Public Consultation Submission

Ireland's National GHG Budget Cycle 2 Proposals (2031-2040)

Prof. Barry McMullin
Dublin City University (*emeritus*)
Prof. John Sweeney
Maynooth University (*emeritus*)
Paul Price
Dublin City University (*adjunct*)

4 June 2025

Executive Summary

- There are many strong aspects to the second cycle national carbon budget process (proposing hard limits on cumulative composite GHG emissions) carried out by the Irish Climate Change Advisory Council [1] [2]. It is clear that the Council has taken its remit very seriously, and has undertaken an extremely comprehensive and technically complex body of detailed analysis in an effort to arrive at well founded and robust budget proposals.
- The Council has engaged in an exemplary demonstration of post hoc transparency, releasing a very complete archive of documentation underpinning its work.
- The Council's shortlisted GHG mitigation scenarios for Ireland clearly attempt to probe at least some of the limits of overall feasibility, including technical, social, political and economic aspects.
- The Council has ultimately proposed GHG budgets for 2031-2040 that are objectively very stringent: compliance with them would require very substantial — indeed radical — mitigation actions in advance of, during, and beyond the specific budget periods under consideration. This will be socially and politically challenging, and will require extremely strong political commitment, communication and leadership to deliver.
- **However:** a key motivation for the adoption of a GHG budget framework for national level climate mitigation rests on the relationship between such budgets and the demonstration of equity in global efforts to hold to (or, in the event of overshoot, return back below) globally agreed absolute temperature rise limits, as expressly articulated in Article 2 of the Paris Agreement [3] [4]. And **based on a careful and detailed examination of the documentation provided by the Council, we can find no evidence that these second cycle budget recommendations have been appropriately assessed for consistency with Article 2 of the Paris Agreement**, as explicitly required by the Act [5], and as the Council itself *did* clearly do in its preparation of the *first* cycle of budget recommendations [6]. That being the case, **we conclude that the current proposals have not (yet) been formulated in a way that clearly or transparently meets the requirements of the Act.**
- **Accordingly, as they stand, these budgets should *not* be recommended by the Minister or adopted by the Government.** Rather, **the Minister should immediately commission an explicit assessment of the consistency of the recommended budgets with the requirements of Article 2 of the Paris Agreement** – via a referral back to the Council itself or directly from such other duly qualified experts as the Minister may determine.
- Finally, of course, the effectiveness of adopting budgets for the period 2031-2040 is completely contingent on achieving cumulative compliance with the preceding two budgets, covering the period 2021-2030. Current projections indicate a high likelihood of significant cumulative budget overshoot by 2030, *even if all currently articulated measures are delivered fully and on time [7]*. Thus, **it is absolutely essential that the Government urgently brings forward substantial new and additional interventions to directly and reliably reduce GHG emissions much more quickly than has been achieved to date.**

Table of Contents

Executive Summary....2
1. The “Carbon” (GHG) Budget Concept....1
2. The Irish GHG Budget Framework....1
3. The Council’s Carbon Budget Methodology....3
4. Mistaken Basis for Revision (Relaxation) of CB3....4
5. Failure to apply a “Paris [Article 2] Test”....5
6. Conclusion....7
References....8

1. The “Carbon” (GHG) Budget Concept

Scientific research, extending over more than a century, has unequivocally established that multiple human activities, but especially emissions of Greenhouse Gases (GHGs), are causing significant increases in global temperature, with consequent destabilisation of climate patterns and intensifying frequency and severity of extreme weather events, causing widespread and serious harm [8]. The largest single contribution to this temperature rise is from emissions of Carbon Dioxide (CO_2). In the specific case of CO_2 it has been established that there is an approximately proportional relationship between the *net cumulative amount* emitted and the subsequent peak temperature increase, largely independently of the specific emissions pathway in time. It follows that if a policy objective is adopted to limit peak global warming to a specific level, then this translates directly into an absolute limit on the total cumulative amount of CO_2 that can subsequently be emitted. This limit is commonly referred to as the remaining (global) “carbon budget” associated with such a temperature objective, as assessed from some reference point in time. In practice, temperature rise is also significantly affected by other GHGs, as well as additional human factors such as changes in atmospheric aerosols, land use, and planetary reflectivity (albedo). These give rise to more complex relationships between human activities and climate disruption, but, given a specific global temperature rise limit, the overall effect can still be approximately expressed via a composite “cumulative GHG (carbon dioxide equivalent) budget”. Given that global human emissions are the sum of emissions associated with separate countries, as reported and assessed under the UN Framework Convention on Climate Change (UNFCCC [9]), such a global GHG budget can, in principle, be regarded as the sum of corresponding national level GHG budgets, on the basis of some articulated international sharing principles. Global, regional or national carbon budgets formulated in this way would represent “forever” limits, i.e. constraining total cumulative emissions for the indefinite future from the chosen reference date onward. However, for practical policy purposes, such a “forever” budget may be further subdivided into allocations for each of a sequence of fixed duration policy implementation periods.

