remaining global carbon budget (for keeping within 1.5°C) using both science and equity principles; (b) alignment of New Zealand's target and budgets with both the temperature goal and keeping within New Zealand's share of the remaining global carbon budget; (c) setting a 2030 target for 50 per cent net reductions of non-methane emissions from 2010 levels (consistent with the IPCC's 2030 advice); and (d) setting a specific methane reduction target for 2050 using IPCC science for achievement of the 1.5°C goal (Taylor, p.214).
2.7 Parliamentary oversight	Section 5ZA	Budgets and plans require Cabinet approval and must be tabled before Parliament following consultation with the 'appropriate representative of each of the political parties' in the House. They are not treated as legislative instruments.
9. Carbon budgeting process		

3.1 Technical criteria	Section 5X	From 31st December 2021 there must be 3 consecutive emissions budgets, 1 current and 2 prospective, in place at any one time. Each budget must state the total emissions that will be permitted for the relevant emissions budget period, expressed as a net quantity of CO2 equivalent. Budgets must be proposed by the Commission at least 12 months before it is due to be notified under 5ZD.
3.2 Offshore mitigation	Section 5Z	(1) Emissions budgets must be met, as far as possible, through domestic emissions reductions and domestic removals. (2) However, offshore mitigation may be used if there has been a significant change of circumstance— (a) that affects the considerations on which the relevant emissions budget was based; and (b) that affects the ability to meet the relevant emissions budget domestically.
3.3 Aviation and shipping	Section 5R	The Commission must, no later than 31 December 2024, provide written advice to the Minister on whether the 2050 target should be amended to include emissions from international shipping and aviation (and, if so, how the target should be amended). The Commission invited submissions from the public up to 31st July 2023 as part of its ongoing review.
10. Public participation	5N	The Act provides for the Commission to engage in public consultation where it believes that is necessary. Various provisions require the Minister and the Commission to make plans public but there is no mandatory public consultation or participation process set out. The recently published Emission Reduction Plan (ERP) under the 2019 Act has a chapter dedicated to public engagement.

11. Progress in meeting targets under the Act		According to Prue Taylor ((Muinzer, 2020, chapter 9) New Zealanders have the fifth highest per capita emissions profile in the Organisation for Economic Co-operation and Development (OECD). New Zealand's latest official Greenhouse Gas Inventory figures show continuing increases in both gross and net emissions. Gross emissions increased by 2.2 per cent between 2016 and 2017, accounting for around 80.9 million tonnes of CO2 equivalent. This brought the increase in gross emissions from 1990 to 2017 to 23.1 per cent. Net emissions, which take into account CO2 absorbed by forestry, increased by 65 per cent compared to 1990 levels by 2017. Emissions from electricity generation and transport continue to grow significantly, as do emissions from agriculture, primarily methane from ruminant livestock and nitrous oxide. A 70 per cent increase in the dairy herd between 1994 and 2017, together with a sixfold increase in the use of nitrogen fertiliser since 1990, are behind the continuing surge in agriculture emissions. With 48.1 per cent of emissions coming from agriculture, of which around 35.2 per cent is methane, New Zealand will not achieve its ambitions unless it takes robust action to reduce methane emissions. She states: 'The political and economic power of the agricultural sector in New Zealand is a major barrier to addressing methane emissions. New Zealand's growing emissions profile is the legacy of years of domestic inaction by successive governments…' 'The emissions trading scheme (ETS) was introduced in 2008, but has not performed as expected. It aimed to cap and progressively reduce emissions of all greenhouse gases and create a market for the trade of emission permits. However, problems included the failure to include methane emissions, the absence of a reducing cap and very low market prices for carbon emissions. In addition to problems with the ETS, local government has been prevented from taking emissions into account as part of its regulatory and planning functions.'
12. Just transition	Section 5ZC	The CCRA makes a number of references to the need to consider justice issues, without using the phrase 'just transition'. Reduction and adaptation plans and risk assessments must, for example, take into account

		vulnerable groups and sectors. Distributional justice, future generational equity and other equity principles are also relevant considerations to target and budget-setting. Taylor comments that the treatment of justice issues is 'generally muddled and superficial', resulting in the omission of significant principles, including the precautionary principle, human rights and interspecies justice (p.222).
13. **Notable policy developments**		• In some of the academic literature that discusses the NZ CCRA, it is noted that strategic compromises were necessary to get the 2019 Bill over the line. Bailey et al, (2021) note that 'inherent to the CCA concept is the idea that the self-reinforcing path-dependencies created by long-term policy commitments and mechanisms means that, within reason, a flawed but agreed CCA may be preferable to something perfect that never materializes', which might help explain some of the weaknesses in the legislation. • NZ has a short, 3-year electoral cycle with Mixed-Member Proportional Representation or MMP. A general election is due to take place on the 14th of October 2023 to elect a new parliament. Climate change was somewhat eclipsed by the COVID-19 pandemic in the public debates leading up to the 2020 election. When the amendment bill was being debated, some experts questioned whether carbon budget periods should not also be the same length rather than the 5-year period set out in the Act (Semmelmayer, 2020). However it was ultimately decided to stick with 5 to facilitate policy commitment. • According to a Guardian article in March this year, the Labour Party is now rolling back on earlier climate commitments putting its coalition with the Green Party under strain. Key policies have been 'dumped or delayed' including a biofuel mandate, a car scrappage scheme and the expansion of public transport and light rail for

		Auckland. The government has extended tax cuts on petrol. 'Despite New Zealand formally announcing a climate emergency in 2020, and previous prime minister Jacinda Ardern calling the climate crisis a matter of "life or death", the country's progress on substantially reducing its emissions has been limited. Since new leader Chris Hipkins took the helm from Jacinda Ardern at the start of the year, he has angled policy relentlessly toward cost of living pressures, scrapping a wide array of reforms and legislative efforts in order to free up "bandwidth" and budgets to focus on economic concerns.' • Over half of NZ's GHGs come from the agricultural sector. Dairy cattle numbers declined slightly by 1% in 2022 to 6.1m, 8% lower than 2014 when the dairy cattle herd peaked at 6.7m. Various reports have highlighted the impact of dairying on water quality and soil in NZ. In 2019, 65% of NZ's total river length had elevated nitrogen concentration levels. Other reports have highlighted NZ's reliance on imported feed to support a growing dairy cow population which is not necessarily increasing the profitability of farms but is increasing the climate impacts of the sector. The president of Federated Farmers, Andrew Hoggard, said in 2021: "Food isn't a nice-to-have, it's a must-have, and New Zealand farmers are amongst the best in the world at producing food in a very low footprint. For New Zealand to go off on some virtue signalling crusade to shut down its agricultural sector, just to say 'Hey, we've reduced a heap of emissions' hasn't solved anything," he added. The sector is hopeful that new scientific developments, such as methane inhibitors, breeding, and using different forms of feed would continue to reduce methane emissions, Hoggard said.

