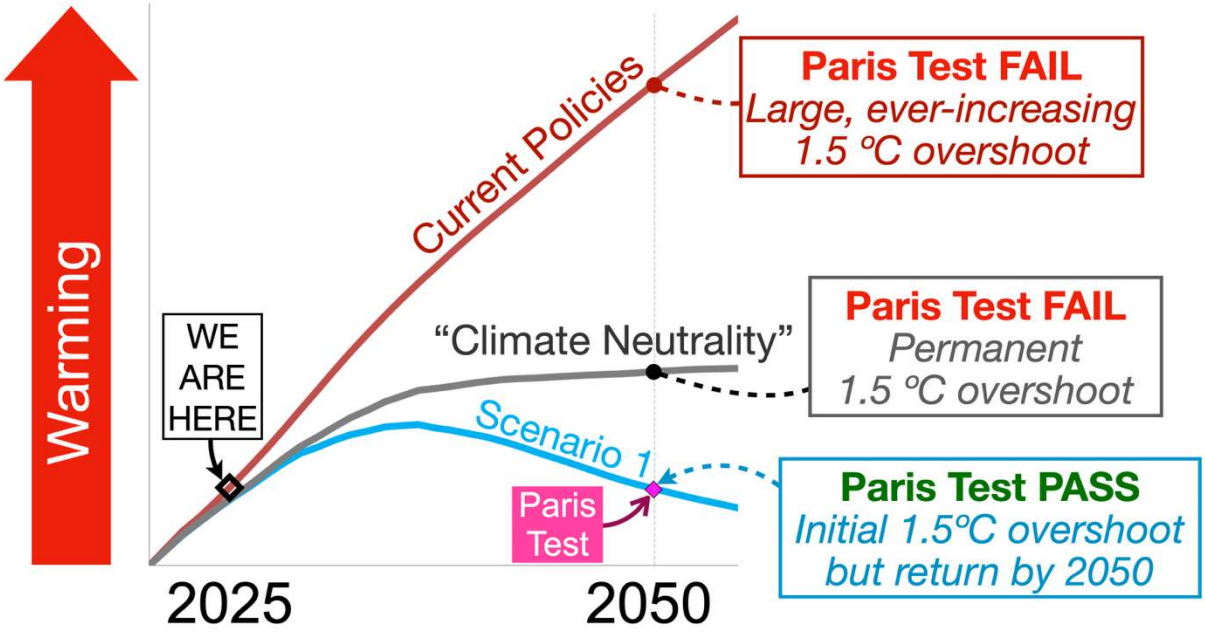

Consistent *Paris Test* assessment of the 2024 Proposal for Ireland's 2031–2040 carbon budgets

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Working paper research report

EJNI ENVIRONMENTAL JUSTICE NETWORK IRELAND

Summary

In its December 2024 **Proposal**[1], the Climate Change Advisory Council (CCAC) recommended 2031–2040 five-year carbon budgets (CB3, 160 $MtCO_2e$, and CB4, 120 $MtCO_2e$). To further inform Ireland's carbon budget process, this report evaluates the underpinning scenario shortlist data and consistently applies the CCAC 2021 Paris Test methodology to data warming outcomes.

Findings and Recommendations:

1. **2030 budget excess emissions are liable to greatly reduce the proposed CB3.** Examining the Proposal shortlist shows an average 30 $MtCO_2e$ exceedance of the legally binding 2021–2030 carbon budgets by 2030. The Proposal did not address this significant carbon budget debt rollover issue. The CCAC should make clear that the proposed 160 $MtCO_2e$ CB3 is further reduced to 130 $MtCO_2e$ unless even stronger mitigation policies than the shortlist's are urgently included in the next Climate Action Plan to limit this rollover.
2. **The Corrected CCAC 2021 Paris Test of [CO_2,N_2O,CH_4] scenarios is 0.15 ºC in 2050. for GWP* (forcing)**, as per journal article review, not 0.23ºC in 2100 as in the CCAC July 2025 Letter. The Corrected Paris Test for forcing is only met by the Shortlist's Scenario 1, from which the same test is found equivalent to **0.15 ºC in 2089 for FaIR (warming)** output.
3. **Contrary to progressing highest ambition, the 2025 equity test reduces ambition.** Consistent application of the CCAC's 2021 'Paris Test' (as corrected by the directly relevant 2024 journal article) enables a globally comparative equity and ambition assessment of the CCAC's 2021 and 2024 carbon budget proposals. Allowing for forcing–warming lag-time, the test is only passed by the scenario (Scenario 1) requiring the deepest, earliest, all-sector mitigation effort, so it is a minimum guide level for Ireland's 1.5ºC fair-share ambition.
4. **Climate neutrality is not Paris-aligned due to sustained 1.5ºC fair share overshoot** of the CCAC 2021 Paris Test. Using GWP* forcing analysis, and CCAC *Temperature Viewer* data shows that the CCAC Proposal is mistaken to suggest that merely achieving temperature neutrality ("no additional warming") at peak warming contribution is a sufficient "climate neutrality" end goal for Ireland's climate action. In fact, the CCAC Proposal's Shortlist scenarios show rapidly reducing warming after peaking for the principal GHGs.
5. **CO_2e-only carbon budgeting is inadequate; a defined 1.5ºC fair-share test is crucial.** Similar GWP_{100} CO_2e carbon budget values can have significantly different temperature contributions for Ireland due to the large impact of differing agri-methane mitigation. CO_2e carbon budgets can thereby misinform decision-makers, hence a consistently applied, explicitly defined 1.5ºC equity test such as the CCAC 2021 Paris Test is essential.
6. **GWP* split gas analysis confirms the need for early, deep agri-methane mitigation.** 2021 Paris Test use of GWP* analysis confirms that early, deep and sustained agri-methane mitigation is crucial to limit peak warming and enable an early return toward the national fair-share test threshold. Contrary to sectoral climate neutrality claims, this means that Agriculture, and agri-methane specifically, are required to achieve substantial period of *climate negative* (warming reduction) annual values, sustained over about 30 years.

The Proposal's recommended carbon budgets do require stronger climate action than recent and projected climate action. However, this report finds that greater advisory clarity is required from the CCAC for Ireland to set out effective climate mitigation policies sufficient to limit emissions warming within a fair-share 1.5ºC threshold, as required by the 2021 climate Act. If carbon budgets are missed, the 2021 Paris Test will remain a valuable gauge of Irish climate governance.

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Cover graphic

The cover graphic illustrates a *CCAC 2021 Paris Test* assessment (GWP* analysis) of three alternative emissions scenarios for Ireland: **Current Policies** (from EPA data for the *With Existing Measures* scenario); **"Climate Neutrality",** meeting the 2024 CCAC Proposal's temperature neutrality by 2050 definition; and **Scenario 1**, the deepest mitigation option within the CCAC Proposal scenario shortlist. According to the CCAC, Scenario 1 is practicable given sufficient effective Government policies and significantly increased sectoral ambition to cut energy, agriculture and land emissions from now onward. Early, deep, and sustained cuts in annual in agri-methane emissions are crucial to net temperature return from overshoot.

Analysis

The following six numbered questions and answering analyses directly relate to the respective numbered summary points above. The CCAC 2024 Proposal includes supporting Excel workbooks[2] – the *Carbon Budget Emissions Scenario Viewer* and *Temperature Analysis Viewer* – that provide the source data for the analysis, supplemented by additional information on GOBLIN LULUCF 2050–2100 emissions provided by the CCAC Secretariat[3].

Accompanying this working paper research report, an Excel workbook[4] includes key source data directly from the above CCAC sources and the derived analysis required to answer the key question headings listed below, including key charts included here as figures. A separate Excel workbook[5] combines European Environment Agency (EEA) GHG Inventory and Projections data as a basis for climate forcing analysis (GWP* calculation) to compare Ireland's most recent With Existing Measures (WEM) and (WAM) scenario data with the CCAC 2024 Proposal shortlist scenarios, as shown in the cover graphic.

1. Would scenario budget exceedance to 2030 reduce the Proposal budgets?

Issue

The CCAC Proposal in December 2024 proposed carbon budgets for the third and fourth budget periods as 160 $MtCO_2e$ for CB3 (2031–2035) and 120 $MtCO_2e$ for CB4 (2035-2040). The Proposal is based on a Shortlist of 15 scenarios (see Appendix 1), which each include named scenario emission pathways from principal energy, agriculture, and land use models.

Under the climate Act, carbon budgets must be adjusted by carrying over any prior exceedance. However, the CCAC Proposal states that *'the Council's carbon budget proposal does not address the potential of carbon budget debt rollover between carbon budget periods'*.

Table 1. Shortlist carbon budgets: five-year $MtCO_2e$ totals for 2021–2050. CCAC 2024 data.

Carbon budget periods	CB1 2021-2025	CB2 2026-2030	CB3 2031-2035	CB4 2036-2040	CB5 2041-2045	CB6 2046-2050
Shortlisted scenarios						
1 300Mt-led L4 S2_P2 GWP100	295	223	156	114	85	69
2 300Mt L4 S2_P2 GWP100	299	227	151	111	85	70
3 300Mt-lowbio L4 S2_P2 GWP100	298	229	149	113	86	71
4 350Mt-led L4 S2_P2 GWP100	296	227	170	130	98	73
5 350Mt L4 S2_P2 GWP100	299	227	162	128	100	78
6 350Mt-lowbio L4 S2_P2 GWP100	299	229	162	128	99	79
7 300Mt-led L4 S1_P2 GWP100	295	225	162	122	94	80
8 300Mt L4 S1_P2 GWP100	299	229	156	119	94	80
9 300Mt-lowbio L4 S1_P2 GWP100	298	232	154	121	95	81
10 300Mt-led L1 S2_P2 GWP100	295	223	158	119	94	83
11 300Mt L1 S2_P2 GWP100	299	227	153	115	94	83
12 300Mt-lowbio L1 S2_P2 GWP100	298	229	150	118	95	84
13 350Mt-led L1 S2_P2 GWP100	296	227	171	134	107	86
14 350Mt L1 S2_P2 GWP100	299	227	163	132	108	91
15 350Mt-lowbio L1 S2_P2 GWP100	299	230	163	132	108	92
Scenario Average for CB periods =	**297**	**227**	**159**	**122**	**96**	**80**
***Agreed CB1 & CB2* plus Avg. shortlist CB3 & CB4 =**	***295***	***200***	**159**	**122**		
Carry forward prior CB exceedance =		2	30	0		
CBs adjusted for CB1+2 exceedances =	**295**	**198**	**129**	**122**		
Rounded CB adjusted for exceedances =	**295**	**200**	**130**	**120**		

Analysis

As shown in Table 1, analysis of the CCAC *Carbon Budgets Emissions Scenario Viewer* Excel workbook data for the 15 shortlisted scenarios shows an average scenario exceedance of 30 $MtCO_2e$ for 2021–2030 relative to the sum of CB1 and CB2 values (495 $MtCO_2e$) already agreed as legally binding. This exceedance is not accounted for in the CCAC 2025 Letter's[6] calculation of the proposed CB3 value. Table 1 also shows that the CO_2e CB values do not reach annual net zero CO_2e in any of the scenarios – this is primarily because Agriculture emissions remain at 12–14 $MtCO_2e$/yr, even after 2050, mostly due to methane not being offset by any CDR.

