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RESEARCH ARTICLE

Reframing the climate debate: The origins and diffusion of net zero pledges

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Abstract

Achieving net zero emissions has rapidly become the dominant long-term objective guiding national climate policies. At the end of 2018, only 24 countries were considering or had adopted long-term net zero targets. By the end of 2021, this had climbed to almost 150 countries, covering 89 per cent of global carbon emissions. In this article, we trace the origins and diffusion of net zero pledges through the lens of international norm theory. Drawing on a newly compiled database of national net zero targets, our analysis highlights the critical role played by climate scientists, transnational advocacy networks, and norm entrepreneurs in articulating the norm of net zero emissions. The IPCC's fifth assessment report was foundational, by introducing the concept of a cumulative carbon budget, allowing translation of abstract temperature goals into more actionable net zero targets. The norm of net zero has been institutionalised at the global political level in the period 2015–2018 and cascaded through the international system in 2019–2020. Yet, it remains subject to various forms of contestation, most notably regarding validity, fairness, scope, and implementation. The norm is now at a critical stage in its lifecycle that will decide whether it gets institutionalised or suffers backsliding and even erosion.

1 | NET ZERO AS AN INTERNATIONAL NORM

In recent years, most countries have rallied behind the goal of reaching net zero emissions by the middle of the century (Fankhauser et al., 2022). In an optimistic scenario, if all net zero commitments are met, the projected median temperature rise by the end of the century could be brought to or just below the symbolic 2°C mark (Meinshausen et al., 2022). However, net zero targets are often adopted without any intermediate targets or specific policy measures (Rogelj et al., 2021). That is why some observers see net zero pledges as a form of 'performative politics' (Aykut et al., 2021), distracting attention from more tangible policies and measures that can help reduce emissions in the short-term.

We argue that net zero pledges constitute a typical case of an emerging international norm, a 'standard of appropriate behavior' (Finnemore & Sikkink, 1998, p. 891). The power of norms is that they are seen as legitimate and entail a sense of 'oughtness', that is, they define what actors should or should not do. Examples of international norms include the abolition of slavery (Klotz, 2002), the introduction of women's suffrage (Finnemore & Sikkink, 1998), and the banning of chemical weapons (Martínková & Smetana, 2020). In recent years, new norms have emerged around climate change and decarbonisation, such as fossil fuel subsidy reform, divestment, and zero deforestation (Blondeel et al., 2019; Green, 2018).

The speed with which the net zero norm has cascaded throughout the international system is remarkable. At the end of 2018, there were only a handful of states that had adopted a net zero commitment. As of mid-2022, there were 146, and counting (Figure 1). To put this in perspective, it took more than 60 years for half

of the world's countries to adopt women's suffrage since it was first adopted by New Zealand in 1893 (Ramirez et al., 1997). To be fair, some international norms also spread rapidly, such as the prohibition of antipersonnel landmines (Price, 1998). Yet, to see so many countries (including major emitters) suddenly and voluntarily embrace the goal of net zero emissions is a significant departure from many years of gridlock in global climate governance (Hale et al., 2013; Victor, 2011). No other major climate norm has been embraced so widely so rapidly.

Here, we trace and explain the rapid diffusion of net zero pledges as a new international norm. While many non-state actors have made net zero commitments, we focus on national governments. Our analysis highlights the critical role played by both norm entrepreneurs, in particular, the self-dubbed 'Lionesses group', an informal network of mostly female climate negotiators and advocates founded in 2013, and epistemic communities, notably the IPCC. The IPCC's Special Report on 1.5°C marked a tipping point in the diffusion of net zero pledges, as governments endorsed the concept in the report's summary. Yet, despite net zero becoming a dominant frame in climate policy debates, the concept remains heavily contested.

In the next section, we embed our analytical approach within the literature on international norm theory and discuss our methods and data sources. In Section 3, we trace the articulation, emergence and development of the net zero norm. In Section 4, we discuss the continued contestation of the net zero norm and how it affects the role and importance of net zero pledges within the changing architecture of climate governance. Finally, we reflect on our results and their empirical and conceptual implications.

Policy Implications

- With almost 150 countries and an even larger number of non-state actors adopting net zero pledges, net zero has rapidly become a global norm, increasing the social costs (to reputation, status, etc.) on holdouts that have not yet adopted the norm. Each country, company, or other entity not adopting the norm will face increasing pressure to justify its position.
- The scientific community and, more specifically, the IPCC can successfully articulate new global norms, rooted in an evolving scientific understanding of a global problem. These norms are more likely to diffuse through the international system with support from transnational advocacy groups.
- Countries have adopted net zero pledges with different motivations, ranging from persuasion (being convinced that net zero is the right thing to do) to mere virtue signalling (only backing the idea to look good to others). Even so, net zero now provides a focal point around which civil society and other actors can mobilise. Those countries that are merely 'posing' can find themselves rhetorically entrapped in their own pledges.
- Now that a critical mass of states has rallied behind the global norm of net zero, the focus of policy-makers and campaigners should turn to norm implementation and compliance. This requires the development of national roadmaps that, at a minimum, set intermediary targets, identify concrete policy measures, and establish monitoring and review systems.
- Like many other global norms, net zero remains subject to contestation, notably regarding its validity and fairness. There is a serious risk of norm erosion or backsliding if these issues remain unresolved. To achieve successful institutionalisation and implementation, major developed economies should take the lead in acting on their net zero pledges in a rigorous, transparent and resolute way.

