PARIS REINFORCE

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D7.5 REPORT ON CO-DESIGN ON PA-COMPLIANT SCENARIOS

WP7 – Model Inter-Comparisons, Global Stocktake & Scientific Assessments

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Lead Beneficiary	University of Cambridge			
Responsible Author	Annela Anger-Kraavi	Email	aa451@cam.ac.uk	
		Phone	+447825338465	
Contributors	Hannah Parris (Cambridge)			
Reviewer(s)	Alevgul Sorman (BC3); Sigit Perdana, Marc Vielle (EPFL); Alexandros Nikas (NTUA)			
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EC Summary Requirements

1. Changes with respect to the DoA

The deliverable was submitted with a delay of six months, agreed upon with the Project Advisor. No other deviation is reported.

2. Dissemination and uptake

This deliverable provides UNFCCC COP participants' interpretations of how the Paris Agreement may be implemented over the period 2020-2100. The data gathered via a survey will be also used in the remaining PARIS REINFORCE modelling exercises to drive demand-oriented policy analysis. At least one academic article will be published based on this deliverable. Featuring publication potential, the deliverable should be treated as embargoed until the corresponding academic paper is published. The data presented in this report should NOT be used without the permission of the authors at any time.

3. Short summary of results (<250 words)

This Deliverable is a key component of the co-design process within the PARIS REINFORCE project. Its aim is to collect and collate stakeholders' perspectives on the future of the Paris Agreement, post-2020, as the basis for developing stakeholder-led modelling scenarios.

Using the text of Articles 2 and 4 of the Paris Agreement to frame the research, we generate an initial dataset and narratives for building post-2020 scenarios of emissions pathways, *based on UNFCCC attendees' interpretations* of how the Paris Agreement may be implemented over the period 2020-2100.

Four narratives emerge from the data. On average, survey respondents identified 2036 as the year of global peak emissions, that there will be a 10.06% decrease in emissions in 2030 (relative to 2020), global net zero will be achieved in 2065 and to achieve this global emissions need to be reduced 3.48% per annum between 2036 and 2065. Furthermore, on average, respondents deem as acceptable or strongly acceptable no more than 20% use of sinks in total emission reduction efforts. Where sinks are used, there is an overwhelming preference for nature-based sinks.

4. Evidence of accomplishment

This report.

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Preface

PARIS REINFORCE will develop a novel, demand-driven, IAM-oriented assessment framework for effectively supporting the design and assessment of climate policies in the European Union as well as in other major emitters and selected less emitting countries, in respect to the Paris Agreement. By engaging policymakers and scientists/modellers, PARIS REINFORCE will create the open-access and transparent data exchange platform I^2AM PARIS, in order to support the effective implementation of Nationally Determined Contributions, the preparation of future action pledges, the development of 2050 decarbonisation strategies, and the reinforcement of the 2023 Global Stocktake. Finally, PARIS REINFORCE will introduce innovative integrative processes, in which IAMs are further coupled with well-established methodological frameworks, in order to improve the robustness of modelling outcomes against different types of uncertainties.

NTUA - National Technical University of Athens	GR	EPU N·T·U·A
BC3 - Basque Centre for Climate Change	ES	bc3
Bruegel - Bruegel AISBL	BE	bruegel
Cambridge - University of Cambridge	UK	UNIVERSITY OF CAMBRIDGE
CICERO - Cicero Senter Klimaforskning Stiftelse	NO	°CICERO
CMCC - Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici	IT	cmcc
E4SMA - Energy Engineering Economic Environment Systems Modeling and Analysis	IT	E4SMA
EPFL - École polytechnique fédérale de Lausanne	CH	EPFL
Fraunhofer ISI - Fraunhofer Institute for Systems and Innovation Research	DE	Fraunhofer ISI
Grantham - Imperial College of Science Technology and Medicine - Grantham Institute	UK	Grantham Institute Climate Change and the Environment
HOLISTIC - Holistic P.C.	GR	HOLISTIC
IEECP - Institute for European Energy and Climate Policy Stichting	NL	IEECP
SEURECO - Société Européenne d'Economie SARL	FR	SEURECO ERAΣME
CDS/UnB - Centre for Sustainable Development of the University of Brasilia	BR	Centro de Desenvolvimento Sustentável UnB
CUP - China University of Petroleum-Beijing	CN	
IEF-RAS - Institute of Economic Forecasting – Russian Academy of Sciences	RU	IEF RAS
IGES - Institute for Global Environmental Strategies	JP	IGES
TERI - The Energy and Resources Institute	IN	teri

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Executive Summary

This Deliverable is a component of the co-design process within the PARIS REINFORCE project. Its aim is to collect, collate and interpret stakeholders' perspectives on the implementation of the Paris Agreement, post-2020, by exploring the research question:

How do policymakers and expert stakeholders in the UNFCCC process interpret implementation of the PA mitigation goals (such as peaking of emissions and balance between anthropogenic emission sources and sinks)?