Finding

The recommended carbon budgets are based on a Shortlist of scenarios that exceed the total of CB1+CB2 for by 30 $MtCO_2e$ on average. Therefore, even though the Shortlist scenarios achieve deeper mitigation over 2021–2030 than is currently projected by the EPA for "With Additional Measures", they are not sufficient to avoid a rollover of the exceedance, resulting in a reduction of CB3 by the exceedance amount. The proposed provisional CB4 of 120 $MtCO_2e$ would then remain unchanged unless affected by a projected CB3 exceedance value.

Notably, the Shortlist is made up of scenarios judged by the CCAC to be feasible if government implements effective climate action policies and measures, and sectors *"realise significantly increased ambition in both the period to 2030 and the period between 2030 and 2040"*[1]. Although the Shortlist average of these scenarios exceeds the 2021–2030 budget by 30 $MtCO_2e$, this is far deeper mitigation than the most recent EPA projection that *"Budget 2 [CB2] is projected to be exceeded by 135 $MtCO_2e$ in the WEM scenario and by 85 $MtCO_2e$ in the WAM scenario"*[7].

Recommendation

The CCAC Proposal does acknowledge that *'"a failure to deliver on CB1 and CB2 will lead to even smaller carbon budgets in the 2030–2040 period, which is a major threat to the feasibility of CB3 and provisional CB4"*[1]. However, it is misleading for the Proposal to recommend a CB3 of 160 $MtCO_2e$, as if it follows on from meeting CB1 and CB2, without acknowledging that the Shortlist average exceeds the agreed legally binding CB1+CB2 of 495 $MtCO_2e$ by 30 $MtCO_2e$. The CCAC should make clear that CB3 would need to be reduced to from 160 $MtCO_2e$ to 130 $MtCO_2e$ (by rollover of the prior budget exceedance) if Climate Action Plans and action only achieve the Shortlist scenario average emissions for 2021–2030. The extreme urgency of climate action now required to achieve Ireland's fair-share 1.5ºC – even judged by the ethically low bar[8] of the CCAC's 2021 Paris Test – is left unclear if the Proposal Shortlist's near-term budget exceedance and potential rollover to reducing CB3 is not made clear.

Under Article 3 of the amended climate Act[9], meeting an agreed programme of five-year carbon budgets is crucial to achieving the 'national climate objective' and, under Section 15, every *"relevant body shall, in so far as practicable, perform its functions in a manner consistent with"* requirements including *"furtherance of the national climate objective"*. According to the CCAC Proposal, its shortlist scenarios may require stronger policies and greater sectoral ambition but they are practicable. Even including all policies included in the WAM scenario, the Government's Climate Action Plan substantially exceeds the Shortlist average by 55 $MtCO_2e$. Therefore, given the above analysis, the Proposal from the CCAC, the relevant climate expert body, finds that the Government and other relevant bodies are not performing their functions in so far as practicable.

2. How can the 2021 Paris Test be consistently applied to the Proposal?

The 2021 Paris Test defined by the CCAC in its 2021 *Carbon Budget Technical Report*[10] assessed the scenario basis of recommended multi-gas [CO_2,N_2O,CH_4] national carbon budgets for consistency with equitably meeting the Paris Agreement temperature goal, as per Article 2. As Dooley et al. state, *"Equitable effort sharing is an irreducibly normative matter"*[11]; nonetheless, in response to the 2021 climate Act, the CCAC's 2021 Paris Test did set out a quantitative test of Ireland's fair-share 1.5ºC climate action. The CCAC stated that the test provides "a minimum level of consistency with the Paris temperature goals"[10], using a global equal per capita normative allocation of the remaining temperature rise. In other words, using a GWP* test of scenarios' cumulative CO2 forcing equivalent from 2021, in 2050, its 2021 Paris Test quantified the CCAC's *maximum* threshold for meeting the 'national climate objective' under the 2021 climate Act.

The test is set out as a global equal per capita threshold pass/fail test of the five alternative "core scenarios" for 2021–2050 underpinning the CCAC 2021 proposal for CB1 and CB2. These core scenarios combined alternative Energy (CO_2) and Agriculture (N_2O and CH_4) mitigation pathway options meeting an all-sector 2030 GHG CO_2e emissions reduction of 51% relative to 2018, as required by the Act. (According to legal opinion[12], the 51% parameter for CCAC assessment ceased to have any legal effect once CB1 and CB2 became legally binding after Oireachtas approval in April 2022[13].) In the core scenarios. For Agriculture non-CO_2, the full headline percentage reduction in N_2O and CH_4, for example a 25% cut, was achieved by the end of 2030, with only a 3% per decade reduction thereafter.

The **CCAC 2021 Paris Test** set a global equal per capita threshold maximum value in 2050 of 0.23 ºC, at 'upscaled' global level, for the temperature commitment (in GWP* CO2 forcing equivalent terms) of each scenario as assessed using the GWP* methodology[14,15] for the three principal greenhouse gases. On this basis, only the 2021 core scenario with the least agricultural mitigation (a -19% non-CO_2 cut by 2030) failed the test.

However, a 2024 journal paper by McMullin et al.[16] found that the CCAC test's quantification required three adjustments that lowered the threshold maximum from 0.23 ºC to a **Corrected 2021 Paris Test** global 'upscaled' value of 0.15 ºC in 2050; this equates to a 'downscaled' CCAC Paris Test threshold of just under 0.10 x10^{-3} ºC or 210 MtCO_2fe. Only two of the five core scenarios then passes this corrected test, which, by 2030, requires Energy net CO_2 to be cut by more than 59% and Agriculture N_2O and CH_4 reductions of more than 35% by 2030.

Issue

The 2024 Proposal was academically critiqued[17] as failing to include any global equity test of the scenarios to assess its fairness relative to Paris Agreement Article 2(2). In response to a resultant Joint Oireachtas Committee request on the lack of an equity test in the Proposal, a CCAC 1st July 2025 Letter to the Committee set out a *'Table 1: The 'Paris Test' applied to the 15 shortlisted scenarios informing the proposal'* (replicated in Appendix 1). The Letter states the same "upscaled" 0.23 ºC global threshold as set out in the CCAC 2021 report. Thus the Letter implies that its applied test is the same as that used in the 2021 Paris Test. However, in the 2021 Carbon Budget Technical Report[10], the defined Paris Test was applied to GWP* cumulative CO_2fe values (forcing) in 2050, for 2021–2050 emissions, whereas the 2024 Proposal relied on FaIR temperature contribution values (warming) in 2100. Moreover, the Letter's test did not acknowledge the journal paper's recommendations (A, B and C)[16] that adjust the 2021 Paris Test threshold downward from 0.23 ºC to 0.15 ºC in 2050 for GWP* scenario pathways.

Therefore, the method used below to assess the CCAC's 2021 and 2024 carbon budget proposals consistently, requires applying the 2021 Paris Test (GWP* basis) to: 2021-definition core scenarios using the updated 2024 data; and 2024 Shortlist emissions data converted by GWP* calculation to cumulative CO2fe from the start of 2021. These GWP* curves and the 2021 Paris Test threshold in 2050 can then be equated to the same temperature threshold level in the shortlist FaIR data to find the horizon year for the equivalent FaIR threshold temperature.

Analysis

Climate forcing (temperature commitment), as approximated by GWP* in CO_2fe, based on a scenario of GHG emissions for CO_2, N_2O and CH_4, results in a time-lagged warming contribution as shown by FaIR climate model analysis. Thus, consistent application of the 2021 Paris Test GWP* forcing threshold in 2050 to FaIR values requires an adjustment to determine the threshold year for the corresponding warming contribution. GWP* analysis of Shortlist's Scenario 1 shows that it almost exactly meets the Corrected 2021 Paris Test threshold (0.15ºC in 2050). Therefore, as shown in Figure 1, the year at which the Scenario 1 FaIR warming contribution reaches 0.15ºC, returning from its overshoot peak, can be used to approximate the time horizon year for the Corrected 2021 Paris Test warming threshold, for application to scenario FaIR pathways as shown in Figure 1.

