ENVIRONMENTAL RESEARCH
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To cite this article: Colm Duffy *et al* 2026 *Environ. Res. Lett.* **21** 088001

ENVIRONMENTAL RESEARCH
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OPEN ACCESS

RECEIVED
2 January 2026

REVISED
3 March 2026

ACCEPTED FOR PUBLICATION
18 March 2026

PUBLISHED
20 April 2026

REPLY

Reply to Comment on 'National temperature neutrality, agricultural methane and climate policy: reinforcing inequality in the global food system'

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Keywords: climate neutral, temperature neutral, Paris Agreement, carbon budget, climate justice, food security, agricultural methane

Abstract

This paper responds to a comment on our study of national "temperature neutrality" (TN) as a basis for climate policy, using Ireland as a case study. The comment mischaracterises our original analysis in several respects; we correct these mischaracterisations and engage with the substantive arguments raised. We demonstrate that the comment constructs a false dichotomy between national TN and net-zero greenhouse gas emissions (NZ-GHG), overlooking the split-gas compromise pathways explicitly evaluated in our original study. In addition, the EU effort-sharing framework is based on absolute GHG emissions reductions, not temperature contributions, and Ireland's obligations under Regulation (EU) 2018/842 and the Paris Agreement require economy-wide absolute reductions. A national TN approach is therefore incompatible with these existing frameworks. We further show that widespread adoption of national TN would create a proliferation dynamic, a "race to the bottom", in which the mitigation gap left by TN-adopting states increases pressure on remaining states, collectively undermining the EU and global mitigation effort. We also rebut the assertion that GWP100 lacks scientific rigour: it is grounded in the same physical climate modelling as TN-based approaches and benefits from a standardised, internationally accepted accounting protocol. Finally, we highlight the equity implications identified in our original study: national TN grandfathers disproportionately high per-capita agricultural CH_4 emissions in Ireland, appropriating emissions space needed by food-insecure developing countries. We conclude that TN is not an effective, fair, transparent, or robust basis for national climate policy.

1. Introduction

Our recent study entitled 'National temperature neutrality (TN), agricultural methane and climate policy: reinforcing inequality in the global food system' [1], received a comment [2]. This is our response.

The aim of our study was to offer a critical examination of the use of 'no additional warming', or TN, approaches to determine national climate policy. To that end, Ireland was used as a case study. Hereafter, the original study [1] will be referred to as Duffy25, and the comment [2] as Wheatley25.

We welcome good faith interpretation and engagement. Wheatley25 is unambiguous on national TN, making a clear, albeit selective, argument in favour of adopting TN as a climate target for Ireland and other '*CH_4-emitting countries*'. However, much of the criticism in Wheatley25 stems from a misunderstanding of Duffy25. As such, we are grateful for the opportunity to clarify the core messages of Duffy25, highlight the various conceptual misunderstandings, and engage in the tangential debate that Wheatley25 offers.

1.1. Key points from Duffy25

To add some context to the rebuttal, and to dispel any misconceptions about what the Duffy25 does and

does not do, we recap the main elements of the study in brief.

Duffy25 uses a suite of emissions scenarios for Ireland, modelled using the reduced-complexity climate model MAGICC [3]. The study assessed how a national TN pathway for Ireland compares with other transition pathways, exploring the potential consequences of prioritising TN in national climate planning.

The national TN pathway was assessed against two split-gas (SG) pathways, and a net-zero greenhouse gas (NZ-GHG) transition pathway. The study concludes that national TN is not the basis of robust, fair, and effective national climate policy. The study uses shared socioeconomic pathway (SSP)1–2.6 as the global baseline, and finds that TN provides only temporary stabilisation. Duffy25 concludes that the unknowable global baseline effectively means that national TN is a '*moving target*' lacking transparency and robustness.

Duffy25 highlights how national TN implicitly 'grandfathers' CH_4 emissions, allowing Ireland to preserve agricultural CH_4 output far above the illustrative equitable 2050 per-capita benchmark derived in the study. The paper broadens the equity lens by highlighting key inequities in the global food system. It posits that a national TN approach risks preserving 'meat-security' for wealthy markets while constraining developmental space for food-insecure countries. Consequently, Duffy25 argues that grandfathering CH_4 emissions to maintain current patterns of animal sourced food product (ASFP) exports is incompatible with fair-share mitigation and a just food-system transition.