2 | ANALYTICAL APPROACH AND METHODS

2.1 | Theory of norm dynamics

2.1.1 | The drivers and stages of norm diffusion

The classical model of international norms is Finnemore and Sikkink's (1998) three-staged life cycle model. The first stage, *emergence*, refers to the origins of norms, that is, how they are built by norm entrepreneurs who communicate and promote new norms through organisational platforms. After passing a tipping point, norms may *cascade* throughout the international system as a majority of states adopt the norm. The final stage, *internalisation*, is reached when a norm is so widely accepted it is no longer questioned and compliance with it becomes *quasi* automatic. Not all norms reach this final stage. The focus of our research lies with the first two stages: the emergence and cascade of the net zero norm.

Multiple actors and mechanisms steer a norm through its life cycle. One crucial factor is the role of norm entrepreneurs, that is, individuals and groups interested in changing existing social norms (Sunstein, 1996). In some instances, these norm entrepreneurs are organised into transnational advocacy networks. New norms

may also be shaped by epistemic communities, or groups with specialised knowledge (Haas, 1992). Such communities of experts often disseminate new norms or understandings along with their technical expertise (Finnemore & Sikkink, 2001).

The most persuasive, and therefore successful, norm entrepreneurs are those able to frame their normative ideas in ways that resonate with a broader, relevant norm audience. This makes framing, or the use of language naming, interpreting, or even dramatising the issue, another crucial factor driving norm diffusion (Johnston, 2001; Payne, 2001; Wiener, 2004). Once a set of states has been persuaded to adopt a norm, additional diffusion mechanisms kick in, notably socialisation and peer pressure. For example, states may adopt a norm because they seek legitimation, conformity, and esteem in the relevant social group with which they identify (Finnemore & Sikkink, 1998).

Another determinant of the success of norms is the extent to which they 'fit' with the dominant 'liberal environmentalist' social order (Bernstein, 2000, 2001; Florini, 1996; Okereke, 2008). Norms that are predicated on the liberal market norms of free trade, open markets, or the support of market instruments over regulatory mechanisms are thought to have greater chances of success. The structural context in which norms are formulated is therefore important, even if it is not all-determining. Rather, actors may pursue social change but their choices may simultaneously be shaped by the rules generated within that very social context they are seeking to change. The relationship between agency and structure, in other words, is co-constitutive in nature (see also Wunderlich, 2013).

2.1.2 | Dynamics of norm contestation

Norm diffusion is most often measured by looking at institutionalisation (Bernstein, 2001; Finnemore & Sikkink, 1998). Norm institutionalisation refers to the degree to which a norm is discursively embraced and accepted by the relevant norm audiences. Evidence of discursive acceptance can be found in treaties and conventions, agreements, rules, standards, and commitments (Bernstein, 2001). It reveals how many states feel constrained by a particular norm, which can help to situate a norm along the stages of its life cycle.

Yet institutionalisation is not the end of the story. Since norms are standards of appropriate behaviour, their strength can be measured by not just looking at rhetoric, but also at behaviour itself. Norm implementation entails the process of translating a norm into formal legislative and policy mechanisms 'and the subsequent use of these mechanisms' (Betts & Orchard, 2014; Stimmer & Wisken, 2019). Global climate governance has long been plagued by an inconsistency between rhetoric and action, which Stevenson (2021) has provocatively labelled 'bullshit'. Aykut et al. (2021) have similarly criticised the 'symbolic and discursive dimension' of the post-Paris climate regime and describe it as a form of 'incantatory governance' that assumes communicative and symbolic devices to be core instruments of the Paris Agreement.

Recent scholarship has highlighted how norms remain subject to contestation, even if they progress from one stage to another in their lifecycle. New norms sit in a highly contested normative environment (Florini, 1996; Krook & True, 2010), may face opposition from norm opponents or 'norm antipreneurs' (Bloomfield, 2016), and are constantly subject to re-interpretation and re-formulation. As Krook and True (2010, p. 104) note, norms should be seen as 'works-in-progress', rather than finished projects.

Contestation can occur in different forms. Discursive contestation entails discussions around a norm's definition, (relative) importance, legitimacy, values, and precepts (Stimmer & Wisken, 2019; see also Wiener, 2004, 2014). Contestation by means of actions that affect or interfere with implementation is referred to as behavioural contestation. In other words, discursive contestation focuses on meanings and interpretations while behavioural contestation focuses on actions (Stimmer & Wisken, 2019; Wunderlich, 2013).