5.7 Denmark

Topic	Country	Notes
14. Emissions profile	**Denmark**	All emissions data from https://ourworldindata.org/co2/country unless otherwise stated.
1.1 CO2 emissions per capita (2021)	5.05 tCO2 per capita	All fossil fuels from energy and industry exc. Land use
1.2 All GHGs per capita (2019)	7.61 tCO2e	Including land use
1.3 Carbon intensity of energy production (2021)	0.16 kg CO2 per kW/hr	
1.4 Historical contribution of cumulative CO2 (1750-2021)	0.24%	Land use not included
1.5 Share of renewables in electricity (2022)	67%	Wind energy contributes 46.8% while biomass contributes 11.2%. According to the most recent IEA country review from 2017, electricity generation in Denmark has changed fundamentally over the past two decades. Coal generation has been vastly reduced, and the bulk of power generation now comes from wind and bioenergy. Supported by a flexible domestic power system and a high level of interconnection, Denmark is now widely recognised as a global leader in integrating variable renewable energy while at the same time maintaining a highly reliable and secure electrical-power grid.
1.6 Share of renewables in total energy supply (2021)	41.38%	In a recent publication, Denmark ranked 6th out of 38 OECD member countries for supply of renewable energy. The report found that Denmark had seen the biggest increase of all countries surveyed, with supply of RE sources increasing by over 19% since 2010. In fact, the wind industry claims Denmark as its country of origin. The Danish physicist and inventor Poul La Cour invented the basic turbine technology to generate electricity. His 1903 windmill design for the village of Askov became a prototype electrical power plant that supplied electricity until 1958. Thanks to La Cour and the electricians he trained, wind supplied 3% of Danish electricity by 1918. The Danish government was the first country to bring

		in large subsidies for renewables in the 1970s including the feed-in-tariff system, which was successfully replicated in Germany. In addition, local energy cooperatives were incentivised by tax breaks to set up wind farms. By 2001, wind turbine cooperatives, representing more than 100,000 families, had installed 86% of all turbines in Denmark. The IEA review notes that the heating sector will be critical for Denmark's low-carbon ambitions. Denmark's large-scale use of combined heat and power plants with heat storage capacity and the increasing deployment of wind power offer great potential for efficient integration of heat and electricity systems. However, policies and regulations need to be aligned to realise that potential.
1.7 Climate action tracker 2022 https://climateactiontracker.org/countries/eu/		Climate Action Tracker treats all 27 EU Member States as one country for the purposes of its analysis. The CAT rates EU's climate targets, policies, and finance as "Insufficient". The "Insufficient" rating indicates that the EU's climate policies and commitments need substantial improvements to be consistent with the Paris Agreement's 1.5°C temperature limit. The EU's 2030 emissions reduction target and its policies and action are consistent with 2°C of warming when compared to modelled domestic pathways. The EU is also not meeting its fair share contributions to climate action.
1.8 Climate Change Performance Index 2022 https://ccpi.org/country/dnk/	4th (no change)	Denmark ranks 4th in this year's CCPI and is again the frontrunner. Despite its relatively strong showing, Denmark's performance remains unaligned with limiting global warming to 1.5°C. As in the previous year's CCPI, Denmark receives high ratings in the GHG Emissions, Renewable Energy, and Climate Policy categories. However, it ranks 26th in Energy Use, earning only a medium in that category. Denmark has committed to, by 2030, achieving a 70% emissions reduction compared with 1990 levels, and aims at climate neutrality by 2050. The independent Danish Council on Climate Change (DCCC), under the Danish Climate Act, is charged with assessing whether governmental policies sufficiently match

		the target. After two years with the 70% target, the DCCC concluded there has been significant progress, but the efforts are not yet sufficient to meet the target. The reduction gap from 2030 has been lowered by 10 million tonnes CO2. However, if the emissions from bioenergy are included, the gap would be larger: Emissions from biomass were (in 2020) approx. 16 million tonnes. More than half of the biomass burned was imported. The CCPI experts criticise that the government focuses too much on carbon capture and storage, with plans to spend €5 billion in support of it until 2030. Denmark adopted a new CO2 tax in June 2022. While this tax does not cover the entire economy, the CCPI experts deem it a good start. However, emissions from burning biomass in the energy sector will not be included. Denmark is a progressive player in climate policy, ranked 4th both in international and national climate policy. Partnering with Costa Rica, Denmark launched the Beyond Oil and Gas Alliance last year, aimed at moving more countries away from extracting fossil fuel. Domestically, the CCPI experts feel Denmark's climate neutrality goal should be brought forward from the current 2050 to reach neutrality by 2040. They note that Denmark is currently not on track to meeting its 2025 target of a 50% emissions reduction compared with 1990.
1.9 Committed emissions from existing and new energy installations		Denmark has sought to increase its energy self-sufficiency since the global energy crisis in 1973. Initially the focus was on the development of oil and natural gas resources in the North Sea. From 1997 to 2013, Denmark was a net exporter of energy. The Danish Ministry of Climate, Energy and Utilities expects Denmark to remain a gas exporter through 2050, when a moratorium on oil and gas exploitation will result in production ceasing.
2. Policy and legislation	Denmark	
a. Legislation	The Climate Act (2020)	The 2020 Climate Act sets a target to reduce Denmark's emissions by 70 percent in 2030 compared to 1990 and climate neutrality by 2050 at the latest. The Act sets a rolling five-year target, 10 years in advance.

		The UN accounting rules are used to calculate greenhouse gas emissions and reductions against the target. The climate council is strengthened and expanded; its funds doubled, and its independence strengthened by self-election of new chairman and members. The Act sets a series of reporting obligations on government, including an annual parliamentary examination of the government's action towards meeting the targets. Government is required to produce on the impact of its climate policy on Danish imports and consumption. Government must also produce an annual global strategy stating how the government's foreign, development and trade policies ensure Denmark's role as a global driver in international climate policy. The Act was amended in 2021 to include the emission reduction target for 2025 of 50-54%. At just 3 pages, the Act is very short.
2.1 Institutions and functions	Section 6-7 Section 8	The Minister for Climate, Energy and Utilities must annually prepare a climate status and projection, which must at least contain the following: 1) Historic greenhouse gas emissions, overall and by sector. 2) Projections of greenhouse gas emissions, overall and by sector. 3) Global report on the international effects of the Danish climate effort. The Minister must present an annual climate programme to the Danish parliament setting out status report, planned initiatives, a report on the Climate Council's recommendations, and a report on research and development and climate science. The Minister for Climate, Energy and Utilities must prepare an annual report to the Danish Parliament on the effects of the overall climate policy after the publication of the climate programme.