2. Conceptual misunderstandings

Before engaging with the substantive points raised in Wheatley25, it is necessary to clarify several conceptual misunderstandings about the claims made in Duffy25. The Wheatley25 comment is framed around three propositions which it attributes to our study:

- that national TN is an '*accountancy trick*',
- that national TN is misaligned with the Paris Agreement (PA) [4], and
- that Duffy25 advocates for a NZ-GHG transition.

Duffy25 does take the position that a national TN approach is not compatible with the PA. However, the remaining propositions do not accurately reflect the claims or analyses in Duffy25. In the sections below, we clarify the most important misunderstandings and issues with the Wheatley25 framing before turning to the broader discussion.

2.1. Net-Zero advocacy claims

Wheatley25 claims of Duffy25 that '*the authors favour a 2050 Net Zero GHG target for developed countries such as Ireland, irrespective of the share of shorter-lived agricultural gases*'. Wheatley25 states that '*Net Zero GHG imposes stronger agricultural GHG emissions reductions than TN*', and that Duffy25 '*consider this outcome preferable*'. However, Duffy25 does not advocate for a specific national pathway. Instead, Duffy25 offers an explicit assessment of '*how national TN compares with other transition pathways and explore the potential consequences of prioritising TN in national climate planning*'.

Wheatley25 cites the statement that '*gradual reductions do not leave sufficient scope for modest increases in agricultural CH_4 by food insecure states that are developing their agricultural sectors*', as further evidence of a preference. This quote is part of an analysis of the limitations of national TN, not an endorsement of NZ-GHG, or any other potential transition pathway.

Wheatley25 attempts to set up a false dichotomy between national TN and NZ-GHG, and in doing so, misrepresents Duffy25. Wheatley25's selective engagement with the transition pathways attempts to frame interpretation of results as advocacy. Unfortunately, this misrepresentation underpins much of the discussion in Wheatley25, rendering substantial elements irrelevant to the claims or analysis presented in Duffy25.

2.2. Misattributed characterisations of national TN ('accountancy trick')

Wheatley25 attributes to Duffy25 the claim that national TN is an '*accounting trick*'. This value-laden language does not appear in the study. Duffy25 critically examines national TN as part of a balanced review. While Duffy25 notes that the national TN framing '*allows ruminant agriculture to continue at or near current levels, while still appearing aligned with global climate goals,*' this is immediately followed by the complementary point that '*support for a national TN approach draws on the behaviour of short-lived gases like CH_4. Unlike long-lived gases such as CO_2, which accumulate in the atmosphere and continue warming until NZ is achieved*' (i.e. NZ-GHG), '*CH_4 breaks down quickly. This means that its contribution to warming can stabilise much sooner and with relatively shallow reductions*'.

Wheatley25 cites the former statement without this accompanying context, interpreting it as an assertion that national TN is an '*accountancy trick*'. This selective attribution is presented as one of the '*primary purposes*' for the comment, but it does not reflect the discussion in Duffy25.

2.3. Unsupported assertions regarding accuracy

Wheatley25 also makes unsupported claims that there are '*several instances*' of errors in Duffy25, '*notably*

in the concluding paragraph, where the often-quoted critiques of GWP'* are '*mistakenly applied to TN*'. However, Wheatley25 did not provide detail of which critiques of GWP* are supposedly misapplied, or how they relate to the analysis presented.

3. Responses & reflections

The remainder of this response addresses the substantive points raised in Wheatley25. Some of these points extend beyond the scope of the analysis presented in Duffy25, but where they raise issues relevant to the interpretation of our study or to the broader context in which it was received, we clarify them here, offering some additional discussion.