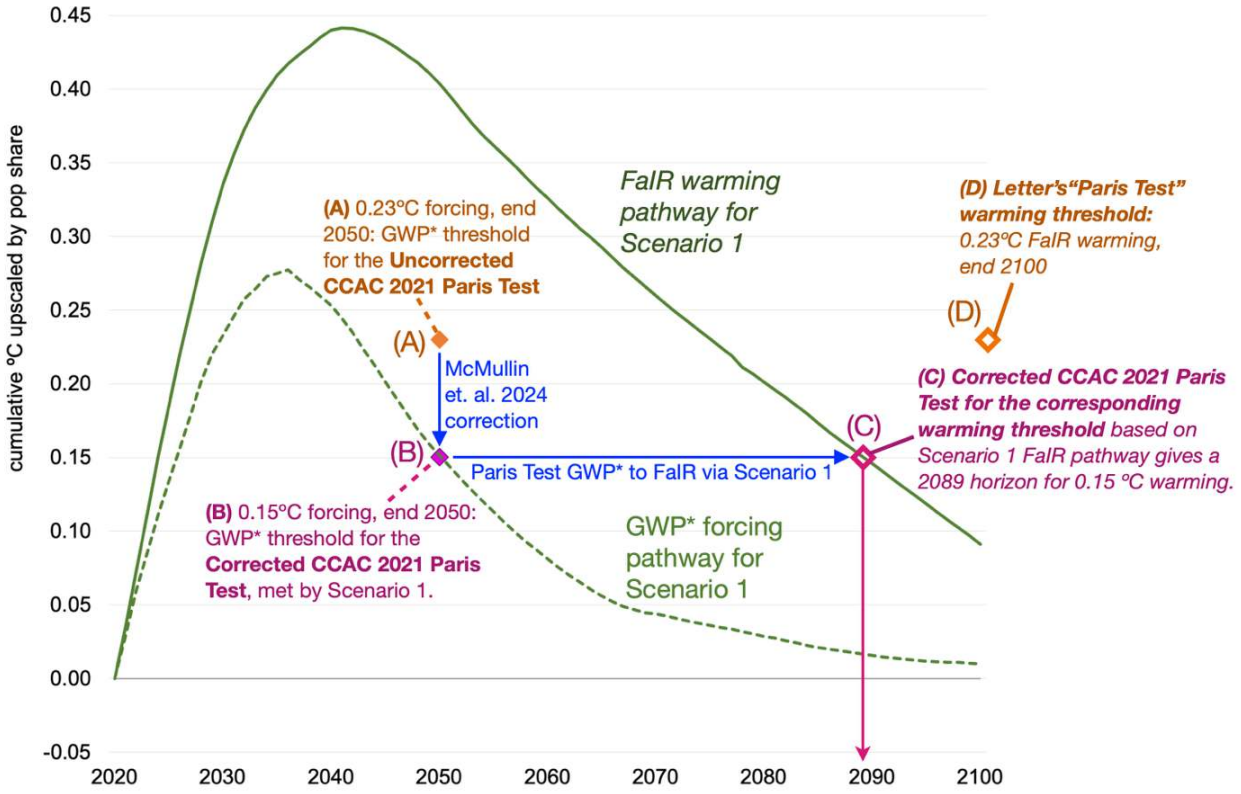

Figure 1. 2021 Paris Test (uncorrected and corrected) versus the Letter's "Paris Test".
Chart of 2020–2100 for [CO_2,N_2O,CH_4] shows GWP and FaIR temperature values for Scenario 1, upscaled by Ireland's population share on a global equal per capita basis. The green dashed line shows GWP* calculated forcing (temperature commitment) from this report's analysis; the solid line shows the corresponding FaIR warming (temperature contribution) in the CCAC Temperature Viewer data. Points A-D annotate: the uncorrected (A) and corrected (B) 2021 Paris Test of GWP* forcing; the equivalent corrected Paris Test for warming, via Scenario 1; and (D) the CCAC 2025 Letter's unrelated "Paris Test".*

Figure 1 shows GWP* (forcing) and FaIR (warming) pathways for Scenario 1's combined [CO_2,N_2O,CH_4] emissions. As per the CCAC 2021 test definition, the pathways are upscaled to global level by Ireland's global population share and using a global equal per capita remaining warming to 1.5ºC (based on a 50:50 chance of meeting that limit).

- Point (A) is the CCAC's **Uncorrected CCAC 2021 Paris Test forcing threshold** for GWP* scenario assessment, as per the 2021 Carbon Budget Technical Report[10]: maximum upscaled 0.23ºC (downscaled 0.15 ºC) by the end of 2050.
- Point (B) is the **Corrected 2021 Paris Test forcing threshold** for GWP* scenario assessment, adjusted as per quantitative adjustments A–C in the McMullin et al. 2024 journal paper[16]. Scenario 1 almost exactly meets this GWP* test in 2050.
- Point (C) is a the FaIR warming value at 0.15ºC for Scenario 1, corresponding to point (B). As Scenario 1 meets the GWP* forcing test in 2050, (C), an upscaled 0.15ºC (downscaled, equivalent to 0.10 mºC) can therefore be used to approximate a **2021 Paris Test warming threshold** test for FaIR scenario pathways. This gives a 2089 time horizon for the 0.15ºC 2021 Paris Test.
- Point (D), 0.23ºC at end of 2100, separately indicates the **Letter's "Paris Test"** of warming contribution. However, this test horizon does not consistently relate to the 2021 Paris Test definition, using a 2050 time horizon, and does not acknowledge the journal paper corrections reducing the 0.23 ºC temperature commitment.

Finding

The Letter's stated "Paris Test" warming threshold, 0.23ºC at the end of 2100, does not acknowledge the 2024 journal paper's downward correction to 0.15ºC. Moreover, the Letter does not provide reasoning for the change in test horizon date from 2050 for forcing to 2100 for warming, nor is any reasoning supplied to relate the Letter's warming test in 2100 to the 2021 Paris Test of GWP* forcing equivalent (temperature commitment) in 2050.

This report's analysis accepts the journal paper correction to 0.15 ºC in 2050 for the Paris Test GWP* threshold for [CO_2,N_2O,CH_4] summed forcing equivalent. As shown in Figure 1, based on the **Corrected 2021 Paris Test GWP* threshold value of 0.15 ºC in 2050** and Scenario 1 exactly meeting that test, the corresponding 0.15 ºC value is reached in 2089 the Scenario 1 FaIR warming pathway.

Recommendation

Instead of the Letter's 0.23ºC "Paris Test" in 2100, a **Corrected 2021 Paris Test warming threshold value of 0.15 ºC in 2089** for FaIR data is recommended for consistent application of the 2021 Paris Test to the 2024 Proposal's Shortlist scenario FaIR output from the Temperature Viewer.

3. Does the Proposal progress highest ambition as per the Paris Agreement?

Issues

The CCAC 2021 Paris Test set out a quantified pass/fail 'national climate objective' test of scenario climate action ambition and the carbon budgets recommended in 2021[10]. The ethics assessment from the CCAC Carbon Budget Working Group evaluation assessed this test as

using assumptions *'amongst the most favourable to Ireland'* that should be viewed as *'upper bounds'* in regard to moral considerations for equity and justice[8].

In meeting the Article 2 temperature and equity objectives, Article 4.3 of the Paris Agreement commits each Party to a *'progression'* over time in climate action to reflect a country's *'highest possible ambition'* – this is the so-called 'Paris ratchet'. This implies that any quantification test used by the CCAC, Ireland's independent climate expert body charged with assessing national carbon budgeting, must at least avoid reducing ambition relative to the 2021 Paris Test

Given the commitment to increasing ambition, the Letter's test assumptions would need to be at least as stringent as the CCAC 2021 Paris Test in assessing CCAC scenarios, otherwise the Letter's equity test could be allow reduced ambition scenarios to pass as sufficient action. The CCAC 2021 Paris Test employed the GWP* method to sum warming from individual CO_2, N_2O and CH_4 emission pathways, to approximate their combined scenario climate forcing (temperature commitment). By contrast, the CCAC 2024 Proposal employed the FaIR reduced complexity ('simple') climate model[18] to assess the warming (temperature contribution) based on included sectoral model pathway emissions. Greenhouse gas emissions immediately cause a climate forcing but the resultant peak warming is typically delayed by more than a decade

To assess any change in ambition and set out a consistent application of the 2021 Paris Test to both the 2021 and 2024 CCAC assessments, the analysis below: (a) examines the Letter's Table 1 "Paris Test" version, and, (b) undertakes a GWP* (forcing) temperature commitment assessment of the Shortlist scenario for comparison with the 2024 Temperature Viewer FaIR warming (temperature contribution) output for the Shortlist.

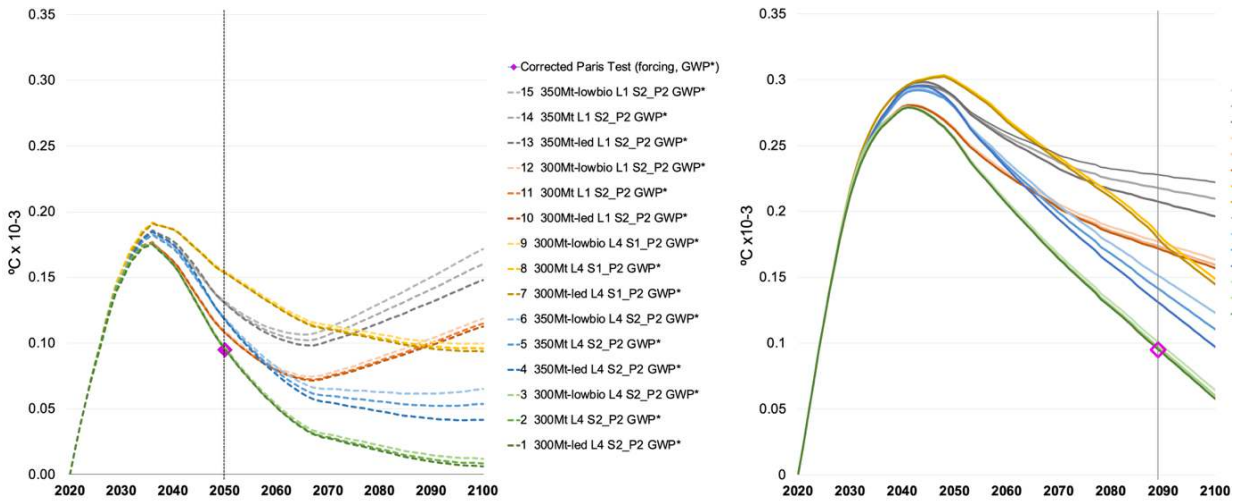

Figure 2. GWP* versus FaIR for the CCAC (2024) 15 scenario shortlist, 2021-2100 in mºC
Left: Calculated GWP output (dashed lines) approximating forcing (temperature commitment) for CCAC (2024) scenarios, based on cumulative $MtCO_2fe$ from start 2021; Paris Test value, 0.095 mºC in 2050 as per corrected CCAC (2021) value in McMullin et al., 2024. Scenario **1 300Mt-led L4 S2_P2** almost passes the test. Right: Corresponding FaIR output (solid lines) showing shortlist scenario warming (temperature contribution) for CO_2,N_2O,CH_4 only, using data from CCAC 2024 Temperature Viewer. **Scenario 1 300Mt-led L4 S2_P2**, as this scenario almost passes the Corrected Paris Test at 2050 in the GWP* chart, so the corresponding value for Scenario 1 FaIR warming, just before 2090 is used as the Paris Test for FaIR output.*

Analysis (a): Letter Table 1

Looking first at the Letter's Table 1 (as reproduced in Appendix 1), its columns give results for each of the 15 scenarios:

- Step 1. A 0.23ºC (global upscaled) threshold value for the given Paris Test is stated as the *'IPCC AR6 calculation of the remaining gap to the 1.5 ºC threshold relative to 2020'*;
- Step 2. *'The long term temperature impact from Ireland's GHG emissions under a given scenario relative to 2020'*. This is the "downscaled" absolute temperature contribution
- Step 3. *'Ireland's long term GHG emissions contribution to warming upscaled to global level on the basis of the scaling factor used in the Paris Test'*.