In particular, how do they describe future pathways based on their *expectations* of future policy development. The outputs of this Deliverable will be used to develop stakeholder-led modelling scenarios that will be undertaken for Deliverable D7.6.

This research builds on the key insights from political discourse theory which argues that the way environmental problems are constructed, interpreted, discussed, and analysed (i.e., its 'narrative') shapes how these problems are addressed through negotiations and policy making (e.g., Dryzek 1997). The use of narratives plays an important role in the quantitative and qualitative traditions of climate change policy research (e.g., Backstrand and Lovbrand 2019 and Fuglestvedt et al., 2018 in the qualitative tradition, and O'Neill et al. 2017, Riahi et al. 2017 in the quantitative tradition). However, the construction of these narratives - particularly in the context of Integrated Assessment Modelling remains driven by the academic community and there is a lack of involvement by policy makers in the design of modelling scenarios (Doukas et al., 2018).

Drawing on the text of Articles 2 and 4 of the Paris Agreement, we identify, collect, and interpret numerical data for six variables that, taken together, describe a narrative of the future implementation pathways for the Paris Agreement:

- the year of peak emissions,
- emissions in 2030,
- the year of achieving net zero emissions,
- the rate of emissions reduction,
- and the attitudes towards the use of sinks and sink types (nature-based sinks versus sink technologies) in achieving net zero emissions (Table 1).

We compare this data to the pathways presented in the IPCC Special Report *Global Warming of 1.5^{o}C (hereafter IPCC SR1.5)* - drawing specifically from the Summary for Policy Makers (IPCC, 2018) and Chapter 2 (Rogelj et al., 2018), to determine whether the narratives held by UNFCCC policymakers and expert stakeholders, based on their expectations of future developments, are consistent with IPCC SR1.5 high overshoot pathways.

The data in this study was collected through an online qualitative survey. Using targeted sampling tactics, the survey recruited 74 respondents drawn from a range of professional roles within the UNFCCC (negotiator/various types of observers) and geographical locations (developed countries/developing countries). In addition to the numerical data collected, the survey also used open ended questions to capture qualitative data on stakeholder attitudes towards the Paris Agreement at the time it came into force, and how their views have changed over time, as well as their preferences on the use of sinks.

Many respondents have an overall pessimistic view of the future of the Paris Agreement and expressed some anxiety about its effectiveness and future implementation. However, this view was not shared by all respondents with some stating that the Paris Agreement was a constructive framework for building future consensus on global action. Regardless of their outlook, all respondents saw the Agreement as a 'work in progress', where the 'pace of change' was too slow. This is reflected in the respondents' prioritisation for reaching global peak emissions and

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undertaking rapid reductions as the most important objectives of the Paris Agreement discussed in this study.

A summary of the main numerical results of the survey is set out in Table 1, and for comparison the respective values from the scenario tracking emissions that keep temperatures between 1.5⁰C and 2⁰C with a high overshoot (Rogelj et al 2018) are also given. This scenario was chosen because it provides an estimate of the emissions path that broadly aligns with emissions pathways implied by the current NDCs (Rogelj et al., 2018) and could be interpreted as a 'high risk' approach to limiting global temperature increase to 1.5ºC. (an objective strongly supported by survey respondents).

Table 1: Summary descriptive statistics of collected variables (sample: all respondents) and respective values from the IPCC SR1.5 high overshoot scenario

		Respondents Survey Data			
	IPCC SR1.5	Mean	Median	Mode	Range
Global Net Zero Year	*2063*	*2066*	*2065*	*2055*	*45*
Global Peak Year	*2020*	*2036*	*2035*	*2025*	*45*
Reduction between Peak Year and Net Zero Year (% reduction/yr)	*2.33%*	*3%*	*3%*	*N/A*	*2%*
Emissions in 2030 compared to 2020 (% reduction)	*-31%*	*-9%*	*-8%*	*N/A*	*42%*
Share of sinks in total effort to reach net zero emissions					
Acceptable	*51%**	*21%*	*20%*	*5%*	*45%*
Strongly Acceptable		*20%*	*13%*	*3%*	*48%*
Acceptable share of …					
nature based sinks in total sink use (%)	*24%*	*77%*	*80%*	*100%*	*69%*
sink technologies in total sink use (%)	*76%*	*37%*	*30%*	*20%*	*91%*

*Source: IPCC SR1.5 data from Rogelj et al (2018) and authors' calculations from survey responses. See Section 4.1 for full results. N/A= not available. * The share of sinks for the IPCC SR1.5 in total emissions reduction efforts is given for 2050 only and not for net zero year because the data does not provide gross emission levels for the nominated net zero year in the high 1.5ºC overshoot scenario (see Table 2.4, p117, Rogelj et al (2018).*

In addition to collecting and interpreting this data, we conduct three 'consistency' tests to determine whether the narrative described by the research participants has an internally consistent logic. This is important because the absence of an internal logic linked to policy objectives can result in policy making that leads to higher than intended emission levels – and a greater chance of missing emission targets consistent with limiting temperature rises to 1.5ºC or even 2ºC.