2.2 Scientific advisory body	Sections 3-5 Section 10 Section 9	The Danish Council on Climate Change is established to provide impartial advice on the climate effort and to assist the Minister for Climate, Energy and Utilities in setting national targets, assess progress and provide recommendations. It must comment on the annual climate status and projections and prepare reports on potential measures. The composition and organisation of the DCCC is set out in section 10. It is an independent advisory body of experts consisting of 1 chair and 8 other members. When vacancies arise the Council elects replacement candidates who are subsequently appointed by the Minister. It is supported by a secretariat of approximately 20 full-time employees with specialist expertise. However recent reports suggest that the Council's budget has been cut by over half in 2023. The Danish Meteorological Institute is the government's adviser on developments in climate science.
2.3 Approach to carbon budgets		There is no carbon budgeting mechanism set out in the Danish act. However, the DCCC included a very thorough review of different approaches to carbon budgeting and target setting in its framework report from 2019 which informed the development of the Act. The report noted that the carbon budgeting framework in the UK CCA did not work as efficiently as intended, with much of the emission reductions occurring for other reasons. It recommended the inclusion of short-term and long-term targets that are reviewed every five years.
2.4 Banking and borrowing		n/a
2.5 Mechanism for review of targets	Section 2	The targets are to be reviewed every five years, and subject to the advice of the DCCC and consistent with the principles set out under section 1.

b. Compliance process	Section 7 (3)(4)	In the climate programme, the Minister for Climate, Energy and Utilities must provide an assessment of whether it appears probable that the national climate targets mentioned in Articles 1(1) and 2(1) will be reached. (4). If it cannot be deemed probable that the national climate targets will be reached, the Minister for Climate, Energy and Utilities must in the climate programme present new initiatives with a reduction effect in the shorter term and initiatives with a reduction effect in the longer term, which together chart a path toward fulfilment of the national climate targets.
c. Fair shares/ ethical consideration of target	Section 1.(2) and (3)	The Act includes a number of 'guiding principles' noting that while climate change is a global problem, Denmark has both a 'historical and moral responsibility to take the lead'. It specifies that Denmark must actively work for the realisation of the Paris Agreement target of limiting the global temperature rise to 1.5 degrees Celsius. According to the Climate Analytics 1.5 report, a fair share analysis, based on the Climate Action Tracker methodology, shows that Denmark's target of reducing its emissions by 73% below 1990 levels (applied here to emissions excluding LULUCF from the reference year's baseline in the absence of a specific target for the LULUCF sector) by 2030 would result in warming between 2 and 3°C (with a 66% probability) by 2100 if all countries were to set targets of an equivalent fair share level of mitigation ambition. If all countries were to achieve emissions reductions of similar ambition to Denmark's projected emissions reductions by 2030 (based on the latest EEA projections), this would result in warming between 2 and 3°C (with a 66% probability) by 2100. According to the analysis, Denmark needs to achieve emissions reductions globally equivalent to at least 114% below 1990 levels (excluding LULUCF emissions) by 2030 to achieve a level of ambition consistent with the Long Term Temperature Goal of the Paris Agreement. This fair share target can be achieved through a

		combination of domestic emissions reductions and funding or support for climate action in developing countries.
2.7 Parliamentary oversight	Section 7-8	The Minister must present an annual climate programme to the Danish Parliament to include a status report on fulfilment of the national climate targets, planned initiatives and measures, and a report on the DCCC's recommendations. The Minister must also prepare an annual report to the Parliament on the effects of the overall climate policy after the publication of the programme.
3. Carbon budgeting process		There is no carbon budgeting process set down in the Act, however in practice Danish climate policy is working from the targets for 2025, 2030 and 2050 to guide emission reduction targets. The Act stipulates that interim targets are to be set every 5 years and 10 years in advance.
3.1 Technical criteria		The 70% emission reduction target includes LULUCF emissions but does not specify the amount of LULUCF and non-LULUCF emissions separately.
3.2 Offshore mitigation	Section 1.(4)	The Act stipulates that the initiatives to be taken to reduce greenhouse gas emissions must result in 'real domestic reductions', but it must also be ensured that Danish measures do not simply relocate all of the greenhouse gas emissions outside of Denmark's borders. Research published by the IMF suggests that small open economies such as Denmark are more vulnerable to carbon leakage and it recommends that pricing carbon is undertaken carefully for this reason. However there is no specific ban on offshore mitigation per se in the Act or in the climate strategy but there is a clear intention to achieve the 2030 and 2050 targets domestically as envisaged by the DCCC in its 2019 report on a framework for Danish climate policy. The Danish ministry for Foreign Affairs has a global climate action strategy.

3.3 Aviation and shipping		Aviation and shipping are not mentioned in the Climate Act and according to Tvarno (2021) the preparatory work by the DCCC does not envisage the inclusion of emissions from international shipping and aviation. However the government has established 14 'climate partnerships' including one for the aviation sector. The website for this partnership states that the key objectives for the Danish aviation sector in reducing CO2e emissions are: • Minimum 70 per cent CO2e reduction on domestic air travel by 2030 compared to 1990 levels • Minimum 30 per cent CO2e reduction on international air travel by 2030 compared to 2017 • Ultimately: to achieve climate neutrality by 2050 It appears as though the main mechanism aside from reducing domestic air travel will be sustainable aviation fuels. For the shipping sector, the transition to a more sustainable shipping industry is regarded as a 'massive challenge'. Blue Denmark has set two targets: climate neutrality by 2050 without the use of offsets. The first ocean-going zero emission vessel must be in commercial operation by 2030. The partnership has developed 6 initiatives and has made 15 recommendations to government.
4. Public participation	Section 12	Public participation and consensus building are key features of Danish climate policymaking. In addition to the multi-stakeholder sectoral Climate Partnerships, the Act provides for the DCCC to establish a dialogue forum to assist the Council with its work. The Minister for Climate, Energy and Utilities must set detailed rules on which organisations and institutions nominate members of the forum.

5. Progress in meeting targets under the Act		In its most recent 2023 status report, the DCCC commends the government for outlining a strategy for how to meet the 70 percent target, but, overall, the Council assesses that the government has not yet demonstrated that the targets are likely to be met. This is mainly due to a significant risk that several of the elements in the government's strategy will not deliver the expected reductions in greenhouse gas emissions. The Council also finds that even if national targets are met, this will not necessarily mean that Denmark will fulfil its new EU obligations. Most likely, Denmark will need to do more in the transport, agricultural and household sectors to also meet these obligations. Finally, the DCCC recommends that the coming year's climate policy should focus on implementation of already agreed policies and measures and on addressing emissions from the agricultural sector.