The Letter table implies that only Step 3 scenario values less than or equal to the given 0.23 ºC threshold pass the test. Notably, even within Table 1 assumptions, only Shortlist scenarios 1 to 5 pass this threshold test, whereas Shortlist scenarios 6 to 15 fail it.

Analysis (b): CCAC 2021 Paris Test, comparing GWP and 2024 FaIR output*

For the 15 scenario shortlist on which CB3 and CB4 proposal is based, Figure 2 compares GWP* outputs from this report's base analysis and the CCAC Temperature Viewer outputs from the FaIR (reduced complexity climate model). Whereas GWP* aims to approximate forcing (temperature commitment), the FaIR output indicates the lagged warming resulting from the forcing. The corrected 2021 Paris Test threshold of 0.95 $x10^{-3}$ ºC (downscaled) is shown at 2050 in the GWP* (forcing) chart and, correspondingly, just before 2090 in the FaIR (warming) chart.

The Figure 2 charts show that only the deepest 2024 mitigation scenario in the shortlist, **1 300Mt-led L4 S2_P2**, achieves sufficient climate action to reach the CCAC 2021 Paris Test threshold 2050 value of 0.95 $x10^{-3}$ ºC for the corrected CCAC Paris Test.

It is notable that the GWP* peak overshoot, temperature commitment (CO_2 forcing equivalent) values are substantially lower than the FaIR temperature contribution (warming) values. The FaIR pathways also take much longer to return from the peak overshoot value than the GWP* pathways.

Findings

The Letter's CCAC test excludes the journal article corrections that reduce the Paris Test upscaled temperature threshold from the stated 0.23ºC to 0.15 ºC – equivalently, on a downscaled basis, reducing from 0.145 mºC to 0.095 mºC. The analysis in Figure 2 shows that only **Scenario 1 300Mt-led L4 S2_P2** passes the 2021 Paris Test, although Scenario 2 and 3 come close. None of the other shortlist scenarios pass the test. Given that the CCAC Cycle 2 carbon budget working group's ethical analysis found that the 2021 Paris Test assumptions *"are amongst the most favourable to Ireland amongst the philosophically plausible positions*" [8], both analyses (1) and (2) indicate that the CCAC Letter's "Paris Test" uses assumptions that are easier to meet than the 2021 Paris Test.

Not only does the Letter's "Paris Test" version applied by the CCAC to warming in 2100 differ from the 2021 Paris Test application to GWP* forcing equivalent in 2050, it also notably fails to include or acknowledge the quantitative adjustments and equity concerns regarding PT2021 that are set out in the earlier 2024 journal article *Defining a 'Paris Test' of national contribution to global climate mitigation: the Irish exemplar* by McMullin et al.[16]. This disregard of relevant

published science is puzzling given the CCAC's awareness of the article and their funding of the underlying research[19].

Notably, the Shortlist scenarios' GWP* forcing pathways only peak about 6 to 10 years earlier the corresponding FaIR temperature contribution (warming) pathways, and the FaIR warming peak is substantially higher than indicated by the corresponding GWP* temperature commitment (forcing). This indicates that GWP* calculation underestimates the warming impact of the principal GHG emissions. Nonetheless, such simplistic GWP* analysis is shown to provide a good guide to the relative forcing and warming impact of alternative scenarios. Therefore, GWP* assessment can be a useful comparative tool for warming *outcomes* even though it does not provide useful information on the key *mitigation* target, cutting the amount of emissions, for which by-gas GHG mass or the linearly equivalent CO2e values remain the accurate gauge for climate action policies.

Recommendation

The 2021 CCAC Paris Test should be applied consistently to both the CCAC 2021 and 2024 Proposal scenarios, to ensure that the same test, based on all 2021–2050 territorial emissions of the principal greenhouse gases [CO_2,N_2O,CH_4]. The Proposal argues that a global SSP1-1.9 scenario (meeting 1.5ºC before 2100 after minimal overshoot) enables a Shortlist scenario assessment of temperature neutrality by 2050 that is *"compliant with the Paris Agreement LTTG [long term temperature goal"*[1]. However, this is not an equity test consistent with Article 2(2)[20] requirement for national policies to be *'implemented to reflect equity'* because it does not provide a quantification test of explicitly defined (normative) national 1.5ºC fair-share action that can be commonly applied to all nations on a differentiated basis of GHGs over a stated period, as the 2021 Paris Test does, even if it can be critiqued as very generous to Ireland[16].

The analysis above shows that the Shortlist includes scenarios that do not meet the 2021 Paris Test and the Letter uses an equity test that is even more favourable to Ireland. Therefore, the Proposal's Shortlist basis must be regarded as less equitable than in 2021 and thus contrary to the Paris Agreement's (Article 4.3) ratchet principle that requires increased national ambition over time.

Therefore, the CCAC could clarify its proposal by making clear that meeting the 2021 Paris Test requires climate action that achieves forcing and warming outcomes equivalent to Scenario 1, requiring at least the deepest mitigation in energy, agriculture and land use deemed practicable by this CCAC scenario.

4. Is the CCAC 2050 climate neutrality requirement Paris-aligned?

Issue

The Proposal states that the CCAC *'interpreted climate neutrality to be the stabilisation of Ireland's contribution to global warming'* and that it *'interpreted the achievement of climate neutrality as being consistent with stabilising Ireland's warming impact as a result of net zero* CO_2 *emissions, along with prescribed deep cuts in methane and nitrous oxide emissions, i.e. temperature neutrality'*. Given the 2021 climate Act's requirement for climate action *"consistent with"* the Paris Agreement Article 2 objective (limiting to 1.5 ºC, equitably), it follows that the the CCAC Proposal is asserting that stabilisation of Irelands' temperature contribution by 2050, at the peak temperature level reached, represents sufficient fair-share climate action to limit to the Paris Agreement 1.5 ºC.

The CCAC Letter[6] does not contradict this implication, despite the prior 2025 journal article by Duffy et al.[21], that stated:

> *'a recent proposal by Ireland's CCAC to frame a national climate neutrality target as 'no additional warming' (or TN) [Temperature Neutrality] departs from the EU's commitment to NZ [Net Zero] GHGs and reflects a political choice that protects Ireland's livestock-dominated, export orientated agricultural and land-use sectors.'*[21]

However, unlike the 2021 Paris Test, Duffy et al. does not address what a sufficient national fair-share commitment to global climate action might be or the CCAC's 2021 Paris Test quantification.

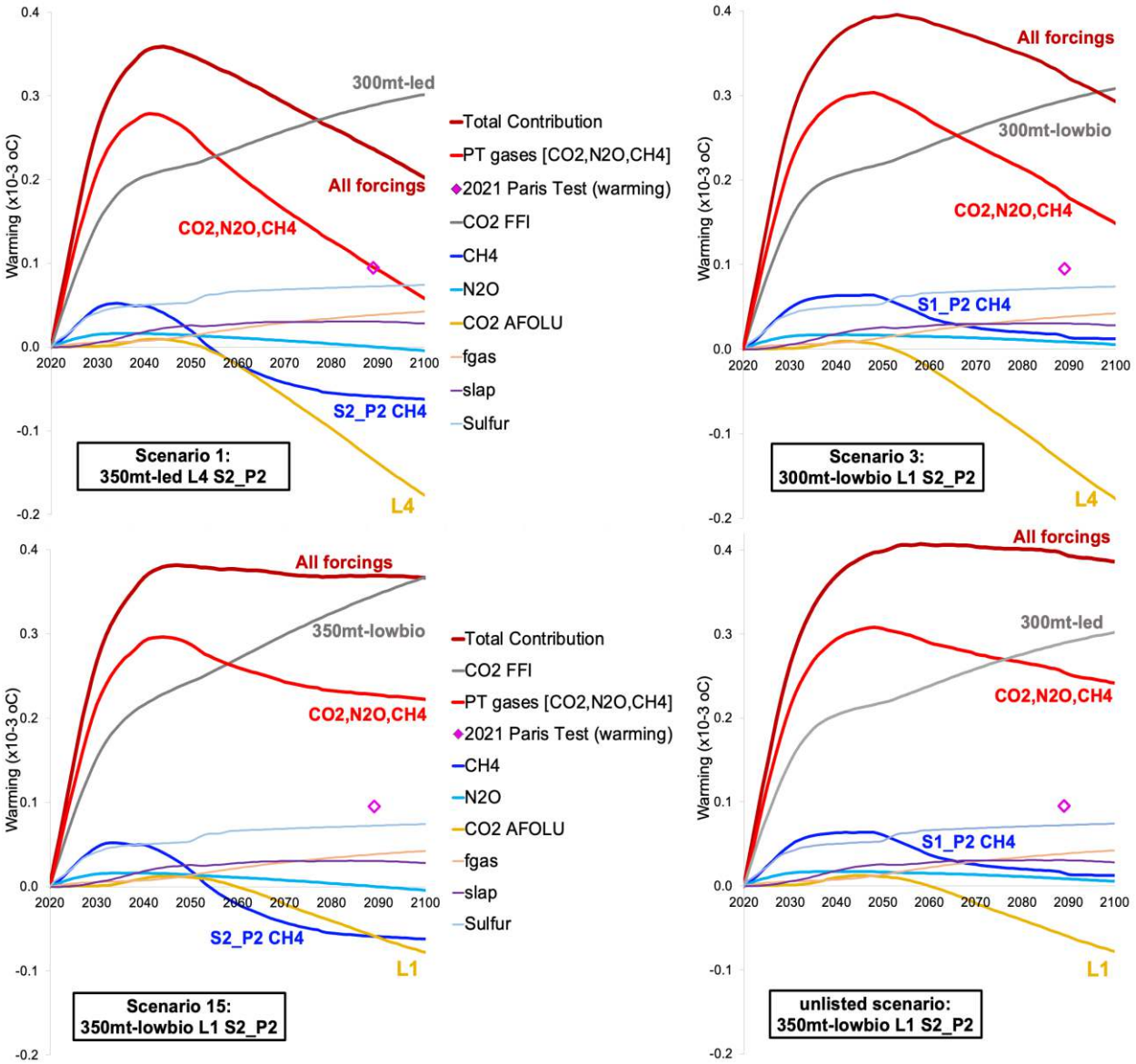

Figure 3. Scenario temperature contributions for all forcings, PT gases and by climate pollutant. *Charts, produced for this report derived from CCAC Temperature Viewer data for three selected scenarios as per the CCAC Letter[6] and an additional unlisted scenario that achieves "no additional warming" for all forcings while using sectoral model scenarios relied on by the Shortlist. The 2021 Paris Test warming value in 2060 (as per the approximation in Figure 2, right). All scenarios shown reach peak warming contribution in overshoot by 2050, but only Scenario 1 meets the 2021 Paris Test value in 2060 for [CO_2,N_2O,CH_4] after initial overshoot.*

Analysis

To assess scenarios relative to climate neutrality (temperature stabilisation at peak warming) and relative to the 2021 CCAC Paris Test, Figure 1 charts results from the CCAC Temperature Viewer. Results are shown for three scenarios (1, 9 and 15) covering the Shortlist range, as per the CCAC Letter[6], and an additional, unlisted scenario that achieves "no additional warming" for all forcings while using the same sectoral scenarios as the Shortlist. In each chart, the magenta diamond shows the 0.095 mºC in 2089 threshold, the CCAC 2021 Paris Test approximated for warming as in Section 1 above.