Overall, the responses from participants coalesced into five types of overall narratives (see Figure 1 for an example of visual presentation – more discussion in section 4.6):

1. ***Narrative 1: Respondents* (group 1) *estimate global emissions to peak prior to 2030.*** This subgroup of respondents (26%) has a narrative whereby global emissions are expected to peak in 2024 with a 23% decrease in emissions from 2020 to 2030. Global net zero emissions are achieved in 2057, and to deliver this, global emissions need to be reduced by 5% per year between 2024 and 2057.
2. **Narrative 2: Respondents (group 2) estimate global emissions to peak after 2030 but expect a decline in emissions between 2020 and 2030.** This subgroup (44%) has a narrative whereby global emissions are expected to peak in 2045, but also experience a 13.7% decrease in emissions between 2020 and 2030. Global

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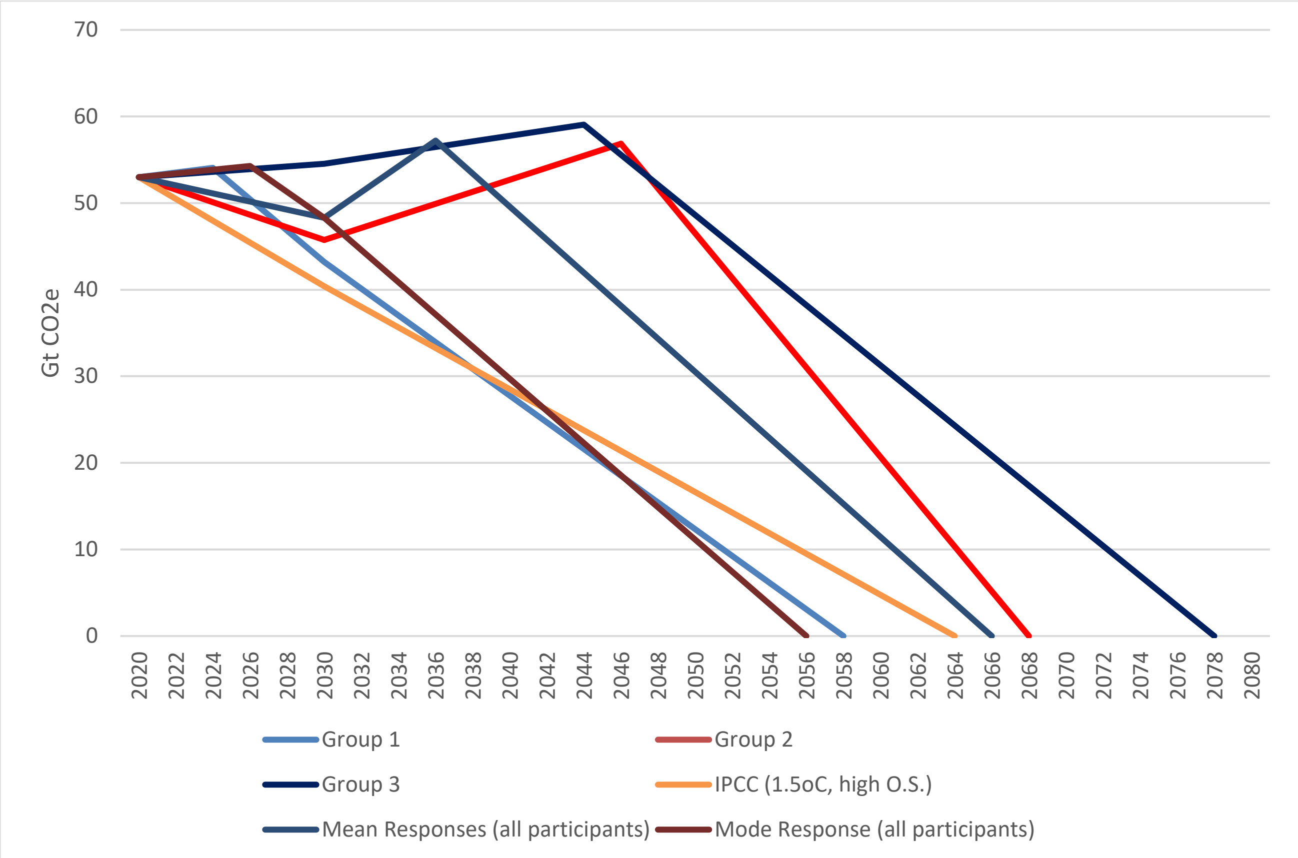
net zero emissions are achieved in 2067, and to deliver this, global emissions need to be reduced by 13% between per year 2045 and 2067.