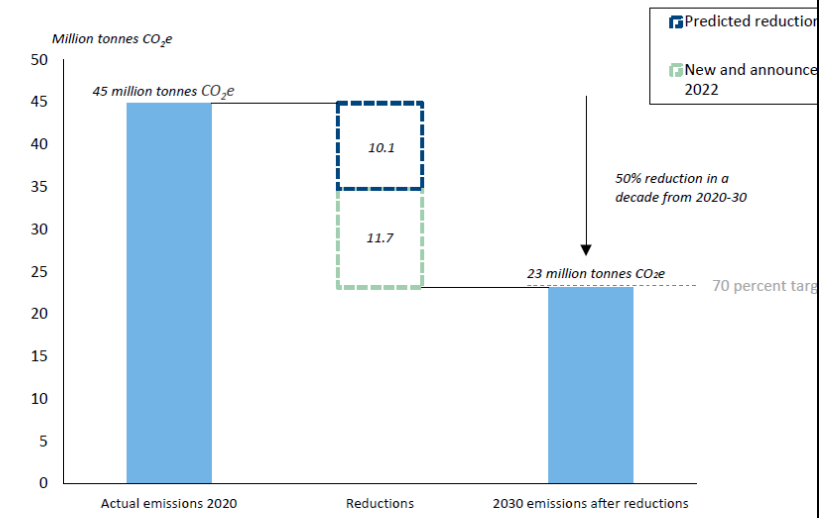


Figure 1 The pathway to 70 percent reduction in 2030

Note: 'Predicted reductions' correspond to previous years' climate policies in combination with the general market de 'New and announced policies 2022' correspond to the policies and measures that were agreed in 2022 and tho the stage of a proposal or a strategy.

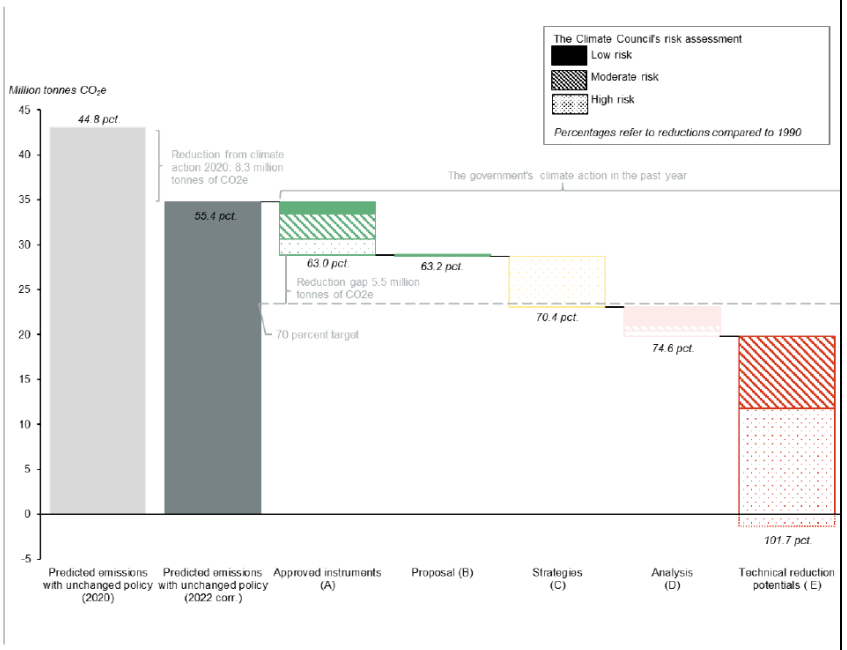
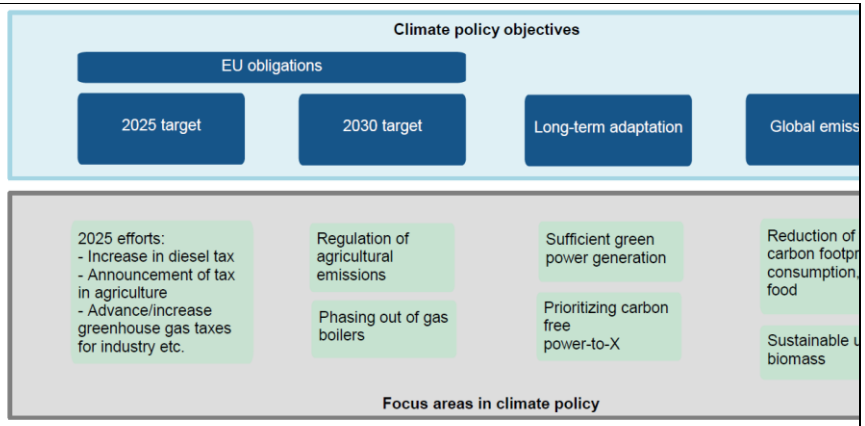


Figure 2 Assessment of the government's initiatives with respect to reduction effect, concreteness and risk in 2030

According to the Status report, when the Climate Act was adopted in 2020, the Danish Energy Agency estimated that, without new policies and measures, Denmark would emit approximately 43 million tonnes of CO2e in 2030. This corresponded to a reduction of 44.8 percent compared to 1990 and left a reduction gap of 20 million tonnes to the 70 percent target for 2030. In its 2022 outlook, the Danish Energy Agency projects that this reduction gap will be reduced by 8.3 million tonnes due to policies approved since 2020. Even though the projected 2030 emissions have decreased considerably, there is still a reduction gap of around 11.4 million tonnes CO2e after adjustments by the DCCC. New

		policies and measures agreed in 2022 reduce the gap by 5.9 million tonnes, leaving a remaining gap to 70 percent of 5.5 million tonnes. This gap is closed through the government's suggested climate policy for the agricultural sector from December 2022, so in terms of concrete climate policy, the government has outlined policy to reach the 70 percent target. However the Council warns of several risks: it notes that a proposed tax of €100 per tonne on agricultural emissions might affect the competitiveness of the agricultural sector and that a CO2 tax on industrial emissions might not be effective. It warns that the government is relying heavily on CCS to meet its 70% target, however the technology is still not proven at scale in Denmark and 'there are many unsolved practical and regulatory issues'. In terms of its obligations under EU climate directives, Denmark is expected to over-comply with the LULUCF obligations between 2021-5 and intends to use a surplus of 2.9m tonnes to comply with its obligations under the Burden Sharing Agreement (non-ETS emissions). Furthermore, the Danish government has decided to cancel 4m CO2 allowances to avail of flexibilities to meet its targets. Even so, the DCCC estimates an accumulated gap of approx. 18m tonnes over the period 2021-30. The Council concludes: 'Measures that could help close the gap include advancing reductions in agriculture, higher taxes on diesel or cancellation of additional EU allowances. However, it must be noted that using allowances comes at a cost, as the government foregoes the revenue it could have obtained by auctioning the allowances. In addition, cancelling EU allowances does not contribute to Denmark's long-term transformation towards climate neutrality.' The Council recommends a renewed focus on rewetting peatlands, increasing wind and solar capacity and implementing CCS in practice.