Finding

Contrary to the CCAC Proposal, inspection of Figure 2 shows that none of the 15 shortlisted scenarios underpinning the Proposal's CB3 and CB4 recommendations follow a temperature stabilisation form when summing warming for three gases [CO_2,N_2O,CH_4) as used in the Paris Test. In fact, all of the scenarios require substantially greater mitigation action – including early and deep cuts in annual agricultural methane emissions and strong afforestation – to achieve *climate negative* outcomes (warming reduction) from the Agriculture and LULUCF sectors to meet the 2021 Paris Test for warming.

Recommendation

The CCAC should correct its stated implication that achieving climate neutrality by 2050 and stabilising at such a peak temperature represents sufficient fair share climate action for Ireland. Such a climate neutrality definition allows for permanent overshoot of at the Paris Test fair share threshold, which is contrary to the Paris Agreement and would align Ireland with allowing the multiple risks inherent in allowing sustained 1.5ºC overshoot[22].

In fact, all of the shortlist scenarios underpinning the Proposal carbon budgets exhibit peak-and-then-decline warming pathways. More importantly, only the deepest mitigation scenario in the Shortlist, **Scenario 1 300mt-led L4 S2_P2**, meets 2021 Paris Test**.** The CCAC could therefore make clear that future national Climate Action Plan and Long-Term Strategy scenarios need to achieve maximum forcing and warming pathways equal or lower than Scenario 1.

5. Are CO_2e budgets alone sufficient to inform Paris-aligned mitigation?

Issue

By regulation[23], Ireland's five-year carbon budgets under the 2021 Climate Act[9] are expressed in megatonnes of CO_2 equivalent ($MtCO_2e$) using GWP_{100}, the standard GHG equivalence metric used by the EPA for UNFCCC GHG emission reporting. However, due to the strong temperature effect of changes in annual methane emissions, GWP_{100} CO_2e carbon budgets for the Shortlist scenarios need to be compared, on a temperature commitment (forcing) basis or temperature contribution (warming) basis, to assess whether information additional to only providing CO2e carbon budgets is required for practicable and meaningful CCAC climate action advice in furtherance of the 'national climate objective', as required by the climate Act, Section 15.

Analysis

A GWP* approach can be used to approximate scenario forcing equivalent using a 'split-gas' approach: that is, assessing the cumulative forcing equivalent for each principal greenhouse gas

and summing their effect over the assessment period. More accurately, a simple climate model such as FaIR or MAGICC, can be used to assess scenario warming due to each gas or overall against a global background model aligned with the Paris temperature goal. But here the GWP* calculation is used as a simple comparative method, as Section 3, above, finds useful. In applying GWP* calculation, it is important to understand that the full effect of methane mitigation only plays out in full over the 20 years following the emission. Thus, a stated scenario percentage cut in methane emissions by 2050, only achieves its full effect on forcing by 2070 and the impact on warming may not be seen in full until about 2090, as indeed the Section 1 analysis comparing GWP* and FaIR output (see Figure 1) indicates for the 2021 Paris Test.

In Figure 4, comparison of GWP_{100} and GWP* pathways for four selected scenarios shows large differences between them, especially due to differences in methane mitigation. Scenario 1 and 15, and the Shortlist average cover the range of the Shortlist. A Scenario X is also defined using the same deep mitigation sectoral scenarios as Scenario 1 – 300mt-led for energy and L4 for land – except that it uses the Teagasc S1_P1 Agriculture scenario, which only cuts methane emissions by -11% by 2040 (rather than the S2_P2 scenario that cuts methane emissions by -30% by 2040).

As a result, Scenario X is almost identical to Scenario 15 in annual and cumulative GWP_{100} terms, but the GWP* cumulative $MtCO_2fe$ warming analysis shows it achieves far less warming mitigation impact. With minimal additional early methane mitigation, Scenario X would qualify as achieving the CCAC's temperature stabilisation definition of climate neutrality by 2050 for [CO_2,N_2O,CH_4] as in the CCAC Proposal. However, due to shallower methane mitigation, the Scenario X forcing equivalent outcome via cumulative GWP* is far worse than that for Scenario 1, which is the only shortlist scenario meeting the Corrected 2021 Paris Test threshold in 2050. Figure 4 thereby shows that GWP_{100} fails to correctly represent the forcing equivalent (temperature commitment) outcome of scenarios that include substantial methane mitigation. As per the Section 3 analysis above, similar but worse results can be expected in a FaIR analysis of Scenario X.

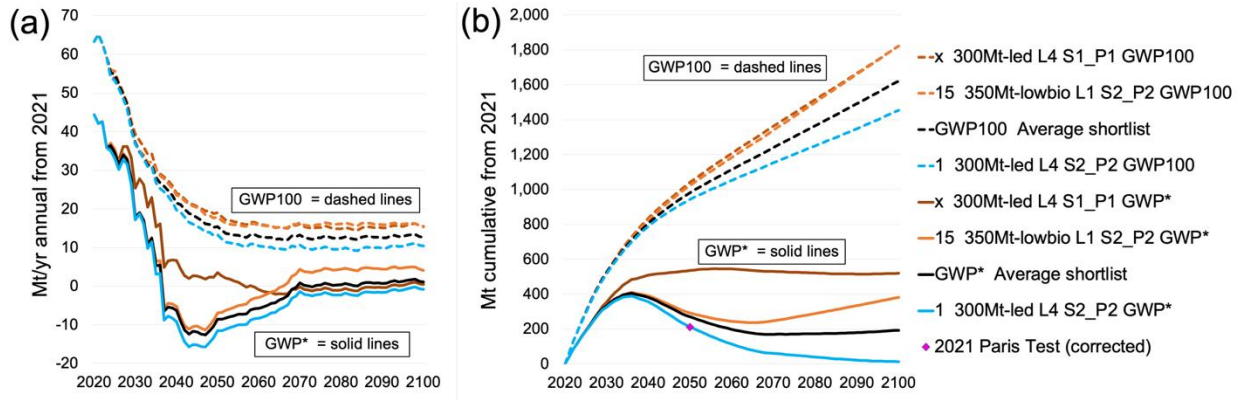

Figure 4. Comparing GWP_{100} and GWP* scenarios meeting the shortlist budget range
Charts – (a) annual values and (b) cumulative values – show GWP_{100} (dashed) and GWP (solid) lines for four multi-gas [CO_2,N_2O,CH_4] scenarios. The CCAC 2021 Paris Test threshold of 210 $MtCO_2fe$ by 2050 is shown in (b) as a magenta diamond, met by Scenario 1. Three of the scenarios directly relate to the Proposal's 15 scenario shortlist basis, numbered as per the CCAC Letter table (see Appendix 1): deepest mitigation in Scenario 1 (blue), shortlist average (black), and the shortlist's least mitigation in Scenario 15 (orange). The fourth scenario shown (brown) is the same as Scenario 1 in using 300mt-led for energy and L4 for land uses, but it uses Teagasc's S1_P1 agriculture scenario, cutting methane by only -11% by 2040 relative to 2018.*

Notably, *none* of these four scenarios achieve the net zero annual GWP_{100} CO_2e outcome by, or before 2050, the objective commonly defined for climate neutrality in EU and UK climate action and carbon budgeting. Scenario 1 stabilises at about 10 $MtCO_2e$/yr after 2050, and the highest GWP100 option, Scenario 15, stabilises at about 16 $MtCO_2e$/yr after 2050. Therefore, the CCAC shortlist is not aligned with the EU climate targets as the large residual methane emissions (due to agriculture) are not offset by carbon dioxide removal (CDR) by 2050 and thereafter.

For the scenario shortlist average, the difference between GWP_{100} five-year carbon budgets and their warming commitment summing corresponding GWP* five-year CO_2 forcing equivalent budgets is also clearly shown in Figure 5(a). As Figure 5(b) shows, the substantial difference between the five-year GWP_{100} and GWP* values is entirely due to methane. (By cutting methane at a rate greater than 3% per decade, GWP* calculation results in negative CO_2fe/yr values.) The total of net negative methane GWP* values to 2060 is far greater than the net negative CO_2 values, showing that the early peak warming and return toward the Paris Test level is primarily dependent on the amount of early, deep and sustained agricultural methane mitigation.