In summary: given an agreed limit on global temperature rise, this can be approximately related to a global forever GHG budget from a specific reference point in time onward. This global budget, together with some declared sharing principles, can guide the equitable formulation or assessment of regional or national scale budgets, potentially divided over fixed policy implementation periods. While there are significant technical details that need to be addressed in practice, the concept of GHG budgets thus provides a scientifically well-founded basis for developing national level climate change mitigation policies, in a manner that can be tested for consistency specifically with equitably shared action to achieve agreed global temperature rise constraints.

2. The Irish GHG Budget Framework

Informed by the above high level scientific considerations, a national climate mitigation framework, relying on the GHG budget concept, has been established on a statutory basis in Ireland, under the Climate Action and Low Carbon Development Act 2015, as amended in 2021 [5] [10] (hereinafter the Act). The Act provides that the independent Climate Change Advisory Council (hereafter “the Council”) should make recommendations for maximum aggregate amounts of GHGs to be emitted

in Ireland (excluding international aviation and shipping or any other extra-territorial emissions) over a rolling 15-year "carbon budget programme", subdivided into three 5-year "carbon (GHG) budgets". The budgets are expressed as aggregate amounts across all relevant GHGs, converted to "equivalent" amounts of carbon dioxide, termed CO_2eq, using internationally agreed conversion factors (per S.I. No. 531/2021, on what is termed a GWP_{100} basis [11]). In the event of an (unplanned) excess of emissions over the approved budget in any 5-year period, there is provision for such excess to be subtracted from the available budget for the following period. In this way, the rolling budget programme, with carry forward, provides a general framework for limiting the Irish contribution to global temperature rise.

The Council, in recommending a budget programme, is *inter alia* charged with doing so in a manner "consistent" with specific articles of the Paris Agreement [3]. This provision in the Act reflects the overall architecture of the Paris Agreement, which relies on voluntary, "nationally determined" contributions to the required global effort: that is, good faith, bottom up, commitment by each of the Parties to make a contribution to the required global effort that is consistent with the agreed global temperature limit, and appropriately reflects its respective "differentiated responsibilities and capabilities". Thus, the proposal of a budget programme by the Council should involve an assessment that it is consistent with a total cumulative warming contribution from Ireland that does not exceed an appropriately equitable claim on the shared global atmospheric space. This inevitably involves some ethical value judgements, which may legitimately be debated or contested [12]. To enter into effect, a budget programme must be separately approved by the Government and the Oireachtas, and is possibly subject to revision in that process: that is to say, it is ultimately subject to collective democratic determination. However: the Government, in bringing forward a budget programme for such approval, is bound (in the same manner as the Council) to do so in a manner consistent with stated provisions of the Paris Agreement.

The first cycle of the carbon budget programme, covering the overall 15-year period 2021-2035, was proposed by the Council in October 2021 [6]. Following detailed parliamentary scrutiny, it was approved by the Government and the Oireachtas, without change, and came into effect in April 2022 [13]. The approved 5-year budget values are as follows:

- 2021-2025 (CB1): 295 $MtCO_2$eq
- 2026-2030 (CB2): 200 $MtCO_2$eq
- 2031-2035 (CB3, provisional): 151 $MtCO_2$eq

The Act provides that, no later than one year before the expiry of the first budget period in the then current budget programme, the Council is required to initiate the process of rolling forward the programme by one 5-year period. Accordingly, the Council engaged in a second cycle of carbon budget development during 2023-2024. The scope of this was to propose a finalised budget for 2031-2035 (CB3), and a provisional budget for 2036-2040 (CB4). The Council submitted this second cycle carbon budget proposal on 12th December 2024 [1] [2] [14]. It proposed the following revised/new 5-year budget values:

- 2031-2035 (CB3): 160 $MtCO_2$eq (a relaxation of 9 $MtCO_2$eq over the provisional value)
- 2036-2040 (CB4, provisional): 120 $MtCO_2$eq

3. The Council's Carbon Budget Methodology

The Council has now completed two cycles of carbon budget development. The approach and methodology has been *generally* the same in both cycles, but with some significant differences in detail (which will be considered further below). However, the common overall approach can be summarised as follows:

1. An *initial* set of possible national GHG emissions *scenarios* are developed, based on appropriate expert input. These extend back in time to at least 2021 (when the first budget programme commenced) and forward to at least 2050, the date specified in the Act for the achievement of the "National Climate Objective". Historical emissions inventories are incorporated where applicable. Various approaches and techniques are used to generate a range of potential *future* emission scenarios, including reference to existing emissions projections, more or less ambitious mitigation rates, and technoeconomic modelling under varying assumptions for factors such as population change, economic activity, international trade, land use change etc. The generated scenarios encompass all relevant sectors, are disaggregated by gas, and have annual time resolution.
2. The generated scenario set is progressively constrained to meet a variety of further criteria, informed *inter alia* by matters laid down in the Act. This is implemented firstly by constraining the initial *design* or formulation of scenarios so that only those meeting certain criteria are generated in the first place. A second level of constraint is implemented by reviewing the initially generated scenario set and removing scenarios that are deemed not to meet specific criteria. The latter process can be iterative.
3. The end result is a (reduced) *shortlist* of qualified or admissible scenarios. These are deemed to meet all the relevant requirements.
4. Each remaining (shortlisted, admissible) scenario is then processed to produce an *aggregated* GHG amount, expressed in carbon dioxide equivalent (CO_2eq), for each of the 5-year budget periods under immediate consideration. These amounts are averaged across the shortlisted scenarios, and rounded to some chosen precision (either 1 $MtCO_2$eq or 10 $MtCO_2$eq) to provide a single candidate proposed budget for each applicable period. Subject to final review and agreement by the Council, these then become the formally proposed budgets.

In our assessment, this *overall* approach reflects the general requirements laid down in the Act and is well grounded in the required scientific (specifically including social scientific) literature. However: this is still contingent on details of implementation. Specific implementation details, in some cases differing between the first and second budget cycle, will now be reviewed more critically.

4. Mistaken Basis for Revision (Relaxation) of CB3

As noted in section 2, in the second cycle the Council has proposed to revise the third carbon budget (CB3: 2031-2035) *upward* (i.e., a relaxation) from its provisional value of 151 $MtCO_2eq$ to 160 $MtCO_2eq$. This is immediately concerning as it appears *prima facie* inconsistent with the requirement of the Paris Agreement Article 3 provision that the "... efforts of all Parties will represent a *progression over time*" (emphasis added). That said, it may be noted that Article 3 strictly refers only to commitments expressed via formal statements of Nationally Determined Contributions (NDCs), and Ireland participates in that specific process on a regional (EU) rather than national basis. Further, the Irish Act governing the domestic carbon budget framework does not explicitly refer to this Article of the Paris Agreement and, in any case, matters of formal legal interpretation lie outside the scope of this submission. Nonetheless, and without prejudice to such legal interpretation, it is appropriate to consider critically the specific reason cited by the Council itself for this proposed budget relaxation. This is stated as follows:

> *The provisional CB3 (2031–2035) was a linear interpolation to meet net zero in GWP_{100} by 2050. Updated analyses of mitigation options were used for the new proposal, in which the Council considered temperature neutrality pathways rather than constraining Ireland to meeting net zero emissions in GWP_{100}. This has resulted in a 9 $MtCO_2eq$ increase in the Council's final proposal for CB3.* [1 p. 3]

However, there is clearly some error in this purported explanation. The scenarios considered in the first cycle of the carbon budget process have been released in digest form directly by the Council itself [15]; and in full detail (with permission of the Council) in the context of an independent academic publication [16]. Examination of this data shows unequivocally that the first cycle scenarios were not constrained to "... meet net zero in GWP_{100} by 2050"; indeed they all involve significant positive aggregate GWP_{100} emissions in 2050. In fact, the first cycle scenarios were constrained to meet net zero on what is called a GWP* aggregate basis; which is formally a *temperature neutrality* constraint (see also the Council Technical Report on the first budget cycle [6 p. 23]). It is true that the Council adopted a different technical approach to *assessing* this criterion of temperature neutrality in the second budget cycle (using a reduced complexity climate model rather than a GWP* basis); but it is simply not the case that this represented a different *criterion* from the first cycle (i.e., the Council have *never* applied a "net zero GWP_{100}" criterion in their carbon budgeting approach).