		 Figure 5. Important focus areas for Danish climate policy in the coming year Note: The policies and measures are placed under the targets that they primarily address. This does not mean that th also have an effect on other targets.
6. Just transition	Section 1	Section 1.(3) of the Act states that Denmark must show that a green transition is possible while maintaining a strong welfare society, where cohesion and social balance are secured. Denmark is the world's largest oil producer to commit to ending oil and gas extraction. In December 2020, a broad majority of parliamentary parties passed a binding law for climate-neutrality by 2050, and the planned phase out of its oil and gas sector is central to meeting these commitments. With more than 55 platforms in 19 oil and gas fields in the North Sea, Denmark has cancelled all future oil and gas extraction tender rounds. Denmark is committed to helping workers transition to new and well-paying jobs and supporting those regions and communities that are most impacted.

		According to the Climate Institute of Canda, at the international level, Denmark, together with Costa Rica, launched the Beyond Oil & Gas Alliance (BOGA) in 2021, for which signatory governments set an end date for their oil and gas exploration and extraction. To date, Denmark is the only country with a large oil and gas sector to make such clear phase-out commitments across its entire economy. There has been an effective dialogue between Danish employers, unions, and government since the 1970s on industrial and climate policy and transitioning the power sector from coal to wind. While oil and gas remain important to the Danish economy, over the past 20 years, crude oil production has declined by 41 per cent and natural gas by 57 per cent, while renewable energy production has increased by around 300 per cent. An estimated 10,000 people are directly employed in oil and gas extraction with another 16,000 indirect jobs, representing around one per cent of total Danish employment, largely located in the Esbjerg region. As part of the Danish climate effort, the government has established 14 climate partnerships with the business community and, in 2019, established a Green Business Forum. Their purpose is to strengthen the dialogue between the government, business, and the trade union movement on opportunities and barriers in the green transition of business. Danish companies are world leaders in offshore wind, and the wind turbine industry employs more than 31,000 people in Denmark. However, as Tamara Krawchenko notes in a blog post for the Canadian Climate Institute, in contrast to other countries with such initiatives, the use of the term “just transition” is far less prevalent in public sector reporting and there is no formal just transition process to monitor and report back on implementation. The reports of the Climate Council do not specifically address aspects of justice in the transition.

7. **Notable policy developments**		The 2025 target is only a few years away and there is currently an outstanding reduction gap to even reach the target's lower limit of 50 percent reduction. The Danish CCC recommended that Parliament should as soon as possible adopt measures that can close the gap. The measures may include, for example, a higher tax on diesel. • **Regulation of agricultural emissions.** In 2021, the Danish Parliament agreed on an emissions reduction target for the agricultural sector of 55-65 percent in 2030 compared to 1990. This corresponds to a reduction of 5-7 million tonnes from the currently projected level of emissions in 2030. If this target is met, it is likely that the 2030 target will also be met, but concrete regulation of agricultural emissions is still lacking. The DCCC recommends that a regulation of agricultural emissions be adopted as soon as possible. A uniform tax on greenhouse gas emissions should form the cornerstone of this regulation. • **Phasing out of gas boilers.** A decision has been made in Denmark to phase out gas for space heating. This transition must proceed rapidly, while at the same time the chosen solutions must work in the long term. This requires, among other things, that a number of barriers in connection with the transition are taken care of. • **Sufficient green power generation.** The green transition implies a sharply increasing demand for electricity. This requires an extensive expansion of wind and solar energy, including the necessary expansion of the electricity grid and a focus on ensuring the security of electricity supply. • **Prioritising carbon-free power-to-X.** There are plans for a significant expansion of power-to-X in Denmark. However, some e-fuels contain carbon, which is a scarce resource. Therefore, priority should be given to e-fuels that are carbon free, and when using carbon to produce e-fuels, it should be carefully considered if alternatives exist.

		• **Carbon footprint from consumption, including food**. Denmark has a large carbon footprint from consumption. The DCCC argues that a benchmark for Denmark's consumption-based carbon footprint could help to guide efforts to reduce this footprint. In particular, Danes have a high carbon footprint from their diet. This is not sustainable from a climate point of view, and there is a need to adjust consumption towards a more climate-friendly diet. • **Sustainable use of biomass.** Denmark's use of biomass for energy production is high and significantly higher than a globally sustainable per capita use. Seventy-three percent of Denmark's renewable energy consumption comes from bioenergy. Furthermore, Denmark imports a large share of its biomass for energy production from other countries. Biomass is a scarce resource and not, in general, carbon neutral. An overall long-term strategy should therefore be drawn up to reduce Denmark's consumption of biomass. At the same time, incentives should be changed to promote additional carbon uptake in forests and reduce carbon emissions from the incineration of biomass. Other useful points to note: • Denmark is planning the first offshore wind farms in Europe without subsidies and it is expected to be the cheapest energy source in Europe—surpassed only by onshore wind power. An influential 2015 assessment of Denmark's potential to meet 100 per cent of its renewable energy needs by 2050, estimates an additional 50,000 additional jobs per year will be created by 2050 (Lund and Mathiesen, 2009; Mathiesen *et al.*, 2015). • Nash and Steurer (2022) note that the passage of the 2020 Act had been driven by an exceptionally strong and vocal civil society campaign which used a citizens' petition to get the

		Parliament to agree to update the 2014 Act. During the 2019 parliamentary elections the climate crisis was one of the most important issues for voters and becoming a central issue in the election campaign with parties competing over their degree of support for the new law. All parties standing in that election had net zero targets, ranging from 2050 to 2045 and even 2040. • In the 2022 parliamentary election, the outgoing Government party of the Social Democrats secured the largest share of the vote. The new Danish government announced more ambitious climate change targets, proposing to reach net zero by 2045 instead of 2050, and cutting greenhouse gas emissions more steeply.

5.8 The EU

Topic	Country	Notes
Emissions profile	**EU-27**	All emissions data from https://ourworldindata.org/co2/country unless otherwise stated
1.1 CO2 emissions per capita (2019)	6.8 tCO2 per capita	All fossil fuels from energy and industry exc. Land use
1.2 All GHGs per capita (2019)	7.7 tCO2e	Including land use
1.3 Carbon intensity of energy production (2021)	0.296 kg CO2 per kW/hr	As this is an average across 27 member states, it is not a particularly useful indicator. The GHG intensity of electricity generation across the EU-27 was estimated by the EEA to be 0.25 kg Co2 per kW/h in 2023.
1.4 Historical contribution of cumulative CO2 (1750-2021)	22%	Land use not included
1.5 Share of renewables in electricity (2021)	37.5%	According to Eurostat.
1.6 Share of renewables in total energy supply (2021)	21.8%	This figure is down from 22.1% in 2020 according to Eurostat. The figure ranges from 62.6% for Sweden to just 11.7% for Luxembourg. The share of RE more than doubled between 2004 and 2021, and transport counts for a 9.1% of RE.
1.7 Climate action tracker 2022 https://climateactiontracker.org/countries/eu/		Climate Action Tracker treats all 27 EU Member States as one country for the purposes of its analysis. The CAT rates EU's climate targets, policies, and finance as "Insufficient". The "Insufficient" rating indicates that the EU's climate policies and commitments need substantial improvements to be consistent with the Paris Agreement's 1.5°C temperature limit. The EU's 2030 emissions reduction target and its policies and action are consistent with 2°C of warming when compared to modelled domestic pathways. The EU is also not meeting its fair share contributions to climate action.