3.1. Implications of a European Union (EU) temperature-based alignment framework

Wheatley25's 'Climate Neutral Scenarios' section outlines pathways for achieving climate neutrality within the context of the EU, arguing that an Irish TN approach is sufficient to achieve '*alignment*' of '*warming impacts*'. Wheatley25 uses an indicative NZ-GHG scenario developed by the European Advisory Board on Climate Change (EABCC) [5, 6] to show alignment of an Irish TN pathway with EU climate action, and, by extension, the PA. Wheatley25's claim here is that the only '*relevant issue is the share of EU warming impact, not the share of emissions*', i.e. Ireland's contribution in terms of emissions is not considered relevant once alignment with temperature outcomes is achieved. However, this Ireland-centric framing is flawed from multiple perspectives: legal, conceptual and methodological.

Firstly, EU effort sharing is not based on temperature contribution, it is explicitly based on absolute GHG emissions reductions. Moreover, the EU interpretation of 'climate neutrality' is NZ-GHG [7]. As an EU Member State (MS), Ireland's target under Regulation (EU) 2018/842 [8] is a 42% reduction in emissions by 2030, relative to 2005. Further, the PA also requires developed countries to undertake economy-wide absolute emission reduction targets [4]. Ireland ratified the PA in 2016 [9]; it is not merely party to PA obligations by virtue of its EU MS status. Ireland is not entitled to unilaterally disregard its EU effort-sharing commitments, and it is unrealistic to expect co-signatories of international climate agreements or regulators to accept that some countries abandon their international obligations. This is a major critique of national TN from a pragmatic policy perspective.

Secondly, Wheatley25 uses an indicative EU27 NZ-GHG scenario from the EABCC [5, 6]. The scenario assumes a particular level of emission abatement across the entire EU27 bloc, comprising contributions from each MS including Ireland. Under a national TN scenario, Ireland's mitigation effort is less than expected in the EABCC scenario, leaving a 'mitigation gap'. Essentially, Wheatley25 argues that, as long as the mitigation gap left by Ireland is made up by other MSs, then the EU27 is aligned with the PA, and so is Ireland as a part of the EU27. However, the assumptions underlying Wheatley25's analysis only hold if a national TN approach does not proliferate among EU MSs. Figure 1 presents a conceptual framework outlining the implications of such proliferation. As more MSs adopt national TN targets, the mitigation gap left by their reduced ambition must be absorbed by the remaining MSs. This increases the burden on compliant MSs, undermines effort-sharing, and creates an incentive for additional MSs to adopt national TN targets. Each TN adopter aligns its mitigation effort with the hypothetical EU NZ-GHG scenario; yet, with every defection, the feasibility of achieving EU NZ-GHG diminishes, leading to a collective 'race to the bottom' in which the EU-wide mitigation effort collapses.

This dynamic extends beyond the EU. Wheatley25 argues that a national TN approach need only '*align*' with a global mitigation pathway such as SSP1-1.9 used by the Climate Change Advisory Council (CCAC). This means that Ireland is aligned with a hypothetical 1.5 °C consistent trajectory that assumes steep global CH_4 reductions beyond Ireland. Under this national TN scenario, Ireland reduces CH_4 only enough to stabilise its warming contribution in line with the assumed pathway. If Ireland were the only adopter, the remaining countries could, in principle, still provide the steep CH_4 cuts required for SSP1-1.9. However, if more countries adopt a national TN target, aiming for stabilisation as opposed to a steep decline in CH_4 emissions, the collective ability to deliver the steep global CH_4 decline that TN relies upon diminishes, ultimately undermining the assumptions used to derive the national TN target in the first instance. In this way, the proliferation of national TN creates a global analogue of the EU 'race to the bottom': each new adopter reduces the pool of countries capable of supplying the mitigation effort that all national TN calculations are anchored to.

Beyond the fundamental incompatibility of national TN proliferation with a 1.5 °C consistent trajectory, such an approach would require all countries to agree on the modelling assumptions. Numerous modelling choices are required to run the simple climate models that determine the point of TN for any given country. Unlike the standardised GWP_{100} accounting approach underpinning international emissions reporting, trading and regulation, there is no standardised protocol for determining national TN via climate models. This undermines practicability, transparency and credibility in national target setting.