On these grounds alone, it should already be a matter for the Council to clarify or correct their given explanation for the proposed revision upward of CB3.

Of course, in the absence of other information, it remains possible that the change of technical approach to assessing the criterion of temperature neutrality (as opposed to a change in the criterion itself) *might* indeed be sufficient in itself to explain the proposed relaxation of CB3. However: even if that is the case, it then brings us to another, and much more serious, difficulty in the detailed methodology adopted by the Council for this budget cycle: the apparent absence of a potentially much more stringent scenario criterion, referred to as a "Paris Test". This issue is presented in detail in the following section.

5. Failure to apply a “Paris [Article 2] Test”

As noted in section 2 above, for the purposes of proposing carbon budgets, the Council (and, subsequently, the Government) is bound, under the Act, to carry out its functions in a manner that is consistent with specific provisions of the Paris Agreement, namely Articles 2 and 4(1). Article 2(1) defines the global quantitative objective of limiting temperature rise to “... well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”. Article 2(2) requires the Parties, in implementing the Agreement, “... to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.”

In the first carbon budget cycle the Council explicitly addressed these requirements via what was termed a “Paris Test”. This was incorporated at step 3 of the overall methodology described in section 3 above. In essence, this was applied as a separate criterion for the retained emissions scenarios. Each scenario was tested by estimating the Irish contribution to global temperature increase, from a specified reference year onward, and assessing whether this represented no more than an equitable share, in the sense of Paris Article 2(2), of the available global increase determined by Paris Article 2(1). The Council adopted a *de facto* reference year of 2021; and assessed equity on a basis of global equal per capita sharing, as of that reference year onward. This approach is certainly open to criticism and was acknowledged as, at best, a *minimal* reflection of the requirements of Paris Article 2(2). But on this basis, all the scenarios that were still in scope at that point either passed or only marginally failed this test. All were then retained and ultimately informed the final budget proposals in the first cycle.

Subsequent to the adoption of the first Irish carbon budget programme two of the current authors (together with Dr. Aideen O’Dochartaigh of DCU) engaged in an independent critical review of this Paris Test. Following extensive peer review, this was published in the journal *Environmental Research Letters* [4]. This paper highlighted the important positive innovations pioneered in the Paris Test, while also suggesting a number of respects in which it could be made robust. In particular, this critical re-evaluation indicated that even full, timely, compliance with the initial carbon budget programme might well already involve significant near term *overshoot* of Ireland’s equitable level of warming contribution. It also raised significant concerns over the choice of the reference year for the test, and the exclusion of any provision for Irish responsibility for emissions arising from international aviation and shipping. All of these concerns indicated a potential need for the Paris Test to be made more stringent in order to defensibly address the obligations of global equity and fairness; which would, of course, imply a *tightening* (rather than relaxation) of the Irish budgets.

However: as far as we can establish, in the second cycle budget process, instead of enhancing its Paris Test, the Council appears to have abandoned it entirely, without meaningful rationale or explanation. Given that the application of this test was a clear and explicit aspect of the Council’s first carbon budget cycle process, this apparent regression is very concerning. The Council’s second cycle report [1] is, at best, unclear in its discussion of this issue. At points the report appears to suggest that the “temperature neutrality” criterion (already mentioned in section 4

above) somehow *substitutes* for the Paris Test (e.g., section 3.8). But the fact that the first cycle included clearly distinct requirements for scenarios to satisfy criteria of *both* temperature neutrality (then assessed via net zero GWP* annual emissions from 2050 onwards) *and* equitable contribution to limiting absolute global temperature rise, clearly demonstrates that these are logically complementary to each other rather than alternatives. In fact, from a scientific point of view, the relationship between the two is that temperature neutrality (by a specified horizon year) is a *necessary* but not *sufficient* condition for satisfying *any* test of equitable contribution to limiting absolute global temperature rise (as otherwise the absolute temperature contribution does not have a peak or upper bound extending beyond the time horizon under consideration). Thus, it may make some methodological sense to ensure that all scenarios meet a criterion of temperature neutrality *before* testing them for equitable contribution to limiting absolute global temperature rise; but meeting the former criterion alone in no way guarantees that the latter criterion will *also* be met.