2.2 | Research design

Our research takes the form of a disciplined interpretive case study (Odell, 2001). This type of study aims to interpret an event, in our case the development of net zero, by applying a known theory to a new domain. Norm theory allows us to 'see' and better understand discursive, organisational and ideational dimensions inherent to international climate policy processes that other, interest-based accounts, often do not. Rather than laying out a causal (and, often teleological) process of norm emergence and diffusion, our aim here is to expand the understanding of the complexity of norm dynamics by also exploring the process of contestation.

Although a growing group of subnational governments, cities, investors, banks, and even international oil companies have committed to net zero (Hale et al., 2021), the focus of this article is narrowed to national governments. One reason is that international norm theory itself has a general focus on norm dynamics between countries (Finnemore & Sikkink, 1998). Moreover, countries play a vital role in the formalisation of climate policy and climate goals, partially from their position as the central parties to the United Nations Framework Convention on Climate Change (UNFCCC), the main venue for multilateral climate action. Countries are also increasingly being held accountable to the climate goals they set through legal action and protests (Setzer & Vanhala, 2019).

Our empirical data comes from both primary and secondary sources. We obtain primary data from documentary research of (open source) policy documents, speeches and public statements of political actors, policy-makers, the scientific community and civil society. Secondary sources include the reporting of various international media outlets as well as NGOs, research institutions, think tanks, or international organisations. We also used quantitative data in the form of an overview of national net zero goals as well as specific queries in English newspapers in the ProQuest central database.

The overview of net zero goals is partially based on data from Net Zero Tracker (Hale et al., 2021). Using their methodology and panel data as a starting point, we collected pledges, speeches, legislation, etc. throughout time to provide an overview of net zero diffusion over time. These data points were assembled from the aforementioned secondary sources, academic literature accessed from the SCOPUS database and through specific searches on the Google search engine. Figures 1–3 were generated using R in the RStudio environment, with the maps being created using the tmap package (Tennekes, 2018). The datasets are made available on the Zenodo data repository (Van Coppenolle et al., 2022a, 2022b).

3 | THE LIFE CYCLE OF THE NET ZERO NORM

3.1 | Norm emergence: the road to Paris

The emergence of the net zero norm can be situated in the period between the early 2000s and COP21 in December 2015. We distinguish two tracks within this phase, based on our collected data: a scientific-institutional track and a political-advocacy track. The scientific-institutional story of net zero is characterised by the synergy between the formalisation of temperature goals and carbon budgets in efforts like the Copenhagen Accord, IPCC Assessment Reports, and the Paris Agreement. In tandem with this track, there was also the pivotal work of advocacy groups and norm entrepreneurs pushing for net zero through NGOs and global climate networks.

3.1.1 | The scientific-institutional track

While net zero dominates current discussions of climate policy, the norm did not emerge out of a vacuum but had several predecessors and competing framings (Table 1). There are three main types of targets: those focusing on concentrations, temperatures, and emissions. Each of them collapses the complexity of the climate system and its interaction with human behaviour into a single metric of climate performance. While not all of them have been equally influential, their purpose was to serve as benchmarks or' 'anchors' to guide climate policy, corporate strategy, and activist campaigns (van der Sluijs et al., 1998). We first touch on these developing concepts and norms, as they together created a sequence that would end up with the net zero norm we know today.

The overarching goal of global climate governance was specified in Article 2 of the 1992 UNFCCC:

> To achieve […] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
>
> (United Nations, 1992, art. 2)

The translation of this stabilisation target into concrete policy objectives was an arduous task, given political

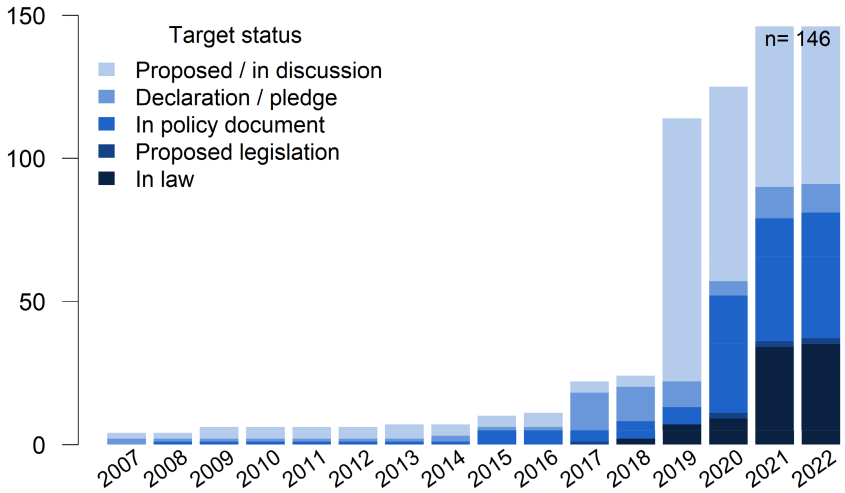

FIGURE 1 Number of countries committed to net zero targets. *Source*: Compiled by Van Coppenolle et al. (2022a).