Finally, Wheatley25 justifies an Irish-centric approach by highlighting Ireland's deeper CH_4 reduction in a national TN scenario relative to the

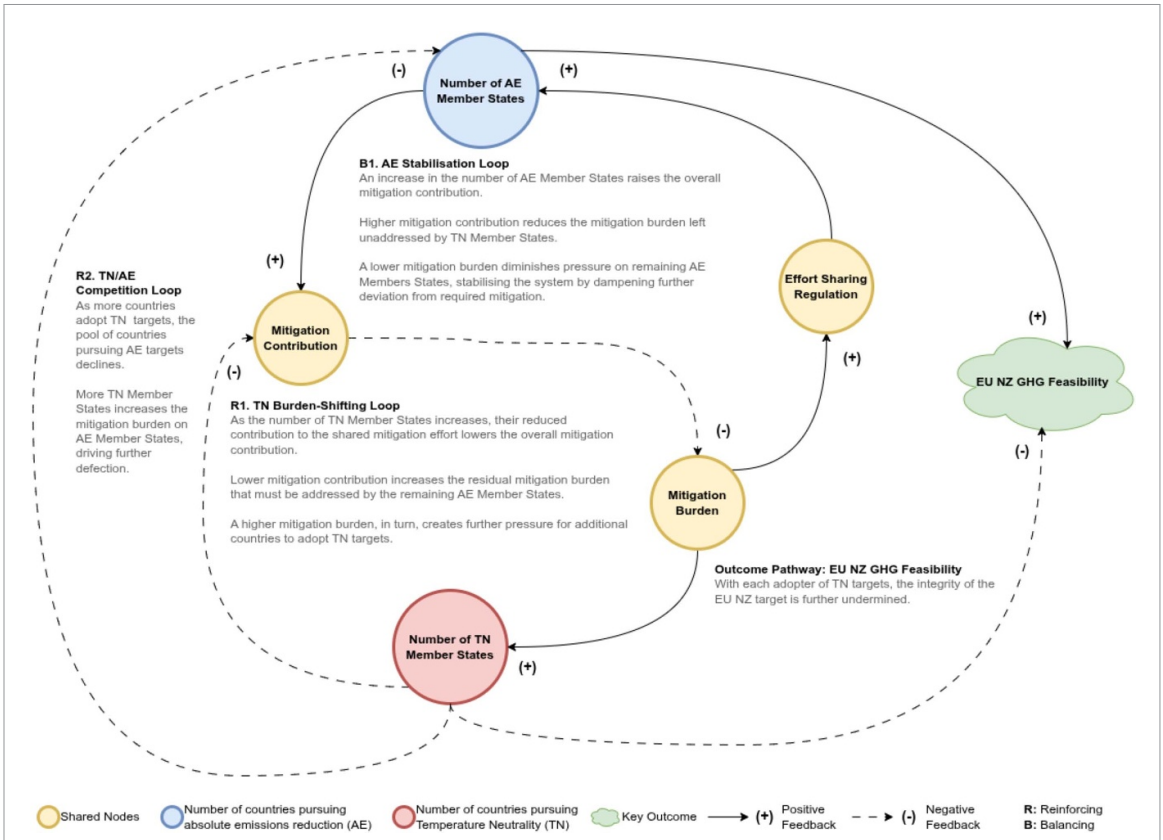

Figure 1. Conceptual illustration of the implications of national temperature neutrality (TN) adoption within the EU. As more Member States adopt national TN targets, the mitigation gap left by reduced ambition must be absorbed by fewer remaining states pursuing absolute emission reductions (AE) under effort sharing commitments. The rising mitigation burden on these AE states creates an incentive for further TN adoption, expanding the gap still further. This dynamic places increasing pressure on compliant states and ultimately undermines the feasibility of the EU-wide NZ-GHG pathway.

Table 1. Sectoral distribution of CH_4 emissions in Ireland and the EU26 (2024).

Total Emissions	Ireland	EU26
CH_4 as % of total GHG emissions	35.58%	12.46%
Sector CH_4 Emission Breakdown		
1. Energy	1.26%	14.33%
2. Industrial processes and product use	0.00%	0.38%
3. Agriculture	75.87%	56.79%
4. Land use, land-use change and forestry	19.31%	3.62%
5. Waste management	3.57%	24.88%
Scenario based CH_4 AFOLU Emissions to 2100		
Per-capita CH_4 emissions	67.5 kg	12.18 kg

Ireland and EU26 2024 emission breakdowns are sourced from the EU's approximated GHG inventories [10]. Projected EU26 emissions are based on the NZ-GHG scenario [5, 6] used in Wheatley25, while projected Ireland emissions are derived from the national TN scenario modelled in Duffy25. EU26 = EU27 excluding Ireland.