The Council's report (p. 29) seems to attach special significance to the fact that the temperature neutrality assessment in this cycle was technically carried out against an explicit background global emissions scenario (SSP 1-1.9) that is generally regarded as representing — at a global level — mitigation that would be consistent with the temperature goal of Paris Article 2(1). It is suggested that this, in itself, is sufficient to ensure that "... Ireland's level of ambition is consistent with high levels of ambition globally." But this reference to SSP 1-1.9 relates to a purely technical use of a global context to set atmospheric parameters for the evaluation of the temperature effect of Ireland's emissions via a reduced complexity climate model (as opposed to GWP* which elides this requirement via a less precise "upstream" parameter calibration). In any case, there is no sense in which this technical use of SSP 1-1.9 ensures or implies that the proposed scale or speed of Irish GHG mitigation represented by the shortlisted scenarios is in itself consistent with *Ireland's equitable share* in realising such a *global* scenario (SSP 1-1.9 or otherwise).

Moreover, given the nature of the technical analysis that was undertaken on behalf of the Council in relation to the temperature neutrality criterion, it seems clear that this *could* have been extended to include the required test of consistency with Paris Articles 2(1) and 2(2) (i.e., national contribution to absolute temperature rise, on the same or similar equity basis to that used in the first budget cycle); but for some reason, which has not been made clear, this analysis was either not sought, or was not considered, in the Council's assessment.

The Council's report seems to separately imply that an updated "Paris Test" analysis for this cycle was inhibited in some way by the need to select an appropriate reference year for the transition from "common" to "differentiated" mitigation effort (section 3.8). But the Council sought specific advice on this question (among others) from an independent professional ethicist, Dr. Kian Mintz-Woo [17], and was given clear advice on criteria for choosing such a reference year that would be at least "minimally" defensible. Accordingly, it is very difficult to understand why the Council did not proceed on the basis of that advice. Instead, the discussion of Dr. Mintz-Woo's contribution included in the Council's report is framed in such a way as to imply (perhaps inadvertently) that this actually provided an ethical defence of the second cycle budget process; whereas in fact, Dr. Mintz-Woo's analysis related exclusively to the first cycle process, and specifically the role of the Paris Test included in that process. Given that the second cycle excluded such a test, this analysis was rendered effectively irrelevant to the second cycle, and no alternative analysis appears to have been sought.

6. Conclusion

There are many strong aspects to the second cycle budget process carried out by the Council. It is clear that the Council has taken its remit very seriously, and has undertaken an extremely comprehensive and technically complex body of detailed analysis in an effort to arrive at well founded and robust budget proposals. It has engaged in an exemplary demonstration of post hoc transparency, releasing a very complete archive of documentation underpinning its work. The shortlisted mitigation scenarios clearly attempt to probe at least some of the limits of overall feasibility, including technical, social, political and economic aspects. The Council has ultimately proposed budgets that are objectively very stringent: compliance with them would require very substantial — indeed radical — mitigation actions in advance of, during, and beyond the specific budget periods under consideration. All of these achievements should be clearly recognised and acknowledged.

Nonetheless: it is our considered view, based on our specific scholarly expertise, and review of all the information provided by the Council, that the omission of an explicit Paris Test of equitable contribution to limiting absolute global temperature rise introduces a fundamental concern for the integrity of the overall process, and thus of the specific budget proposals themselves. As outlined in section 1, the key motivation for the adoption of a carbon budget framework for national level climate mitigation rests on the relationship between such budgets and the demonstration of equity in global efforts to hold to (or return below) globally agreed absolute temperature rise limits. Accordingly the abandonment of testing for this relationship risks undermining the fundamental scientific and ethical basis for Ireland's GHG budget system.

In principle, of course, it might be that the Council's shortlisted scenarios would indeed all pass such a test; and on that basis the existing budget proposals might still stand. But in the absence of a clear demonstration that this is actually the case, we conclude that the current proposals have not (yet) been formulated in a way that meets the requirements of the Act specifically in relation to showing consistency with Article 2 of the Paris Agreement. We note that the requirement to ensure such consistency applies separately to the Council, the Minister and the Government as whole. **Accordingly, as they stand, these budget proposals should *not* be recommended by the Minister or adopted by the Government.** Rather, the Minister should immediately commission an explicit assessment of the consistency of the recommended budgets with the requirements of Article 2 of the Paris Agreement – via a referral back to the Council itself or directly from such other duly qualified experts as the Minister may determine.