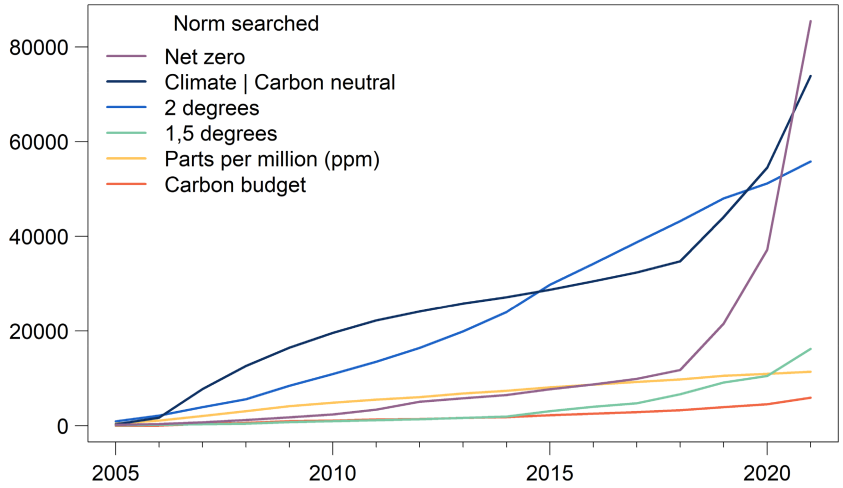

FIGURE 2 Cumulative climate norm mentions in newspapers from 2005 until 2021. *Source*: Cumulative, absolute mentions of several specific climate norms in newspapers since 2010, gathered from the ProQuest central database (Van Coppenolle et al., 2022b).

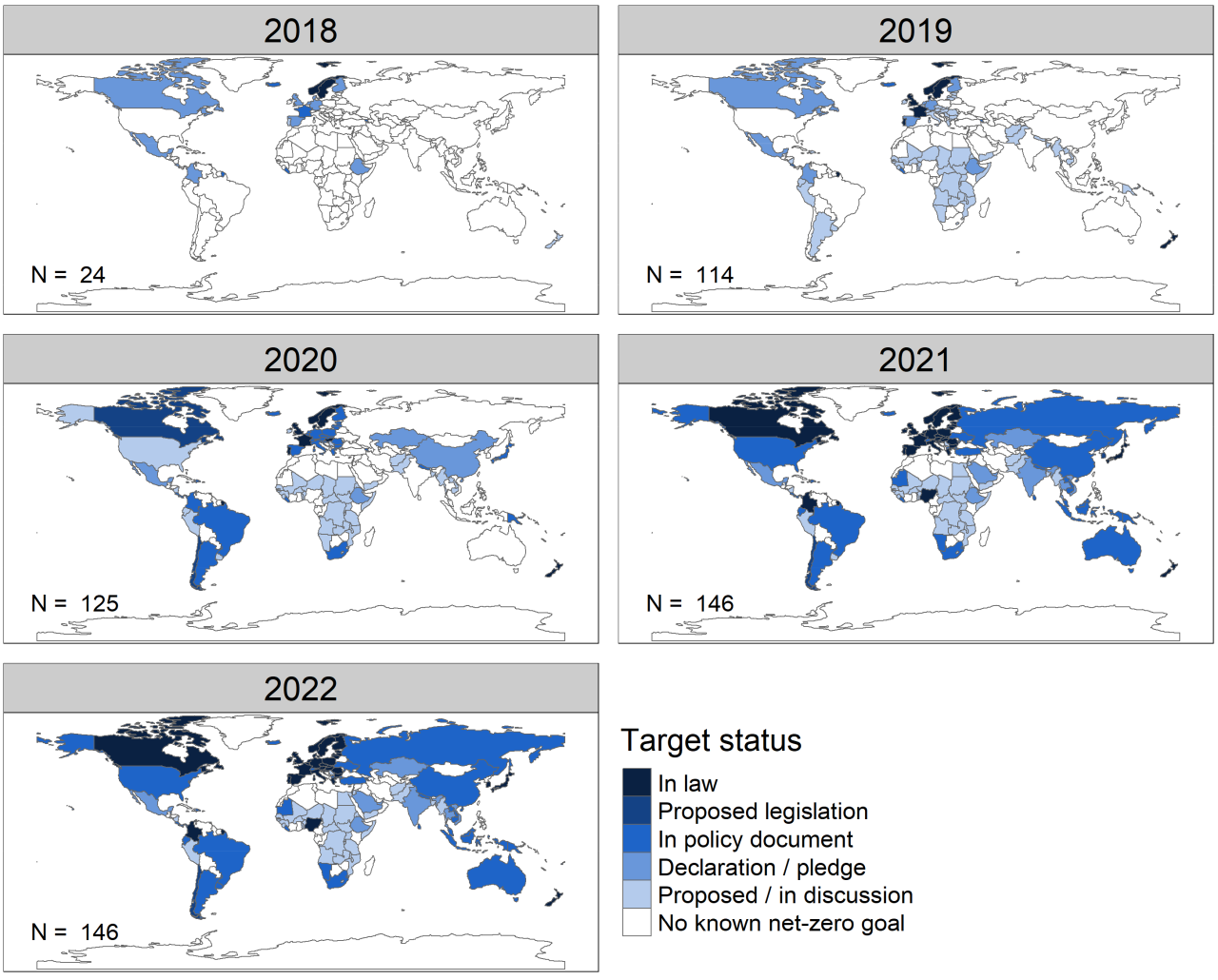

FIGURE 3 Diffusion of net zero targets from 2018 to May 2022. *Source*: Collection of historical net zero targets (Van Coppenolle et al., 2022a).