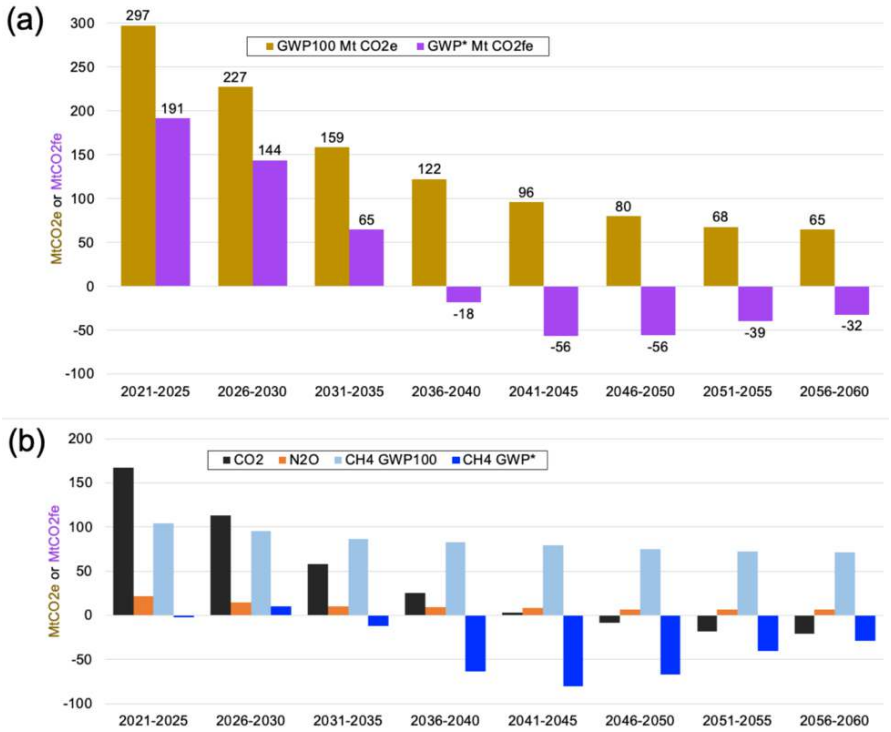

Figure 5. Five year GWP_{100} and GWP* totals and by gas values, 2021–2060,
(a) Ireland CCAC 15 scenario shortlist average: five-year totals 2021–2060 via GWP_{100} ($MtCO_2e$) and GWP ($MtCO_2fe$). (b) Component by-gas values for the totals shown in (a): only the value for methane changes between GWP_{100} and GWP*.*

Finding

The analysis in Figure 4 and Figure 5 show that CO_2e budgets as used in the Proposal are alone *insufficient* to inform action consistent with meeting a fair-share 1.5ºC temperature goal, such as achieving the minimally equitable CCAC 2021 Paris Test. For CO_2 and N_2O, summing annual GWP_{100} emission values does directly relate to resulting cumulative warming, and their GWP* annual values are identical to their GWP_{100} CO_2e values. However, for methane, slowly declining annual emissions will stabilise the resulting temperature contribution, and sustained changes in annual emissions can result in a large change in methane-related warming impact. Substantial

cuts in annual methane emissions over time result in large reductions in methane equivalent to CDR in temperature terms.

For Ireland, deeper sustained reductions in the level of annual methane emissions would result in a substantial net warming reduction equivalent to the negative emissions that would be recorded for atmospheric CO_2 removals by CDR. Thus, although GWP_{100} does provide a useful gauge of mitigation, as its values directly relate to by-gas mass emissions (including methane), GWP_{100} does not usefully approximate the warming commitment (as per GWP*) or warming contribution (as per FaIR) impact of methane, especially in sectors or countries with a large fraction of methane in total emissions such as in Ireland, primarily due to cattle and sheep farming.

Recommendation

Carbon budget proposal recommendations stated in CO_2e alone are insufficient to inform national climate action aligned with meeting a fair-share Paris Test for Ireland, given the large share of methane in Ireland's emissions profile. Therefore, as in the 2021 CCAC assessment, 'split-gas' scenarios must be specified to document the percentage reduction emission pathways over time for each of CO_2, N_2O and CH_4, separately, and in sum meet the Paris Test. In particular, Teagasc scenarios, which include most methane, MACC measures, and annual reporting need to state pathways and reductions separately for N_2O and CH_4. Currently, Teagasc MACC scenarios often only report CO_2e values rather than stating separate evidenced pathways separately for N_2O and CH_4 which can obscure the critical amount of methane mitigation.

6. What does Paris Test GWP* use indicate for agri-methane mitigation?

Issue

Departmental[24], advisory[25], research[26], and agri-food industry[27] documents suggest that Agriculture (or Agriculture and LULUCF) need only achieve climate neutrality by stabilising its overall sectoral or methane-only temperature contribution. Whether either of these assertions is adequate within national climate action and the recommended carbon budgets can be assessed by analysis of the CCAC Shortlist using consistent CCAC 2021 Paris Test application to the 2021 and 2024 proposals.

Analysis

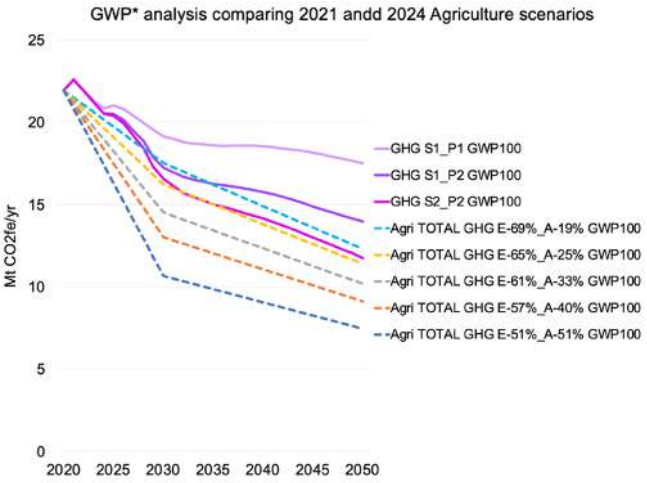

Figure 6. Annual GWP_{100} pathways ($MtCO_2e/yr$) for the Agriculture GWP* output in Figure 4.

Using GWP_{100} CO_2e/yr, the standard GHG equivalence reporting method, Figure 6 shows selected Agriculture mitigation scenarios, 2020–2050, for both the Cycle-1 2021 core scenarios (dashed lines) and the Teagasc agriculture scenarios used in the Cycle-2 2024 Proposal. Figure 6 shows that, compared to Cycle-1, the Cycle-2 Teagasc scenarios delay Agricultural mitigation.

Based on the Figure 6 scenarios, Figure 7, uses GWP* to assess Agriculture GHG forcing in the five Cycle-1 core scenarios (dashed lines) and the three Cycle-2 Teagasc scenarios included in the final shortlist (solid lines). All, except Teagasc's shallowest mitigation scenario S1_P1, are found to reach negative annual CO_2fe/yr values before 2035 and all of these sustain negative annual values for multiple years, due to animal methane mitigation. The forcing impact of the scenarios, based on cumulative CO_2fe up to 2050 shows that even the deepest S2_P2 Agriculture scenario used in the 2024 Proposal shortlist peaks at a higher temperature than the 2021 Cycle-1 scenarios, and the peak is delayed by comparison.

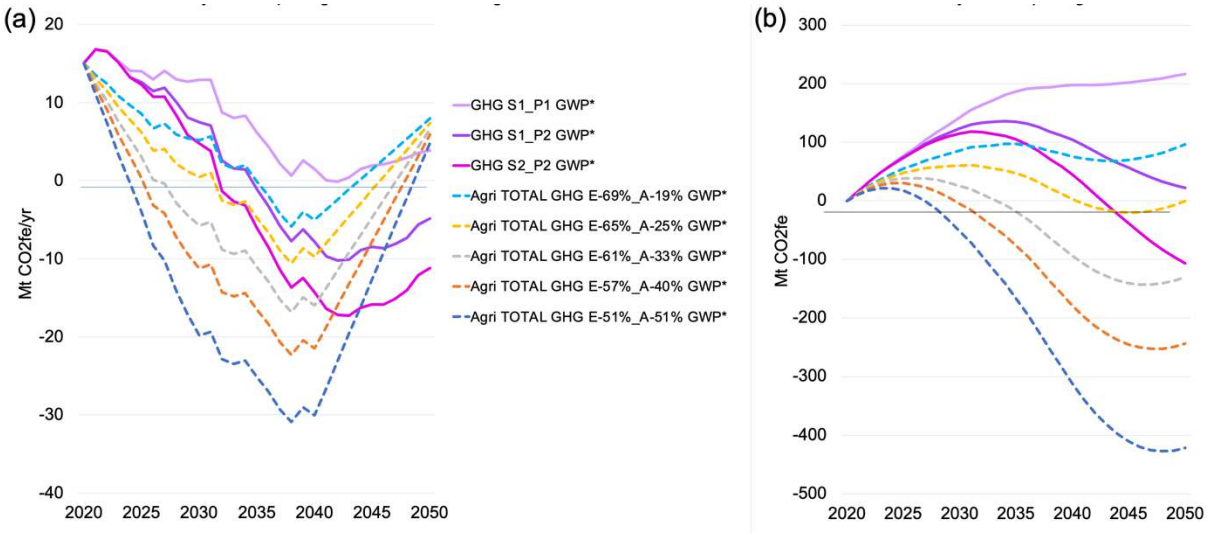

Figure 7. Cycle-1 and Cycle-2 Agriculture: annual and cumulative GWP* analyses.
Cycle-1 (dashed) scenarios are derived based on 2021 core scenario assumptions but using 2024 Proposal Agriculture data. (However, note that, unlike Cycle-1 core scenarios, annual CH_4 and N_2O emissions are assumed to be stable in CO_2e terms at the 2050 level from 2050 onward.) Cycle-2 2024 Proposal Teagasc scenarios (solid) shown include the S2_P2 and S1_P1 scenarios used in the Proposal shortlist, with the additional S1_P1 pathway to show a 'temperature neutrality' sectoral outcome. Left: annual CO_2fe/yr values. Right: cumulative CO_2fe from 2020, providing an approximate comparative scenarios' warming analysis.

(Note: scenario methane mitigation actions from the Teagasc MACC measures are heavily dependent on high adoption by farmers of methane reducing feed additives that may not prove as effective as the Proposal CCAC modelling assumes. For example, the 2023 MACC analysis reports that total dairy sector emissions have increased despite MACC efficiency improvements economic rebound effects – reinvesting resulting increased profits – have increased total dairy production. Therefore, precautionary mitigation, aiming to meet carbon budget and EU goals without fail, is far more likely to limit milk and meat production, and animal numbers, in line with meeting Agriculture emission without fail.[28])

Finding

It is clear from examining the scenario shortlist Agriculture data supporting the Proposal that the only included Teagasc scenarios (S2_P2 and S1_P2) both require early, deep cuts in animal

methane emissions and even deeper cuts in nitrous oxide emissions. Therefore, the Proposal and its underpinning scenarios contradict any suggestion that 'temperature neutrality' is a sufficient 2050 goal for agricultural methane or for the Agriculture sector overall.