Finally, it must be emphasised that the effectiveness of adopting budgets for the period 2031-2040 is completely contingent on achieving cumulative compliance with the preceding two budgets, covering the period 2021-2030. Current projections indicate a high likelihood of very significant cumulative budget overshoot by 2030, *even if all currently articulated measures are delivered fully and on time [7].* **Thus, it is absolutely essential that the Government urgently brings forward substantial *new and additional* interventions to directly reduce GHG emissions much more quickly than has been achieved to date.**

References

[1] CCAC 2024 ‘Carbon Budget Proposal Report 2024’ Climate Change Advisory Council (Ireland) https://tinyurl.com/CCAC-CB-Cyc2-Rpt

[2] CCAC 2024 ‘Carbon Budget Proposal Report 2024: Letter to Minister’ Climate Change Advisory Council (Ireland) https://tinyurl.com/CCAC-CB-Cyc2-Ltr

[3] UNFCCC 2015 ‘Decision 1/CP.21: Adoption of the Paris Agreement’ United Nations Paris, France FCCC/CP/2015/10/Add.1 http://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf

[4] McMullin B, Price P R, *et al.* 2024 ‘Defining a “Paris Test” of national contribution to global climate mitigation: the Irish exemplar’ *Environ. Res. Lett.* **19** 4 p. 041006 https://doi.org/10.1088/1748-9326/ad3660

[5] Oireachtas 2021 ‘Climate Action and Low Carbon Development (Amendment) Act 2021’ Houses of the Oireachtas (Parliament of Ireland) No. 32 of 2021 https://tinyurl.com/IE-ClimateAct2021

[6] CCAC 2021 ‘Technical report on carbon budgets’ Climate Change Advisory Council (Ireland) https://tinyurl.com/CCAC-CB-TR

[7] EPA 2025 ‘Ireland’s Greenhouse Gas Emissions Projections 2024-2055’ Environmental Protection Agency (Ireland) https://tinyurl.com/EPA-Projections-2024-2055

[8] 2023 ‘Climate Change 2023: Synthesis Report. Summary for Policy Makers. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change’ Intergovernmental Panel on Climate Change Geneva, Switzerland https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

[9] UNFCCC 1992 ‘United Nations Framework Convention On Climate Change’ United Nations http://tinyurl.com/od8tdn6

[10] Oireachtas 2015 *Climate Action and Low Carbon Development Act 2015* http://www.irishstatutebook.ie/eli/2015/act/46/enacted/en/html

[11] GOV-IE 2021 ‘S.I. No. 531/2021 - Climate Action and Low Carbon Development Act 2015 (Greenhouse Gas Emissions) Regulations 2021’ Rialtas na hÉireann - Government of Ireland https://www.irishstatutebook.ie/eli/2021/si/531/made/en/print

[12] McMullin B 2022 ‘Adoption of the first Irish Carbon Budget Programme, 2021-2035: Opening statement for the Oireachtas Joint Committee on Environment and Climate Action’ Oireachtas Éireann/Parliament of Ireland https://tinyurl.com/IE-CBP-2022-BMcM

[13] GOV-IE 2022 ‘Carbon Budgets 2022’ Rialtas na hÉireann - Government of Ireland https://tinyurl.com/Gov-IE-CBP-2022

[14] CCAC 2024 ‘Carbon Budget Proposal Report 2024: Summary for All’ Climate Change Advisory Council (Ireland) https://tinyurl.com/CCAC-CB-Cyc2-Summ

[15] CCAC 2021 ‘Carbon Budget Scenario Digest (spreadsheet workbook, .xlsx format)’ Climate Change Advisory Council (Ireland) https://tinyurl.com/CAAC-IE-CB2021-Scenarios

[16] CCAC 2022 ‘Ireland Scenarios with LULUCF 2021 [Excel workbook]’ Secretariat of the Climate Change Advisory Council of Ireland https://doi.org/10.5281/zenodo.7075669

[17] Mintz-Woo K 2024 ‘Irish Carbon Budgets: Some Moral Considerations’ Climate Change Advisory Council (Ireland) https://tinyurl.com/MintzWoo-2024-CB-moral