TABLE 1 Key framings of global climate targets.

Climate targets	Unit
Greenhouse gas concentrations	Parts per million (ppm)
Emission cuts	Percentage from a baseline
Outcome temperatures	Degrees celsius (°C)
Radiative forcing	Watts per square metre ($W\,m^{-2}$)
Cumulative carbon budgets	Gigatons of CO_2
Carbon intensity	CO_2 emissions per unit of GDP
Peak in emissions	Year
Net zero emissions (carbon/climate neutrality)	Year
(Near) zero emissions	Gigatons of CO_2 (or CO_2-eq)

Sources: Based on McLaren and Markusson (2020), Oppenheimer (2005), Boykoff et al. (2010), Lenton (2011), and Matthews and Caldeira (2008).

differences over what constitutes 'dangerous' interference (Oppenheimer, 2005), and evolving scientific understandings, particularly about climate sensitivity to CO_2 concentrations (Andronova et al., 2007).

One of the first reinterpretations of the UNFCCC's goal to avoid 'dangerous' climate change came in the form of the emission reduction targets introduced in the Kyoto Protocol (UNFCCC, 1997). The problem with setting goals in terms of emission cuts was that they could not easily capture the potential of negative emission technologies like bioenergy with carbon capture and storage (BECCS). Climate models, as reported by the IPCC (notably AR4 and AR5), therefore still centred on a particular GHG concentration target, notably 450 ppm. This 'ppm' framing was also pushed by the activist network 350.org, which was set up in 2007, taking inspiration from the work of climate scientist James Hansen (McLaren & Markusson, 2020).

Nonetheless, international climate policy seemed to lean towards a temperature-based target, namely that the world should not warm more than 2°C above pre-industrial temperatures. While the two degrees target was already well entrenched in climate policy discussions since the mid-1990s, it was formally endorsed by the EU in 2007 and the G8 in 2009 (Randalls, 2010), and it was referred to in the Copenhagen Declaration (UNFCCC, 2009). Yet, it was not until the 2010 Cancun Agreements before the two degrees limit became formally enshrined in international climate politics, with governments committing to 'hold the increase in global average temperature below 2°C above pre-industrial levels' (UNFCCC, 2011).

These developments made scientists and policymakers turn their sights to the question of *how* to achieve this temperature goal: more specifically, working out the corresponding greenhouse gas (GHG) emission reduction pathways. Carbon budgets would provide the scientific and geophysical foundation for translating the temperature goals into more actionable targets, such as net zero pledges (Geden, 2016).

The 2014 IPCC's fifth assessment report (AR5) firmly established the concept of a carbon budget. When considering pathways likely to limit warming to below 2°C, the report stated that 'these pathways would require […] near zero emissions of CO2 and other long-lived greenhouse gases by the end of the century' (IPCC, 2014, p. 20). AR5 thus made the connection between the temperature goal, the carbon budget, and the concept of 'near zero emissions' (Lahn, 2020). Carbon budgets radically changed the approach to climate change, shifting from debates on acceptable amounts of atmospheric concentrations over time to a unitary quantity of emissions allowed within the budget (Lahn, 2021).

The concept of net zero emissions can also be expressed as 'carbon neutrality' (when referring to net zero carbon emissions) or 'climate neutrality' (when referring to net zero greenhouse gas emissions). Overall, however, net zero emission targets are scientifically more clearly defined than neutrality concepts (Hansen et al., 2008; Rogelj et al., 2015). Figure 2 shows that net zero has become the dominant climate norm among alternative framings in media articles since 2019.

3.1.2 | The political-advocacy track

Parallel to the scientific track, some countries had already adopted some form of net zero much earlier than the boom in 2019 (Figure 1), albeit under the label of carbon neutrality. New Zealand, Norway, and Costa Rica were the first to adopt a carbon neutrality pledge in 2007. In the ensuing years, their example was followed by a handful of others, including Iceland (2008), Maldives (2009), Ethiopia (2013), Marshall Islands (2015), and Portugal (2016) (Flagg, 2015; Republic of the Marshall Islands, 2015; Yamin, 2021). These early adopters showed the beginnings of political support to the norm.

These early neutrality pledges built heavily on carbon offsetting and carbon accounting, ideas that are still relevant, as they refer to the 'net' in net zero. After all, it will be very difficult to reduce all emissions to zero on the timescale needed, therefore any remaining emissions will need to be 'balanced' through removals by sinks, emissions trading or offsetting mechanisms; so-called flexibility mechanisms that are embedded within the global climate governance architecture (UNFCCC, 2016). The 1997 Kyoto Protocol's, for example, allowed for participating, industrialised Annex-I states to meet their targets based on a collection of flexibility mechanisms such as joint implementation or the Clean Development Mechanism (Held & Roger, 2018), while the governance of carbon markets in the 2015 Paris Agreement

is arranged under its Article 6. As such, the norm's fit within the extant global climate governance architecture helps to better understand its emergence and early successes (Bernstein, 2001).