EU; with Ireland's CH_4 emissions reduced by 41% relative to the EU NZ-GHG reduction of 24%. However, this does not meaningfully aid understanding. Wheatley25 misses the critical context that agricultural CH_4 emissions in Ireland increased by ca. 13% since 1990, whilst those in the EU decreased by over 20% [10]. To add some additional context to the debate, table 1 shows CH_4 emission breakdowns for Ireland and the EU26 (EU27 less Ireland). The same EU emission and population data [5, 6, 11] as Wheatley25 have been used. CH_4 makes up a substantially higher share of Ireland's emission profile, with a higher proportion from Agriculture Forestry and Other Land Use (AFOLU) sources. As such, Ireland's CH_4 reduction efforts must be substantially larger. However, in 2050, Ireland's per capita CH_4 emissions are over 5.5 times that of the EU26.

3.2. Physical behaviour of CH_4 and mischaracterisation of GWP metrics

Wheatley25's 'Distinctive Characteristics of Agricultural GHGs' section outlines, at length, physical climate response behaviour, with a strong emphasis on '*biogenic* CH_4'. Wheatley25 correctly states that the chemical lifetime of CH_4 is ca. 12 years. However, regardless of the original source (biogenic or fossil), the powerful direct warming impact of CH_4 is the same. The difference between biogenic and fossil CH_4 lies in the categorisation of the CO_2 produced from the oxidisation of CH_4. In the fossil case this represents a net addition of carbon to the atmosphere, while in the biogenic case it returns recently-cycled carbon [12]. It is the warming impact

of CH_4 that is the primary concern over policy-relevant time scales.

Wheatley25's statement, that reduced complexity climate models capture the relevant physics of CH_4 emissions, is also correct. But Wheatley25 incorrectly concludes that GWP metrics like GWP_{100} '*lacks scientific rigour*'. GWP_{100} values are based on climate modelling and therefore account for the physical processes referred to in sections 3A-C in Wheatley25. It is not possible to calculate GWP_{100} values without accounting for these processes, for example the atmospheric lifetime of CH_4 (referred to in 3B of Wheatley25) is one of the key determinants of CH_4 GWP_{100} values.

Point 3D in Wheatley25 notes that GWP_{100} values evolve over time as background atmospheric concentrations change. This is correct, but fails to acknowledge that GWP_{100} values are periodically updated in IPCC assessments precisely to incorporate such changes, and that the evolution of GWP_{100} over the century is slow and predictable compared with the volatility introduced by adopting a fundamentally different framework such as national TN [13]. Wheatley25 repeatedly refers to CH_4 and N_2O as '*agricultural gases*' and invokes the convexity of their forcing-to-concentration relationship to imply that their marginal warming impact is diminishing in a way that is especially relevant to biogenic emissions. This is incorrect: the radiative forcing from CH_4 is independent of its origin, and the convexity Wheatley25 describes is a generic property of the forcing function, not a distinguishing feature of agricultural emissions. Although convexity itself does not cause national TN to be unstable, it does mean that the warming contribution of a country's stabilised CH_4 emissions depends on the evolving global background concentration of CH_4. Duffy25 highlights this '*moving target*' as a key weakness; as global mitigation progresses, the marginal forcing from a constant national emission rate changes accordingly.

Duffy25 illustrates this moving target issue using a CCAC TN scenario and SSP1-2.6, showing that stabilisation is lost as early as 2056. Though Wheatley25 uses SSP1-2.6 in their figure 1, the stabilisation issue beyond 2050 is not addressed, instead, Wheatley25 asserts that the CCAC analysis has used the '*very stringent SSP1–1.9 pathway*', which '*automatically calibrates national CH_4 methane mitigation against the global mitigation effort*'. However, Wheatley25 is not calibrating against the global mitigation effort, but against a hypothetical scenario.