1.8 Climate Change Performance Index 2022 https://ccpi.org/country/eu/	19 (up 3)	The EU is updating its 2030 climate and energy policy framework considering its Nationally Determined Contributions (NDCs) to reach a 55% net emissions reduction by 2030 and climate neutrality by 2050. Negotiations between European Council and European Parliament are underway within the "Fit For 55 package" and are expected to conclude in 2023. The CCPI experts noted that foreseen ambition levels remain inconsistent with the 1.5°C goal of the Paris Agreement. Also, to contribute a fair share to achieving the Paris Agreement objectives, the EU should cut emissions by at least 65% by 2030 and become climate-neutral by 2040. During the recent energy crisis resulting from factors such as drastically reducing Russian natural gas imports because of the invasion of Ukraine, the EU has looked inter alia towards Africa and other areas for securing new fossil gas supplies and developing new gas/hydrogen infrastructure (pipelines, LNG). The CCPI experts highlight that the EU's diversification strategy towards new gas supplies and infrastructure should by no means be financed by public funding sources in order to not lock in additional emissions for decades to come. Such sources need to be channelled only to deployment of renewable energy and energy savings. The experts demand that the EU ensure that current emergency measures and diversification strategy do not hamper the long-term decarbonisation targets.
1.9 Committed emissions from existing and new energy installations		A 2010 study by Davis *et al* (2010) found that infrastructure in Europe (presumably EU-28 – it's not clear whether Switzerland and Russia were included) represented 74GtCO2 or 15% of the then global emissions commitment. McGlade and Ekins (2015) found that even with CCS in the mix, Europe had 20% of unburnable oil reserves under a 2 degree scenario, 11% of gas reserves, 78% coal, and even higher figures in scenarios without CCS. A more recent assessment by Tong et al (2019) found that more than half of these committed emissions are predicted to come from the electricity sector; infrastructure in China, the USA and the 28 member states of the European Union represents approximately 41 per cent, 9 per cent and

		7 per cent of the total, respectively. Figure b. in the Tong paper estimates that EU28 committed emissions at 49GtCO2 yr^{-1} . However as European coal plants are generally older at 32.8 years, they have shorter remaining lifetimes than newer plants built in China. The EU will push for a global pledge at COP28 this November to phase out unabated fossil fuels "well ahead of 2050". The commitment would mean stopping coal power and eliminating emissions from the oil and gas sector, but with only a minimal role for carbon capture, according to EU Climate Chief Frans Timmermans. Speaking at the gathering, attended by Cop28 chief Sultan Al Jaber, Timmermans said the EU wants governments to sign up to a pledge with three main elements: tripling renewables rollout by 2030, better energy efficiency, and an accelerated phase-out of fossil fuels with a "residual" role for carbon abating technologies.
2. Policy and legislation		
d. Legislation	The European Climate Law 2021	The European Climate Law adopted in 2021 writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate-neutral by 2050. The law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. Climate neutrality by 2050 means achieving net zero greenhouse gas emissions for EU countries as a whole, mainly by cutting emissions, investing in green technologies and protecting the natural environment. The European Climate Law sets a legally binding target of **net zero greenhouse gas emissions by 2050**. The EU Institutions and the Member States are bound to take the necessary measures at EU and national level to meet the target, taking into account the importance of promoting fairness and solidarity among Member States. The Climate Law includes **measures to keep track of progress and adjust our actions accordingly**, based on existing systems such as the governance process for Member States' national energy and climate

		plans, regular reports by the European Environment Agency, and the latest scientific evidence on climate change and its impacts. The Climate Law includes: • a legal objective for the Union to reach climate neutrality by 2050 • an ambitious 2030 climate target of at least 55% reduction of net emissions of greenhouse gases as compared to 1990, with clarity on the contribution of emission reductions and removals • recognition of the need to enhance the EU's carbon sink through a more ambitious LULUCF regulation, for which the Commission made a proposal in July 2021 • a process for setting a 2040 climate target, taking into account an indicative greenhouse gas budget for 2030-2050 to be published by the Commission • a commitment to negative emissions after 2050 • the establishment of European Scientific Advisory Board on Climate Change, that will provide independent scientific advice • stronger provisions on adaptation to climate change • strong coherence across Union policies with the climate neutrality objective • a commitment to engage with sectors to prepare sector-specific roadmaps charting the path to climate neutrality in different areas of the economy
2.1 Institutions and functions		The EU has long-established institutions and law-making procedures in the field of climate action. See https://www.consilium.europa.eu/en/policies/climate-change.

	Art. 4	Article 2 makes it clear that the goal of climate neutrality by 2050 is to be achieved collectively: The relevant Union institutions and the Member States shall take the necessary measures at Union and national level, respectively, to enable the collective achievement of the climate-neutrality objective set out in paragraph 1, taking into account the importance of promoting both fairness and solidarity among Member States and cost-effectiveness in achieving this objective. The law requires the Commission to review relevant EU legislation in order to ensure that the target of climate neutrality is achieved. This process became known as 'Fit for 55' and has involved the revision of most of the EU climate and energy directives including those relating to the EU ETS, the Energy Efficiency Directive, the Energy Performance in Buildings Directive and the Renewable Energy Directive, LULUCF as well as the Effort Sharing Regulation for non-ETS emissions.
2.2 Scientific advisory body	Art. 3	The law establishes the European Scientific Advisory Board on Climate Change which shall 'serve as a point of reference for the Union on scientific knowledge relating to climate change'. Tasks of the board include: (a)considering the latest scientific findings of the IPCC reports and scientific climate data, in particular with regard to information relevant to the Union; (b)providing scientific advice and issuing reports on existing and proposed Union measures, climate targets and indicative greenhouse gas budgets, and their coherence with the objectives of this Regulation and the Union's international commitments under the Paris Agreement; (c)contributing to the exchange of independent scientific knowledge in the field of modelling, monitoring, promising research and innovation which contribute to reducing emissions or increasing removals; (d)identifying actions and opportunities needed to successfully achieve the Union climate targets;