This does not mean that agency has not played a part in the emergence phase of the norm. Quite the contrary, an important role can be attributed to norm entrepreneurs. Long-time climate advocate and negotiator Farhana Yamin is accredited to be the first norm entrepreneurs to promote net zero (Darby, 2019).

Yamin's focus on net zero emerged from a critique of the discussions around temperature limits, with the Sudanese chief negotiator for the G77 group of developing countries denouncing the Copenhagen accord, and its 2° objective, as 'a suicide pact' (Lynas, 2009). Yamin realised that discussions around half a degree difference between 1.5 and 2°C were too vague, and therefore hard to communicate to policy-makers and the wider public. For Yamin, net zero was a more practical and unifying translation of the science, even better than 1.5°C (Yamin, 2021). Base years no longer matter, questions of burden-sharing and justice only affect the timeframe (i.e., 'by when should we reach net zero?') and, as such, net zero is a more actionable target than carbon budgets (see also Rogelj et al., 2019).

In March 2013, she pitched the net zero idea at the Paris-based Institute of Sustainable Development and International Relations (IDDRI). IDDRI commissioned a paper from Yamin on the topic (Haites et al., 2013), published in October 2013, gathering much attention from NGOs, think-tanks and academia. Yamin also helped to set up an informal network of women, self-dubbed the 'Lionesses', where minds converged on net zero as an appropriate guiding principle for climate policy. The group included, among others, Farhana Yamin, Laurence Tubiana, Christiana Figueres, Tessa Tennant, and Rachel Kyte (Darby, 2019). The idea of net zero was further disseminated through papers, conferences, workshops, and lectures (Gurría, 2013; Ritter, 2014). In early 2014, Yamin founded Track Zero which functioned as a 'research, policy and advocacy hub' (Yamin, 2021, p. 232) to support the transnational net zero campaign she had launched (track0.org).

Support gradually increased during the run up to COP21 in Paris. The 2014 Emissions Gap Report applied IPCC science to calculate timetables for net zero emissions (UNEP, 2014). In late 2014, the long-term goal of carbon neutrality was backed by the UN-Secretary General (Ki-Moon, 2014) and the World Bank Group president (Kim, 2014). As mentioned, at the time, the World Bank Group's Vice-President and climate envoy, Rachel Kyte, was also part of the Lionesses network. The 2014 Lima Call for Action spoke of 'long-term zero emissions sustainable development pathway, consistent with carbon neutrality/net zero emissions by 2050, or full decarbonisation by 2050 and/or negative emissions by 2100' (UNFCCC, 2014). The norm was also being championed by business actors. The B Team, a group of business leaders co-founded by Richard Branson, called on the UNFCCC 'for a long-term net zero GHG emissions goal by the year 2050' at COP21 (Evans, 2015; The B Team, 2015).

3.2 | Norm institutionalisation: Cementing net-zero by 2050

The 2015 Paris Agreement marked the start of the institutionalisation of net zero. Its headline goals were still expressed as temperature targets in Article 2: to limit man-made warming to well below 2°C and preferably to 1.5°C. Yet, importantly, the Agreement also had a complementary long-term goal in Article 4, which was stated differently:

> To undertake rapid [emissions] reductions […] so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.
>
> (UNFCCC, 2016, p. 22)

Negotiators had wrestled with the language, and the phrase 'net zero' did not make the final version, even though it appeared in negotiation drafts (Ad Hoc Working Group on the Durban Platform for Enhanced Action, 2015). As Laurence Tubiana (2021), France's Special Representative for COP21, recalls, it was only on the last day that a consensus was found on the sentence, the final phrasing leaning on the 1997 Kyoto protocol in its description of anthropogenic emissions by sources or removals (see e.g. Article 6, UNFCCC, 1997).

The Paris Agreement also asked the IPCC to write a special report on the impacts of global warming of 1.5°C (UNFCCC, 2016). This resulted in the publication of the 'Special Report on Global Warming of 1.5°C' (henceforth, SR1.5), together with a 'Summary for Policymakers' in October 2018 (Livingston & Rummukainen, 2020). The Summary is always prepared by the authors and approved 'line by line' by a Plenary Session of the IPCC with delegates of the 195 IPCC member states, in dialogue with the authors. This means that all member states agree with the content of the Summary. The key sentence of the SR1.5 was the following:

> In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO_2 emissions decline by about 45 per cent from 2010 levels by 2030, reaching *net zero* [authors' emphasis] around 2050.
>
> (IPCC, 2018, p. 12)

This single phrase completed the process of institutionalisation of the net zero norm at the highest global

political level. All 195 member countries of the UNFCCC agreed that to limit global warming to 1.5°C, the world ought to reach net zero emissions by mid-century. The significance of this sentence cannot be overstated, despite it only referring to CO_2 emissions and no other GHGs. It has been described as 'one of the most important sentences of the last few centuries' that may turn out to become the "grammatical unit that saved the world' (Roston, 2021). The sentence did not appear without resistance. At COP24 in 2018, a coalition of major fossil fuel producers—the United States, Russia, Saudi Arabia and Kuwait—refused to support a motion to 'welcome' the IPCC's 1.5 report (Bradshaw et al., 2019).