Finally, metrics such as GWP_{100} have been designed to capture the detail needed to be used for emissions accounting, while maintaining the simplicity required to be applied flexibly in the policy context. The fact that more complex models exist does not undermine the fundamental utility of the aforementioned metric, which enables a clear attribution of total warming, unlike national TN. The '*leave one out*' method of modelling GHG emissions with a reduced complexity model, as employed by both Wheatley25 and Duffy25, is an effective method for attributing marginal warming contributions of GHG emissions from countries and other entities. However, such attribution simply reflects the physical climate response captured by the model; it does not indicate whether those emissions are justified, nor does it quantify a country's total contribution to warming, which is the relevant basis for mitigation responsibility and equity under the PA.

3.3. Paris Agreement (PA) alignment

Duffy25 shows that a national TN approach is not compatible with meeting the temperature goals of the PA and is in conflict with its broader obligations. Article 4 requires that Parties '*reflect their highest possible ambition*' and that developed countries '*continue taking the lead by undertaking economy-wide absolute emission reduction targets*' [4]. By replacing absolute reductions with temperature-based criteria, the national TN framework proposed by Wheatley25 lowers ambition and contradicts these obligations.

Furthermore, as shown in section 3.1, the reliance of national TN on assumed global CH_4 trajectories creates a dynamic in which widespread national TN adoption would erode the collective mitigation effort, undermining the very assumptions used to calculate TN contributions. Article 2 of the PA states that it '*aims to strengthen the global response to the threat of climate change*' [4]. Proliferation of national TN approaches will undoubtedly undermine that response.

From an equity perspective (PA Articles 2 and 4), Duffy25 also highlighted the substantial 'grandfathering' embedded in national TN. Ireland's per-capita agricultural CH_4 emissions in 2020 were 6.3 times the calculated global equity share, and under the CCAC TN pathway Ireland would retain more than six times the 2050 global equity share, while the per-capita share under the EU26 NZ-GHG scenario (table 1) largely aligns. This preserves Ireland's disproportionately high share of agricultural CH_4 emission and is in conflict with the PA recognition of the '*fundamental priority of safeguarding food security and ending hunger*' [4]. Duffy25 showed that just 0.3% of Ireland's substantial ASFP exports reach low-income, food-insecure countries, and that national TN adoption by high-emitting countries effectively appropriates the emissions space needed by developing countries to expand ASFP production to address hunger. The EAT-Lancet Commission emphasises the need for healthier diets and fairer distribution rather than maintaining high-emitting production for wealthy markets [14].

Wheatley25 largely dismisses Duffy25's equity and sustainable development analysis as '*normative perspectives*' without engaging with the evidence

presented, making only passing reference to trade, technology transfer and climate finance. The principles of equity, human rights and sustainable development are core elements of the PA. This entrenches Wheatley25's Ireland-centric perspective; ignoring the consequences of national TN proliferation, the developmental needs of food-insecure countries, and the need for wider food system transformation. Duffy25, in contrast, offers a much wider interpretive analysis, grounded in the PA.

3.4. Other Wheatley25 omissions

Wheatley25 defends the CCAC's national TN scenarios, but does so by selectively engaging with a narrow subset of Duffy25's arguments. Several central issues raised in Duffy25 are simply not addressed.

The intense focus on CH_4 ignores the fact that TN distorts the emissions reductions required for N_2O and CO_2. Ireland has high per-capita emissions of both gases. Under national TN, reductions in N_2O and CO_2 are effectively substituted with additional CH_4 reductions, shifting attention away from the carbon dioxide removal (CDR) needed to offset residual emissions. A rapid expansion of land-based and technological CDR is widely recognised as essential for limiting warming to 1.5 °C [15], yet Wheatley25 does not engage with this requirement at all.

Additionally, Wheatley25 ignores the analysis of alternative SG pathways in Duffy25. These pathways represent alternative, compromise, definitions of climate neutrality, which remain pragmatically and transparently based on GWP_{100} accounting. In setting up a false dichotomy between TN and NZ-GHG, Wheatley25 conveniently omits them, even though a compromise pathway is far more likely to garner international acceptance than potentially rewriting the entire accounting rulebook.