		(e)raising awareness on climate change and its impacts, as well as stimulating dialogue and cooperation between scientific bodies within the Union, complementing existing work and efforts. In June 2023 the Board published its scientific advice for the determination of an EU-wide 2040 target.
2.3 Approach to carbon budgets	Art. 2 Art. 4 para 4	Union-wide greenhouse gas emissions and removals regulated in Union law shall be balanced within the Union at the latest by 2050, thus reducing emissions to net zero by that date, and the Union shall aim to achieve negative emissions thereafter. The law refers to the need to follow IPCC science and accounting. In its June 2023 advice to the EU the ESAB recommends keeping the EU's greenhouse gas emissions budget within a limit of 11 to 14 Gt CO2e between 2030 and 2050. Staying within this budget requires emission reductions of 90–95% by 2040, relative to 1990. This range considers multiple dimensions of fairness and feasibility of the emission reductions. The target and budget figures in the headline refer to net domestic greenhouse gas emissions, including emissions from intra-EU aviation and maritime transport. When making its legislative proposal for the Union 2040 climate target as referred to in paragraph 3, the Commission shall, at the same time, publish in a separate report the projected indicative Union greenhouse gas budget for the 2030-2050 period, defined as the indicative total volume of net greenhouse gas emissions (expressed as CO2 equivalent and providing separate information on emissions and removals) that are expected to be emitted in that period without putting at risk the Union's commitments under the Paris Agreement. The projected indicative Union greenhouse gas budget shall be based on the best available science, take into account the advice of the Advisory Board as well as, where adopted, the relevant Union legislation implementing the Union 2030 climate target. The Commission

		shall also publish the methodology underlying the projected indicative Union greenhouse gas budget.
2.4 Banking and borrowing		There is no provision for banking and borrowing between budget periods (which have not been set yet) however EU climate targets have traditionally used flexibilities in the interest of 'fairness and solidarity' between and within Member States. These flexibilities include, for example, statistical transfers between MS's, cancellation of ETS allowances and use of LULUCF credits. The approach is described by Torney and O' Gorman (2020) as striking a balance between adaptability and certainty in carbon emissions reduction.
5.7 Mechanism for review of targets	Art. 4 para 7 Art. 6 Art. 11	The provisions of article 4 are to be kept under review in light of international developments and efforts undertaken to achieve the long-term objectives of the Paris Agreement. Article 6 sets out a review process commencing by September 2023 and every five years thereafter of the consistency of Union measures with the climate neutrality objective and adaption. Within six months of each global stocktake referred to in Article 14 of the Paris Agreement, the Commission shall submit a report to the European Parliament and to the Council, together with the conclusions of the assessments referred to in Articles 6 and 7 of this Regulation, on the operation of this Regulation, taking into account: (a)the best available and most recent scientific evidence, including the latest reports of the IPCC and the Advisory Board; (b)international developments and efforts undertaken to achieve the long-term objectives of the Paris Agreement.

		The Commission's report may be accompanied, where appropriate, by legislative proposals to amend this Regulation.
5.8 Compliance process	Art. 6	Where the Commission finds that measures are inconsistent with the climate neutrality objective it shall take the necessary measures in accordance with the Treaties.
	Art. 7	The Commission must carry out an assessment of national measures by September 2023 and every five years thereafter. Where the Commission finds, after due consideration of the collective progress assessed in accordance with Article 6(1), that a Member State's measures are inconsistent with the climate-neutrality objective set out in Article 2(1) or inconsistent with ensuring progress on adaptation as referred to in Article 5, it may issue recommendations to that Member State. The Commission shall make such recommendations publicly available.
	Art. 6 para 4	The Commission shall assess the consistency of any draft measure or legislative proposal, including budgetary proposals, with the climate-neutrality objective set out in Article 2(1) and the Union 2030 and 2040 climate targets before adoption, and include that assessment in any impact assessment accompanying these measures or proposals, and make the result of that assessment publicly available at the time of adoption. The Commission shall also assess whether those draft measures or legislative proposals, including budgetary proposals, are consistent with ensuring progress on adaptation as referred to in Article 5. When making its draft measures and legislative proposals, the Commission shall endeavour to align them with the objectives of this Regulation. In any case of non-alignment, the Commission shall provide the reasons as part of the consistency assessment referred to in this paragraph.

5.9 Fair shares/ ethical consideration of target		With the adoption of the European Climate Law in 2021, the EU made a legal commitment to achieve the goal of reducing its emissions to net zero by 2050 at the latest and aiming to achieve negative emissions thereafter, in pursuit of the long-term temperature goal set out in the Paris Agreement. The law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 emission levels. The ESAB considered the issue of the EU's 'fair share' in its report on the 2040 target: 'The most ambitious category of pathways assessed by the IPCC are consistent with an at least 50% chance of limiting warming to 1.5°C by the end of the century (with no or limited overshoot). The remaining global carbon budget, consistent with limiting warming 1.5°C, is between 300 Gt CO2 (83% chance) and 500 Gt CO2 (50% chance) from the start of 2020 (± 220 Gt CO2, depending on the changes in emissions of other greenhouse gases, such as methane and nitrous oxide emissions from agriculture). Estimating the EU's fair share of this remaining budget has legal, ethical and practical dimensions. Dividing a 500 Gt CO2 budget according to different approaches to equity shows that, from the start of 2020, the EU's share of the budget based on an equal per capita allocation of emissions would amount to 20-25 Gt CO2. Dividing the same budget using approaches informed by other ethical principles (such as ability to pay or historical emissions) produces estimates of the EU share, which in some cases suggest that the EU has already used its fair share of the global carbon budget. The Advisory Board collected and analysed over 1,000 EU emission pathways, and identified among them 36 scenarios that: • are consistent with limiting global warming to 1.5°C with no or limited overshoot; • are consistent with the EU's emission reduction objectives for 2030 and 2050;

		• did not display characteristics exceeding one or more thresholds that would raise geophysical or sociocultural feasibility concerns, such as geological storage capacity or the rate of decline in final energy demand. The Advisory Board further assessed these scenarios in terms of associated environmental risks (in relation to a high reliance on carbon capture, utilisation and storage (CCUS), carbon removals from land or bioenergy) and the challenges of short-term technological scale-up (for solar, wind and hydrogen energy). The analysis found that reductions in EU domestic emissions of at least 88% and up to 92% can be achieved, taking environmental risks and technology scale-up challenges into account. These correspond to an EU greenhouse gas budget of 16–14 Gt CO2 equivalents (CO2e) for 2030-2050. It also found that reductions of up to 95% can be achieved without exceeding any of the environmental risk levels identified, if technological scale-up challenges can be overcome, in particular related to the rapid scale-up of renewable energy. Such reductions could further reduce the 2030-2050 greenhouse gas budget to 11 Gt CO2e. As the most ambitious reductions result in cumulative emissions that are higher than the most lenient equity-based fair share estimate (based on equal global per capita emissions), the Advisory Board considers that the EU should be looking to address this shortfall as part of its commitment to the Paris Agreement temperature goal. Taking fairness into account, the Advisory Board therefore considers that the minimum reduction for 2040 should be 90% below 1990 levels, with a corresponding greenhouse gas budget under 14 Gt CO2e for 2030-2050. Consequently, the Advisory Board recommends a 2040 target of a reduction in emissions in the range of 90–95% compared to 1990, corresponding to a budget of 11–14 Gt CO2e in 2030-2050.' (p.14-5)
2.7 Parliamentary oversight		The European Parliament has a formal role in the EU legislative process. Together with the Council and the European Commission it passes EU laws,