3.3 | Norm cascade: From an idea to a global norm

After the Paris Agreement's adoption, a growing number of national governments, international organisations, and businesses started to make net zero pledges. In September 2017, 19 countries founded the Carbon Neutrality Coalition, committing to 'transitioning to a net zero GHGs and climate-resilient future' (Stam & Simon, 2018). At the end of 2017, 22 countries had adopted or were considering net zero pledges. This group of first movers can be labelled 'norm leaders' (Finnemore & Sikkink, 1998).

The SR1.5 report moved the concept of net zero from a specialised environment of climate scientists and advocates onto the public and political stage. Suddenly, the term 'net zero' had become commonplace. In December 2018, the EU Commission, formulated its ambition to achieve net zero GHG emissions by 2050 (EU Commission, 2018). In June 2019, the UK was the first G7 economy to pass a net zero emissions law. Around the same time, UN Secretary General António Guterres called on governments worldwide to 'announce plans […] to achieve net zero emissions by 2050' ahead of the UN Climate Action Summit in September later that year (Farand, 2019).

Figure 3 shows the number of countries that have committed to net zero targets. There was a steep increase in net zero pledges in 2019. Of particular importance was the establishment of the Climate Ambition Alliance at the September 2019 Climate Action Summit, a multi-stakeholder network that aims to achieve net zero CO_2 emissions by 2050. At the time of its conception, it counted 66 national governments among its members. That corresponds to about one-third of all parties to the UNFCCC, which is the threshold identified by empirical studies beyond which norm cascade occurs (Finnemore & Sikkink, 1998). Indeed, by COP25 in December 2019, the Alliance had already grown to 73 (Prensa Presidencia, 2019; UNFCCC, 2019). As of June 2022, there were 120 member states.

The norm's institutionalisation further received a shot in the arm with two notable developments in late 2020. First, in September 2020 at the UN General Assembly, Chinese President Xi Jinping announced that his country would achieve carbon neutrality by 2060. China was quickly followed by two other major Asian economies, Japan and South Korea, both pledging to reach carbon neutrality in 2050. Second, Joe Biden won the presidential campaign in the US in November 2020. Throughout the campaign, he had proposed the US would reach net zero emissions no later than 2050. With Biden's election, the two largest economies and emitters in the world, had rhetorically embraced the net zero norm.

By December 2020, 127 countries, covering 63 per cent of global GHG emissions, had committed to some form of net zero, according to Climate Action Tracker (2020). If all these commitments were met, they calculated, temperature rise by the end of this century would be reduced from an expected 3.6°C at the time of signing the Paris Agreement to 2.1°C, in a best-case scenario. The UN hailed the commitments as the 'most significant and encouraging climate policy development of 2020' (UNEP, 2020, pp. XIV).

4 | NORM CONTESTATION

The norm's rapid diffusion and widespread institutionalisation does not mean it is no longer subject to contestation. The net zero norm has been contested in at least four major ways, three discursive ones (questioning the norm's validity, fairness and scope) and one behavioural form (non-implementation).

A first major form of norm contestation revolves around the *validity* of net zero. This covers ongoing discussions around the extent to which the norm is well-grounded, reasonable, or ultimately 'acceptable'. Some countries have even proposed alternative, competing norms. One example is Saudi Arabia, which has championed the notion of a 'circular carbon economy' (CCE). CCE is set around four principles of carbon management: reduction, removal, reuse, and recycling (Shehri et al., 2022). On the surface, this CCE framing is compatible with net zero, but there are important differences. The socio-technical imaginary of net zero hinges on a 'balance': residual emissions from hard-to-abate sectors are balanced by negative emissions from technologies that remove carbon from the atmosphere. The framing of CCE, by contrast, rests on a 'closed-loop circle': carbon-based fuels and materials can remain central to the energy system as long as they are paired with massive carbon removal technologies. In other words, the notion of CCE allows fossil fuel producers to retain a central role in the energy landscape, given large scale carbon removal (Buck, 2021). The incompatibility between the two conceptualisations

was revealed in 2021, when Saudi energy minister Abdulaziz bin Salman dismissively referred to the IEA's net zero roadmap as coming from 'La La Land' (Wang & Perkins, 2021).

Even so, in late 2021, Saudi Arabia adopted its own net zero target by 2060; as did other fossil fuel producers, including Australia (2050), the UAE (2050), and Russia (2060). In May 2021, Saudi Arabia even co-founded the 'Net-Zero Producers Forum', which is purportedly 'dedicated to developing long-term strategies to reach global net zero emissions.' It shows how contestation by one actor can play out at various levels and in different forms. Saudi Arabia proposes and promotes alternative norms, dismisses concrete plans that lay-out credible pathways to net zero by 2050, and co-founds a net zero group, all at the same time. Others are more straightforward. In the UK, for example, within the ruling Conservative party's parliamentary faction, a Net Zero Scrutiny Group has been formed by several backbenchers. This increasingly vocal group links the UK government's net zero policies to the 2021–2022 energy price crisis and calls instead for 'cuts to green taxes and an increase of fossil fuel production' (Taylor & Horton, 2022).