3.5. A just transition for farmers

Wheatley25 is justifiably concerned about the domestic societal burden associated with mitigation efforts. The underlying rationale for a national TN approach appears to be that it avoids unnecessary disruption of productive farming systems that underpin rural livelihoods. In fact, current farming in Ireland is characterised by numerous socio-economic, as well as environmental, problems. Just 43% of farms are classified as economically viable, and there is a succession crisis brewing with an average farmer age of 59 years old [16]. Meanwhile, penalties associated with missing EU targets post-2030 could cost Irish society as much as €26 billion [17]. Adopting a flawed climate target that puts Ireland off course to comply with the EU Effort Sharing Regulation in GHG reduction may be politically convenient in the short-term, but certainly does nothing to address the underlying challenges faced by Ireland's farmers.

Recent bioeconomy focused modelling work shows that SG pathways have the potential to produce more food, more fibre and more energy than today, whilst sparing land for nature [18]. A compromise SG target would be based on current GWP_{100} accounting, and is more closely aligned with AFOLU actions needed at global scale, reducing reputational and regulatory risk compared with a 'go-it-alone' national TN approach. SG targets can also be designed to ease mitigation burdens to domestic industry, while remaining consistent with international emissions policies. In summary, TN is a beguiling but flawed basis for national climate policy that distracts from the socio-economic and environmental imperative for a more substantial reappraisal of sustainable and resilient farming.

4. Conclusion

We welcome the opportunity for further reflection on national TN as a basis for climate policy offered by Wheatley25's selective engagement with Duffy25. However, Wheatley25 mischaracterises much of the analysis in Duffy25, setting up a false dichotomy between national TN and NZ-GHG; as such, much of the debate is tangential to Duffy25.

We stand by our evidence: TN is not an effective, fair, transparent or robust basis for national climate policy. However, engagement in additional debate has provided the opportunity to further elaborate on some of the fundamentally flawed assumptions that underpin national TN modelling, which, if widely adopted, would result in a 'race to the bottom', undermining the global mitigation effort. National TN is not aligned with EU effort-sharing or the PA.

At its core, the divergence between Wheatley25 and Duffy25 arises from fundamentally different framings of the climate policy problem. Wheatley25 approaches national TN narrowly, viewing it primarily as a mechanism to reduce domestic mitigation burdens, whereas Duffy25 evaluates national TN within the broader context of Paris-aligned responsibility, equitable burden-sharing, and the structural features of the global food system. As the analysis in Duffy25 shows, stabilisation is lost once global conditions deviate from the assumed pathway, making national TN an inherently unstable target that is highly sensitive to external factors. Furthermore, Wheatley25 does not engage with the implications of national TN for CO_2 and N_2O mitigation, nor with global food security, in particular the injustices and inefficiencies associated with preserving disproportionately high CH_4 emissions for high-income ASFP producers supplying predominantly high-income consumers.

The selective focus of Wheatley25 also overlooks the practical and political (in)feasibility of national

TN, compared with various alternative approaches. The SG (compromise) pathways evaluated in Duffy25 are based on existing GWP_{100} accounting, and offer a transparent and internationally coherent basis for a compromise definition of climate neutrality. They avoid the problem of 'moving targets', and better align with the PA and EU requirements for absolute emission reductions.

We thank Wheatley for the opportunity to further engage with the arguments put forward by national TN proponents. We believe this has helped to highlight the shortcomings of a national TN approach for climate policy and to clarify the reasons for divergent views.

Acknowledgment

CDu & DS are grateful for funding provided by Ireland's Department of Climate, Energy and Environment through a services contract to develop and use modelling capacity via the FORESIGHT consortium, and through the LandingZoNES project. HD & RM are grateful for funding provided to the SELFS project. Both projects are funded through the EPA Research Programme (2021-2030), which is a Government of Ireland initiative funded by the Department of the Climate, Energy and Environment. DS and HD were members of the CCAC-appointed Carbon Budgets Working Group, contributing AFOLU and energy scenarios, respectively, to inform recommended carbon budgets. CD was the principal developer of the open-source AFOLU model used but was not involved in its application for the CCAC carbon budget scenarios.