GWP* calculation has been applied to support the misleading 'temperature neutrality' or 'no additional warming' interpretation of the Paris Agreement (PA) objective, derived from PA Article 4. In such a case 'net zero' CO_2fe/yr values via GWP* could be achieved within 20 years via minor reductions in methane emissions. However, any such interpretation ignores the PA Article 2 requirements for Parties to make efforts to limit to 1.5ºC that are implemented to reflect equity. Meeting the stringent temperature goal equitably, will require sustained net negative emissions targets[29]. As well as later CDR achievement after 2020, early, deep and sustained cuts in annual methane emissions result in the level of net negative forcing (as per GWP*) and net negative temperature necessary to limit fair-share 1.5ºC overshoot and return to the Paris Test threshold.

Recommendation

GWP_{100} and GWP* analysis show that 2024 Cycle-2 Agriculture scenarios from Teagasc delay agricultural mitigation compared to their Cycle-1 core scenarios, and only the deepest mitigation scenario (S2_P2) achieves a negative GWP* cumulative warming reduction by 2050. Therefore, the CCAC could clarify that 'climate neutrality' is not a sufficient goal for Agriculture overall, or for agri-methane only. Thus the CCAC can advise agriculture-related regulators, advisors, researchers, and industry to correct their messaging to state that Agriculture needs to achieve climate negative outcomes, in forcing and warming terms, through early, deep and sustained reductions in agri-methane emissions particularly.

An emphasis on precautionary action would enforce declining limits on meat and milk production to transition toward increased Irish farming production, and societal consumption of plant-based food crops, directly from tillage and horticulture. This would align with research[30–32] finding that Europe could more resiliently feed its projected, increased 2050 population while cutting synthetic nitrogen fertiliser use and animal feed imports to zero through decreased meat and milk production and increased local nitrogen cycling with a primary focus on growing plant-derived foods.

Conclusion

Overall, this report concludes that the CCAC Proposal requires greater advisory clarity to set out effective climate mitigation policies sufficient to limit emissions warming within a fair-share 1.5ºC threshold, as required by the 2021 climate Act. This report finds that the 2024 Proposal's shortlist scenarios exceed the already agreed, legally binding carbon budgets (CB1 and CB2) up to 2030, implying an urgent need for much stronger mitigation policies and measures to be included in the delayed Climate Action Plan[33].

This report extends the CCAC 2021 Paris Test (as corrected by McMullin et al.[16]) to enable consistent quantitative evaluation of both the CCAC's 2021 (Cycle-1) and 2024 (Cycle-2) carbon budget proposals. Contrary to the 'Paris ratchet' (Paris Agreement, Article 4.3), the 2024 Proposal does not represent a progression in ambition because the CCAC's climate neutrality interpretation and the Letter's version of a "Paris Test" represent inadequate 1.5ºC fair-share ambition relative to the CCAC 2021 Paris Test. Only the deepest of the Proposal's shortlist of scenarios passes

2021 Paris Test. Contrary to the CCAC's interpretation, climate neutrality is not a sufficient test of climate action ambition due to the resulting sustained overshoot of the national 1.5ºC fair share level defined by the 2021 Paris Test.

This report's analysis further shows that expressing proposed recommended carbon budgets in GWP_{100} CO_2e values alone is insufficient to guide climate action aligned with meeting the Paris Test threshold. Thus, explicit detail on the separate mitigation pathways for each of CO_2, N_2O and CH_4 is required for each Shortlist scenario (and for the component scenarios from the energy, agriculture and land models).

Comparison of GWP* analysis with the Temperature Viewer output for 15 shortlisted scenarios shows that GWP* analysis underestimates the warming impact of emissions and peak scenario warming, but it does provide a simply calculated guide to relative scenario outcomes and the 2021 Paris Test for GWP* remains meaningful. Although warming output from a simple climate model using the relevant 1.5ºC low overshoot scenario (SSP1-1.9) – as used in the Proposal's FaIR analysis – is more accurate than GWP*, such usage does not avoid the need for an explicitly defined Paris Test threshold quantification to test scenarios relative to a national 1.5ºC fair-share.

The CCAC scenarios and this report's Paris Test consistency analysis confirm that 'temperature neutrality' by 2050 (also called 'no additional warming' or 'climate neutrality'), stabilising Ireland's temperature contribution at a peak reached before 2050, does not achieve sufficient climate action to meet Ireland's commitment to act in a manner consistent with the Paris Agreement's Article 2 objectives, as required by the 2021 climate Act. In fact, for the Paris Test gases [CO_2,N_2O,CH_4], the shortlist scenarios all substantially reduce temperature impact after peaking prior to 2040. Therefore, the CCAC should correct the Proposal suggestion that *"stabilising Ireland's warming impact"* at a peak warming level by 2050 is the key test of its scenarios. Instead the CCAC should provide a Paris Test that is consistent with returning to a climate neutral temperature stabilisation at the Corrected 2021 Paris Test after peak overshoot of the test's temperature threshold, as per the analysis in Section 2 of this report.

Similarly, this report's scenarios and analysis also confirm that temperature neutrality is a grossly insufficient goal for Agriculture (contrary to many government, advisory, research and industry statements). In fact, as both GWP* analysis and the CCAC FaIR data confirm, early, deep and sustained reductions, in agri-methane particularly, are crucial to achieving the lagged 'temperature negative' outcomes essential to peaking and returning Agriculture's and Ireland's all-sector temperature contribution to meet the Paris Test. The Teagasc scenarios for the 2024 CCAC Proposal are also shown to be less ambitious that those produced for the 2021 CCAC proposal, contrary to the Paris ratchet requirement for increased ambition.

Overall, the CCAC 2024 Proposal does show that significantly increased ambition is practicable for Government in making its next Climate Action Plans, by all sectors, and in the decisions by relevant bodies that, cumulatively, equate to total GHG emissions over time and resultant warming. The Proposal thus indicates that the Government and relevant bodies are not acting in accord with Section 15 (as amended) of the climate Act. Nonetheless, this report's analyses point out six areas where the CCAC could clarify its Proposal and messaging. Otherwise, the public is not being fully informed as to the extreme urgency now required for Ireland's climate action to meet, or even come close to staying within, a minimal fair share of its commitment to meeting the Paris Agreement 1.5ºC temperature goal. The window for 1.5ºC action is closing rapidly. Extended overshoot will be very dangerous.

Appendix 1: Table 1 from CCAC Letter of 1st July 2025

The Climate Change Advisory Council (CCAC) is the expert body that proposes carbon budgets for approval by Ireland's parliament, the Oireachtas. Following the its first CB assessment in 2021[10], the CCAC proposed carbon budgets – CB1 295 $MtCO_2e$ (2021–2025) and CB2 200 $MtCO_2e$ (2026–2030) – were endorsed by the Oireachtas as legally binding, with a provisional budget for CB3 151 $MtCO_2e$ (2031–2035).

Following the CCAC's Cycle-2 CB assessment, a Proposal Report[1] recommended a revised CB3 of 160 $MtCO_2e$ and a provisional CB4 of 120 $MtCO_2$. Independent scientific critique[17] identified that this Proposal did not provide any test of 'equitable implementation', as required by the *Climate Action and Low Carbon Development (Amendment) Act 2021*[9] to be 'consistent with' Paris Agreement Article 2 (2), and as undertaken in the CCAC's first CB assessment[10] in the form of a defined Paris Test[16].

In June 2025, the Joint Oireachtas Committee requested such a test and in response a CCAC Letter[6] of 1st July 2025 set out a Table 1 (replicated below) presenting a shortlist of the 15 scenarios that informed the CB3/CB4 proposal, stating that *"averaging the cumulative GHG emissions for the scenarios, which strictly comply with the 'Paris Test', would result in no change in the Council's carbon budget proposals"*. This sentence appears to refer only to Scenarios 1–5 in Table 1, as these are shown as having an upscaled Step 3 temperature contribution in 2100 of less than or equal to 0.23ºC, the test threshold stated under Step 1.

As discussed in the main text of this report, with reference to the McMullin et al. journal paper[16], the Letter's test definition does not appear to align with the 2021 Paris Test definition which gave this value as a 2050 (rather than 2100) horizon threshold for 2021–2050 scenario emissions. Moreover, the McMullin et al. article corrected the threshold from 0.23 ºC to 0.15 ºC Also it is important to note that the 2021 Paris Test relied on the GWP* method, so the Letter's Step 1 threshold is was for forcing (temperature commitment) in 2021, whereas temperature contributions from the FaIR model are stated under Step 2 ("downscaled") and equivalent Step 3 ("upscaled") values

Table 1: The 'Paris Test' applied to the 15 shortlisted scenarios informing the proposal.

	Scenario	Step 1	Step 2	Step 3	Maximum allowable GHG emissions under a given scenario	
		IPCC AR6 calculation of the remaining gap to the 1.5 °C threshold relative to 2020	The long term temperature impact from Ireland's GHG emissions under a given scenario relative to 2020	Ireland's long term GHG emissions contribution to warming upscaled to global level on the basis of the scaling factor used in the Paris Test	2031-2035	2036-2040
		°C	$x10^{-3}$ °C	°C	Mt CO_2 eq	
1	300mt-led L4 S2_P2	0.23 (0.14-0.32)	0.10	0.15	156	114
2	300mt L4 S2_P2	0.23 (0.14-0.32)	0.10	0.16	151	111
3	300mt-lowbio L4 S2_P2	0.23 (0.14-0.32)	0.11	0.16	149	113
4	350mt-led L4 S2_P2	0.23 (0.14-0.32)	0.14	0.21	170	130
5	350mt L4 S2_P2	0.23 (0.14-0.32)	0.15	0.23	162	128
6	350mt-lowbio L4 S2_P2	0.23 (0.14-0.32)	0.17	0.25	162	128
7	300mt-led L4 S1_P2	0.23 (0.14-0.32)	0.18	0.28	162	122
8	300mt L4 S1_P2	0.23 (0.14-0.32)	0.19	0.29	156	119
9	300mt-lowbio L4 S1_P2	0.23 (0.14-0.32)	0.19	0.29	154	121
10	300mt-led L1 S2_P2	0.23 (0.14-0.32)	0.20	0.31	158	119
11	300mt L1 S2_P2	0.23 (0.14-0.32)	0.20	0.31	153	115
12	300mt-lowbio L1 S2_P2	0.23 (0.14-0.32)	0.21	0.32	150	118
13	350mt-led L1 S2_P2	0.23 (0.14-0.32)	0.24	0.37	171	134
14	350mt L1 S2_P2	0.23 (0.14-0.32)	0.25	0.39	163	132
15	350mt-lowbio L1 S2_P2	0.23 (0.14-0.32)	0.26	0.41	163	132
Average across all 15 shortlisted scenarios					159	123
Average 15 Scenarios (rounded to the nearest 10)					160	120

Figure 8. Copy of Table 1 in the CCAC Letter of 1st July 2025 to the Joint Committee.