		and decides on international agreements including reviewing the Commission's legislative work programme. It conducts scrutiny of all EU institutions and regularly conducts hearings into climate and energy policies.
8. Carbon budgeting process		
3.1 Technical criteria		The EU follows IPCC accounting guidelines to report on greenhouse gas emissions and removals by sinks.
3.2 Offshore mitigation		There is no mention of offshore mitigation in the Law. However recital para.22 states: Carbon sinks play an essential role in the transition to climate neutrality in the Union, and in particular the agriculture, forestry and land use sectors make an important contribution in that context. As announced in its communication of 20 May 2020 entitled 'A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system', the Commission will promote a new green business model to reward land managers for greenhouse gas emission reductions and carbon removals in the upcoming carbon farming initiative. Furthermore, in its communication of 11 March 2020 entitled 'A new Circular Economy Action Plan for a cleaner and more competitive Europe', the Commission has committed itself to developing a regulatory framework for certification of carbon removals based on robust and transparent carbon accounting to monitor and verify the authenticity of carbon removals, while ensuring that there are no negative impacts on the environment, in particular biodiversity, on public health or on social or economic objectives.
3.3 Aviation and shipping		The climate law makes no reference to international bunker fuels or aviation/ shipping emissions. However all intra-EU flights are required to monitor report and verify their emissions and surrender allowances under the EU ETS to cover those emissions. All EU countries joined CORSIA which is the Carbon Offsetting and Reduction Scheme for International Aviation which

		addresses emissions from international aviation. As regards shipping, the EU participates in the IMO and has recently decided to include CO2 emissions from all large ships in the ETS from January 2024. The EU has also adopted a new FuelEU maritime Regulation to boost the demand for marine renewable and low-carbon fuels, by setting a maximum limit on the greenhouse gas content of energy used by ships calling at European ports and by encouraging zero-emission technology at berth (where ships stay in ports), with a technology-neutral approach.
9. Public participation	Art. 9	The law has a section on public participation and includes in para.38 of the recital: As citizens and communities have a powerful role to play in driving the transformation towards climate neutrality forward, strong public and social engagement on climate action should be both encouraged and facilitated at all levels, including at national, regional and local level in an inclusive and accessible process. The Commission should therefore engage with all parts of society, including stakeholders representing different sectors of the economy, to enable and empower them to take action towards a climate-neutral and climate-resilient society, including through the European Climate Pact. 1.The Commission shall engage with all parts of society to enable and empower them to take action towards a just and socially fair transition to a climate-neutral and climate-resilient society. The Commission shall facilitate an inclusive and accessible process at all levels, including at national, regional and local level and with social partners, academia, the business community, citizens and civil society, for the exchange of best practice and to identify actions to contribute to the achievement of the objectives of this Regulation. The Commission may also draw on the public consultations and on the multilevel climate and energy dialogues as set up by Member States in accordance with Articles 10 and 11 of Regulation (EU) 2018/1999.

		2.The Commission shall use all appropriate instruments, including the European Climate Pact, to engage citizens, social partners and stakeholders, and foster dialogue and the diffusion of science-based information about climate change and its social and gender equality aspects.
10. Progress in meeting targets under the Act		The ESAB is due to conduct an assessment by September 2023 on progress to date.
11. Just transition		The Just Transition Fund is a new instrument of the EU's cohesion policy 2021-27. While just transition does not get a specific mention in the EU climate law, there are many references to the need for fairness and solidarity across and within Member States, in light of their economic capability, national circumstances and the need to make the transition just and socially fair through appropriate education and training programmes.
12. **Notable policy developments**		The next European Parliament elections will be held in June 2024, with a new Commission appointed shortly afterwards.

6. Conclusions and lessons learned

Ireland's climate law and the carbon budgeting framework recommended by the Climate Change Advisory Council rank highly among countries with robust climate laws that include science-based targets, accountability mechanisms in the policy cycle and opportunities for public participation. This conclusion is supported by a comparative study carried out by Torney (2022) which assessed whether and to what extent Ireland's new climate law delivers eight core components that have been identified in international comparative research as key features of national framework climate laws.

In respect of all eight elements, Dr Torney's research found that the 2021 Act strengthens Ireland's existing legislative framework for climate action, noting that the original 2015 Act was rather weak to begin with, in that it lacked quantitative targets for emission reductions. When benchmarked against international best practice, Torney's assessment of Ireland's amended climate law is favourable overall. In respect of many of the core design elements selected by Torney (2022), the 2021 revisions place Ireland broadly in the realm of international best practice. The key challenge that Ireland faces, though by no means alone, is in the realm of policy implementation and in devising detailed sectoral mitigation strategies that have the buy-in of all stakeholders. In addition, the prospect of 'overshoot' means that radical interventions will be required in the energy system to curtail demand growth and across the land use sector to enhance sinks and limit emissions, which in turn requires more focused political debate and public engagement.

However, a number of important lessons can be learned from studying other countries included in this report.

1. A 'no backsliding' principle should be enshrined in any future revision to the 2021 Climate Act to ensure that no carbon budget programme can be less ambitious than the previous one, and that overshoot of a carbon budget triggers an emergency process to revise the Climate Action Plan midstream.
2. Carbon budgets should make explicit provision for, or exclude, assumptions about negative emissions technologies and set absolute limits on offshore mitigation.
3. Modelling assumptions that contribute to the making of a carbon budget for any sector should incorporate climate risks, projected damages under various scenarios and positive climate feedbacks.
4. Methane emissions should continue to be reported as CO2e in sectoral targets and carbon budgets.

5. Aviation and shipping emissions should be reported transparently and mitigation strategies for these sectors included in the annual Climate Action Plan. Non-territorial emissions should be reported on an annual basis by the EPA or the Council.
6. The Council should in its carbon budgeting process and/or in its annual review consider how to include the question of fossil fuel lock-in or committed emissions as a result of new fossil fuel infrastructure such as pipelines, connections, LNG storage or gas fired power plants.
7. The Council should consider taking a more active role in climate communications and climate literacy programmes, and make recommendations to government on incorporating carbon budgets into existing climate communications activities.
8. The Council should recommend to government that it engage with relevant stakeholders to draw up sectoral partnerships or agreements (similar to those in the Netherlands or Denmark) leading to sectoral just transition plans.
9. The Council should commission a review of Ireland's fair share contribution opportunities under the Paris Agreement to consider levels of and approaches to climate finance, support for loss and damage, a review of trade policies and international support for a fossil fuel phase out.
10. The Council should recommend that Ireland's next NDC include an explanation of how Ireland's total contribution represents a 'fair share' of the common but differentiated obligations under the Paris Agreement.

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