Conflict of interest

The authors declare that they have no conflict of interest.

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References

[1] Duffy C, Doedens C, Moriarty R, Daly H, Styles D and Meinshausen M 2025 National temperature neutrality, agricultural methane and climate policy: reinforcing inequality in the global food system *Environ. Res. Lett.* **20** 094019
[2] Wheatley J 2026 Comment on 'National temperature neutrality, agricultural methane and climate policy: reinforcing inequality in the global food system' *Environ. Res. Lett.* **21** 088002
[3] Meinshausen M, Raper S C B and Wigley T M L 2011 Emulating coupled atmosphere-ocean and carbon cycle models with a simpler model, MAGICC6—Part 1: model description and calibration *Atmos. Chem. Phys.* **11** 1417–56
[4] UNFCCC 2015 Paris agreement on climate change. United Nations framework convention on climate change (available at: https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf#page=5.26)(Accessed 23 March 2026)
[5] European Environment Agency., European Scientific Advisory Board on Climate Change 2023 Scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030–2050 (Publications Office) (available at: https://data.europa.eu/doi/10.2800/609405) (Accessed 27 November 2025)
[6] Byers E *et al* 2023 *Scenarios Processing, Vetting and Feasibility Assessment for the European Scientific Advisory Board on Climate Change* (IIASA) (available at: https://pure.iiasa.ac.at/18828)
[7] EU 2021 REGULATION (EU) 2021/1119 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL (European Union) (available at: https://eur-lex.europa.eu/eli/reg/2021/1119/oj/eng#:~:text=Climate) (Accessed 27 February 2025)
[8] European Union 2023 Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030. Consolidated version OJ L 156 (available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02018R0842-20230516&qid=1710343267770)
[9] United Nations 7. d Paris Agreement (United Nations) (available at: https://treaties.un.org/doc/Publication/MTDSG/Volume%20II/Chapter%20XXVII/xxvii-7-d.en.pdf)
[10] European Environmental Agency 2024 Approximated estimates for greenhouse gas emissions (available at: www.eea.europa.eu/en/datahub/datahubitem-view/f6e68f73-b494-4f8c-8c73-8a153a53f64a) (Accessed 27 November 2025)
[11] Eurostat EUROPOP2023: population projections for the EU and EFTA countries (available at: https://ec.europa.eu/eurostat/databrowser/view/proj_23np/default/table)
[12] Intergovernmental Panel On Climate Change (IPCC) 2023 *Climate Change 2021—The Physical Science Basis: Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* 1st edn (Cambridge University Press) (available at: www.cambridge.org/core/product/identifier/9781009157896/type/book) (Accessed 27 November 2025)

[13] Reisinger A, Meinshausen M and Manning M 2011 Future changes in global warming potentials under representative concentration pathways *Environ. Res. Lett.* **6** 024020
[14] Rockström J *et al* 2025 The EAT–Lancet Commission on healthy, sustainable, and just food systems *Lancet* **406** 1625–700
[15] Shukla P R, Skea J and Reisinger A R IPCC 2022 *Climate Change 2022: Mitigation of Climate Change* (IPCC) p 1
[16] Dillon E, Donnellan T, Moran B and Lennon J 2025 Teagasc national farm survey 2024 (Teagasc) (available at: https://teagasc.ie/wp-content/uploads/uploads/media/website/publications/2025/NFSReport2024.pdf) (Accessed 12 September 2025)
[17] IFAC, CCAC 2025 A colossal missed opportunity : Ireland's climate action and the potential costs of missing targets Irish Fiscal Advisory Council and Climate Change Advisory Co%20of%20missing%20targeuncil (available at: www.climatecouncil.ie/councilpublications/otherpublications/Ireland%E2%80%99s%20climate%20action%20and%20the%20potential%20costs%20of%20missing%20targets%20FINAL.pdf) (Accessed 18 March 2025)
[18] Styles D *et al* 2025 Science & policy WP7 summary report (IEA Bioenergy) (available at: www.ieabioenergy.com/wp-content/uploads/2025/09/IEA-Bioenergy_Intertask_BECCUS_Phase2_Science-and-Policy-Report.pdf)