Appendix 2: Context

Carbon budgets as a legally binding guide to Climate Action Plans

Ireland's *Climate Action and Low Carbon Development (Amendment) Act 2021*[9] (shortened here to the *climate Act*) set out a programme of carbon budgeting on a five-year cycle, as quantified and recommended by the Climate Change Advisory Council (CCAC), for final approval or amendment by the Oireachtas. Carbon budget periods, set out in megatonnes of carbon dioxide equivalent ($MtCO_2e$) represent legally binding limits on the total greenhouse gas emissions from all sectors in each five year period from 2021–2025 onwards. In each assessment cycle, the CCAC sets out carbon budgets for the next three sequential five-year periods, the first two being for approval or amendment by the Oireachtas and the third being a provisional budget.

Crucially, under the Act the carbon budgeting programme must be *"consistent with"* Article 2 of the Paris Agreement (PA): pursuing efforts to limit global average temperature increase to 1.5°C above pre-industrial levels implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances. Therefore, the CCAC is required to show how Ireland's carbon budgeting is aligned with achieving 1.5ºC equitably. In effect, Ireland's carbon budgeting and meeting its agreed carbon budgets provides a quantification of Ireland's fair share commitment to international climate justice.

The carbon budgets should thus provide a legally binding guide to climate action policy as set out in the Government's definition of sectoral emission ceilings (within the carbon budgets) and its annually updated Climate Action Plan. However, EPA emission projections show that Government climate action to date is falling far short of what is required to meet the budgets: by 2030 the combined two budgets for 2021–2030 (CB1 and CB2) of 495 $MtCO_2e$ are expected to be exceeded by a significant margin of 77 to 114 Mt CO_2eq[7].

CCAC carbon budget proposals to date and the CCAC 2021 'Paris Test'

In its October 2021 **Carbon Budget Technical Report**[10], completing its first cycle of carbon budget assessment, the CCAC defined a quantified **Paris Test** as a pass/fail test of the greenhouse gas emission scenarios to assess the global equity fairness of its three proposed five-year society-wide carbon budgets for 2021–2035. A subsequent journal article, McMullin et al. 2024[16], described the CCAC assessment as an "exemplar case of a transparent national 'Paris Test' of domestic mitigation ambition'", but also provided evidenced critique of the test's quantification and normative choices relative to Ireland's commitment to meeting the Paris Agreement (PA) Article 2 objective.

The 2021 CCAC proposal used GWP* analysis to assess the temperature commitment core scenarios' emissions for 2021–2050 to assess the equity of its 2021 Paris Test based on a global equal-per-capita share of the remaining temperature rise to 1.5ºC and Ireland's 2020 share of global population. Based on annual emissions values for each principal GHGs – carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) – the use of the GWP* methodology enables the climate forcing or temperature contribution of alternative multi-GHG scenarios including methane to be compared. GWP* calculation results in an annual time-series of CO_2 forcing equivalent (CO_2fe/yr) values for each GHG and in aggregate. Mass CO_2fe/yr values are identical to mass CO_2e/yr for CO_2 or N_2O, but these values are very different for methane because changes in annual methane emissions over time have a large impact on the resultant climate forcing and

subsequent, lagged warming. Using GWP* calculation, reducing annual methane emissions at a 20-year average rate greater than -0.3% per year results in negative annual CO2fe values, equivalent to removing the given quantity of CO2 from atmosphere via CDR.

Summing annual CO_2fe/yr values over a time period results in a cumulative CO_2fe change approximating proxy for temperature change, but in GWP* warming analysis the full temperature effect of the methane mitigation over a policy period only becomes fully apparent if the analysis extends 20 years beyond the policy period. A scenario's cumulative CO_2fe over a given period equates to an approximation of climate forcing (warming commitment), which can be converted to equivalent by-gas or multi-GHG temperature contributions, either on a national ('downscaled') basis or a global ('upscaled') fair-share basis. Scenario GWP* cumulative outcomes should approximate the more accurate lagged warming outcomes shown by reduced complexity or 'simple' climate models, such as FaIR or MAGICC.

The CCAC's second cycle of assessment resulted in its December 2024 **Proposal**, setting out five-year carbon budgets for 2031–2040: 160 $MtCO_2e$ for CB3 (2031–2035) and, provisionally, 120 $MtCO_2e$ for CB4 (2036–2040). Unlike the first cycle, the Proposal omitted any quantified equity test of the 15 scenario **Shortlist** underpinning its carbon budget recommendation. Instead the CCAC *"interpreted climate neutrality to be the stabilisation of Ireland's contribution to global warming"* by 2050, but did not test the Proposal relative to meeting a fair-share 1.5ºC temperature goal and with Ireland's commitment to PA Article 2, as required by the 2021 Climate Act.

Following scientific critique[17] of the Proposal's 1.5ºC equity test omission, the CCAC responded to a request from the Oireachtas Joint Committee in a **Letter** of 1st July 2025, setting out a Table applying a version of 2021 Paris Test' to the shortlist.

CCAC 2024 Proposal modelling and commentary

The CCAC emission scenarios underpinning the Proposal combine outputs from three models: an energy and industry CO_2-only model (UCC TIM), agriculture GHGs, primarily CH_4 and N_2O (Teagasc MACC), and a land use model (UL Goblin). Selected warming impact analysis of temperature contributions, collectively or by type are shown in Figure 3. The CCAC Paris Test examines the temperature contribution of the three most important GHGs for sectoral mitigation [CO_2,N_2O,CH_4]: CO_2 emissions mostly come from fossil fuel and cement production; over most CH_4 and almost all N_2O comes from Agriculture; and land use results in CO_2 emissions and removals, as well as substantial CH_4 emissions

Averaging the UCC TIM model values for the 15 shortlisted scenarios, fossil fuel and industry CO_2 emissions have to be cut by -62% by 2030, -87% by 2035, and -96% by 2040 (relative to the key 2018 reference year). Current sectoral projections of much higher energy and cement emissions to 2030 indicate Government policies are not aligned with the CCAC scenario input assumptions.

Within the scenarios, cutting methane has the greatest temperature impact, as the CCAC Temperature Analysis Viewer data shows. The shortlist scenarios – see the CCAC Carbon Budget Emissions Scenario Viewer – show that substantial early and sustained reductions in animal methane emissions (primarily from cattle) are crucial to enabling sufficient warming reduction to limit Ireland's peak all-sector temperature contribution and enable an early return to a 1.5ºC fair share. The shortlist only includes two Teagasc scenarios for Agriculture, both with substantial near-term methane mitigation: S1_P2 (CH_4 -15% by 2030; -22% by 2040) and S2_P2 (CH_4 -19% by 2030; -30% by 2040). These scenarios also require even larger percentage reductions in nitrous oxide (N_2O) emissions (mostly from fertiliser): cut by more than -60% by

2030 and more than -66% by 2040. As prior research warned[19] and the Temperature Viewer data shown in Figure 3 confirms, even these very deep N_2O reductions are far less impactful in limiting warming than the CH_4 reductions.

Notably, in the CCAC's 2021 analysis, the Teagasc scenarios provided for Agriculture required equal percentage CH_4 and N_2O emission reductions, and a minimum -25% reduction for both gases was required for the core scenarios to pass the 2021 Paris Test. As GWP* and simple climate model analysis shows, for the same percent reduction, CH_4 mitigation has a far greater temperature impact than N_2O mitigation. Thus, even the deepest mitigation in the new Teagasc scenarios fall short of the methane reduction that was shown as necessary in 2021.

Methods and Limitations

Data sources and methods

The analysis in this report depends and comments on data, documents and analysis relating to the CCAC carbon budget assessment cycles concluding in 2021 and 2024. The CCAC's 2021 Carbon Budget Technical Report describes the Cycle-1 'core scenarios' and the 2021 Paris Test used to assess them in 1.5ºC global fair-share terms. To provide a basis for consistent evaluation of the two assessments, this report uses the CCAC's 2021 Paris Test definition but accepts the quantification corrections made to that test that are described in the May 2024 journal paper[16] by McMullin et al..

Underpinning its 2024 Proposal, the CCAC released two key Excel workbooks: the *Emissions Viewer*, which provides scenario by-gas emissions data up to 2050; and the *Temperature Viewer*, which provides aggregate and by-gas temperature impact data for selected scenarios relating to the scenario shortlist informing the final carbon budget recommendations.

Based on the CCAC Proposal's Carbon Budget Emissions Scenario Viewer and Temperature Analysis Viewer data[2] and supplementary LULUCF data to 2100[3], this report's desk-based analysis created a new Excel workbook with Annual and Cumulative worksheets to calculate GWP_{100} and GWP* scenario timeseries for Ireland up to 2100. Derived from the calculated cumulative GWP* worksheet results for Ireland, in $MtCO_2fe$ from the start of 2021, equivalent sheets then show downscaled national temperature contribution in mºC (milli ºC) and upscaled global values in ºC. In these sheets, the 2021 core scenario definitions, in terms of by-gas percentage change relative to 2018, were applied to the updated 2024 data to produce 2021-type core scenarios for comparison with the 2024 proposal. Using the Temperature Analysis Viewer, derived Excel sheets were created to show the aggregate and by-gas temperature contributions, on equivalent downscaled and upscaled (via equal per capita and global population share) conversion basis, for each scenario in the 15 scenario shortlist, for comparison with the GWP* output.

This methodology provides a basis for consistent quantitative evaluation of the CCAC's 2024 Proposal's scenarios, carbon budgets and advice, using the CCAC 2021 Paris Test (PT2021) and its GWP* warming impact methodology (as corrected). The Proposal is thereby compared to: the CCAC's 2021 proposal, current policies' national emission projections, and the PA Article 4.3 'ratchet' commitment to increase national climate action ambition over time. This analysis forms the basis of this report's key findings and recommendations.

Limitations

Based on publicly available data and email communication with the CCAC, this report depends on the author's best current understanding of the CCAC Proposal and the subsequent Letter's "Paris Test" version. Further scenario or test clarifications from the CCAC could somewhat change the analysis. Nonetheless, this report provides critical commentary toward assisting the CCAC in making additional advisory adjustments to clarify and better inform the recommended carbon budgets and their consideration by Government. This report does not assess the individual measures or their assumed resultant mitigation within the energy, agriculture, or land models used in the Proposal.

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