A second form of contestation revolves around *fairness* and, particularly, the different capabilities and responsibilities of developing and developed countries (Okereke & Coventry, 2016). India, for example, repeatedly made it clear that it did not want to commit to net zero (Gerretsen, 2021). The country has a long-standing preference for international climate equity based on the "Common but Differentiated Responsibility' (CBDR) principle, which means that developed countries have a responsibility to decarbonise much faster than the developing world (Dubash, 2013). Although at COP26 in 2021 India's prime minister, Modi, eventually announced a net zero target by 2070, the delivery date is two decades after net zero commitments by developed countries and it is conditional on the availability of $1 trillion in climate finance from developed countries throughout 2030 (Koshy, 2021).

A third form of contestation concerns the difference in *scope* and the lack of detail in many net zero commitments (Rogelj et al., 2021). Important differences remain between net zero pledges in terms of which GHGs are included or the extent to which offsetting and carbon credits will be used. For instance, China, South Korea and Japan all committed to carbon neutrality (or net zero CO_2 emissions), leaving out a significant proportion of emissions coming from other GHGs. The United States, the EU and the UK, by contrast, have all committed to net zero GHG emissions (climate neutrality). According to Hans et al. only around 40 per cent of countries include all GHGs in their net zero commitment (35 per cent only include carbon emissions and 15 per cent did not specify).

In addition, as explained above, *net* zero emissions do not equate to zero emissions, but imply that any remaining emissions would be offset by negative emissions or through emissions trading under Article 6 of the Paris Agreement (UNFCCC, 2016). More than three quarters of governments do not specify whether they intend to use offset credits elsewhere to meet their net zero targets. Excessive reliance on Negative Emissions Technologies (NETs) such as BECCS and Direct Air Capture (DAC) is risky since some of these technologies are not (yet) effective or scalable, or may create tensions around land-use (Carton et al., 2020). It may open the door for actors to support the net zero norm even if they have no intention to implement meaningful climate policy (Anderson & Stone, 2015). Some environmental NGOs have even proposed a new climate frame, namely, to eliminate all fossil fuel use, thus excluding negative emissions technologies and carbon dioxide removal as viable options to reach carbon neutrality (Evans, 2015; Paterson, 2021).

A fourth and final major form of contestation refers to the (lack of) *implementation*. Net zero plans or pledges often lack concrete roadmaps and intermediate goals to reach their ultimate objective. Though 146 countries were identified to commit to some kind of net-zero pledge by 16 May 2022, only 35 countries have encapsulated this into law. Forty four countries have mentioned a net zero based goal in a policy document, with 66 countries remaining having only mentioned the norm in a declaration or stated it as a proposition (Van Coppenolle et al., 2022a). This shows that the norm, though widely spread, still widely lacks the legislative 'teeth' for implementation and enforcement.

5 | CONCLUSION

In this paper, we traced the meteoric rise of the net zero norm, from a handful of commitments in 2018 to 146 in 2022, drawing on key concepts from norm theory. The emergence of net zero pledges owes much to evolving scientific and political understandings of the climate change problem. The UNFCCC's overarching goal of climate stabilisation was translated into emission reduction targets (Kyoto Protocol) and temperature limits (Cancun Agreements) while the scientific community remained focused on emission concentrations. The introduction of the concept of carbon budgets proved to be the missing link. The norm's rapid diffusion was made possible through the work of various individual and institutional norm entrepreneurs. At the same time, continuity in the global climate regime, in which emission trading and carbon markets allows for a flexible approach to achieve 'net' zero emissions has also been conducive to the norm's success.

Although the norm has been widely institutionalised, it remains subject to various forms of contestation.

There are significant differences among net zero pledges in terms of scope, definition, as well as implementation. One of the strengths of net zero is that it translates the complex issue of climate change to a relatively straightforward concept that leaves a lot of room for interpretation. As we see the concept move from a scientific landscape to mainstream 'goal setting', it is important to not lose track of the purpose and intent of the rhetoric behind net zero.

Our paper makes several contributions and also highlights avenues for future research. Theoretically, our study illustrates the continued relevance of Finnemore and Sikkink's (1998) life-cycle model of international norm diffusion. At the same time, it highlighted the role played by the IPCC as a norm entrepreneur, inviting more research on the opportunities and limits of epistemic communities to shape global norms. Empirically, our main contribution is the compilation of a database of net zero pledges throughout the years. The dataset is freely available and can be used for future inquiries, such as the causal mechanisms that have led countries to adopt net zero pledges.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available on Zenodo at https://doi.org/10.5281/zenodo.6671488 and https://doi.org/10.5281/zenodo.6644989.

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