3. **Narrative 3: Respondents (group 3) estimate global emissions to increase to 2030 and to reach global peak emissions after 2030**. This subgroup of respondents (30%) has a narrative whereby global emissions are expected to peak in 2044 but also experience an increase in global emissions of 2.9% from 2020 to 2030. Global net zero emissions are achieved in 2077, and to deliver this, global emissions need to be reduced by 6% per year between 2044 and 2077.
4. **Narrative 4: Using the average results across all respondents** Using the average values across all respondents, this narrative sees global emissions peaking in 2036, with a 10.06% decrease in emissions in 2030 (relative to 2020). Global net zero will be achieved in 2065 and, to achieve this, global emissions need to be reduced by 3.48% per year between 2036 and 2065. Contribution of sinks to achieving this net zero emissions goal should be no more that 20% of total effort and, where sinks are used, there is an overwhelming preference for nature-based sinks which should make up about 76% of total sink use (or more) and sink based technologies make up, at most, around 37% of the total sink mix.
5. **Narrative 5: Using the modal results across all respondents.** Using the values that appear most often across all respondents, this narrative sees global emissions peaking in 2025 and global net zero emissions being achieved in 2055. Contribution of sinks to achieving this net zero emissions goal should be no more that 2.5%-5% of total effort and, where sinks are used, there is an overwhelming preference for nature-based sinks which should make up close to 100% of total sink, however up to 20% use of sink technologies within the total sink mix may be acceptable.

Figure 1: Narratives based on the survey responses and IPCC SR1.5 1.5ºC high overshoot scenario



Source: IPCC Scenario from 1.5ºC high overshoot scenario (Rogelj et al. 2018); Authors' calculations from survey responses.

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This analysis suggests that 26% of respondents to the survey have an internal logical narrative that aligns Paris Agreement milestones with the way it is described by IPCC SR1.5 high overshoot (narrative 1 described above). Each group in Figure 1 had a mix of respondents, who identified as an 'observer' as well those who identified as 'negotiators' – implying that each group had heterogenous perspectives of the Paris Agreement. The remaining respondents – 74% - identified a year for global peaking of emissions, or a year for achieving global net zero emissions that have later – or significantly later - timeframes than the IPCC SR1.5 high overshoot scenario, implying that respondents expect a larger amount of global emissions between 2020 and global net zero.

This higher level of global emissions between 2020 and achieving global net zero implies that limiting global temperature increases to 1.5°C may require a greater reliance on the use of negative emissions (nature-based sinks and sink technologies) after global net zero emissions is achieved – although the exact amount envisaged by respondents was not investigated in this study. This implied greater reliance on the use of sinks contrasts with the respondents' own views in the survey that sinks should only constitute a relatively small part of the total emissions reduction activity (mean: 21%, mode: 5%) and that sink technologies should only form a small part of the total sink mix (mean: 37%, mode: 20%). Consistent with the literature on the use of sinks, and BECCS in particular (e.g., Fuss et al., 2014; Shue, 2017; IPCC, 2018), this also raises significant logistical and ethical considerations and resource constraints, calling into question whether the narratives represent viable future emission pathways that limit global warming to 1.5°C. The reliance on the use of negative emissions in some of the narrative emissions pathways underscores the importance of continuing to improve the transparency of sink use in future IAM exercises – one of the objectives of the PARIS REINFORCE Project. It also suggests that future modelling exercises could limit the role of sinks, particularly BECCS, in achieving modelled temperature outcomes in line with respondents' preferences.

The regional results in this study suggest that the survey respondents have incorporated the principle of comman but differentiated responsibilities and respective capabilities into their narratives and all respondents describe a regional level narrative that sees developed countries as implementing more emissions reductions in a more rapid timeframe. However, based on the geographical location, respondents have different interpretations for what this means for emissions in 2030 – with developed country respondents seeing all countries (except Indonesia) reducing their emissions over the next 10 years, while developing country respondents anticipating that developing countries will experience an increase.

The pathways presented in the IPCC SR1.5 is often assumed to represent the only type of narratives that are consistent with achieving the Paris Agreement objectives. This report suggests that respondents have absorbed much of the key messages in the IPCC SR1.5 pathways but that there is a dynamic interpretation of the concepts around peaking, net zero, sinks, rapid reduction, and differentiated responsibilities as explored in this study.

This study demonstrates the value of using milestones from the Paris Agreement to (re)construct and analyse the narratives that participants have about potential implementation of climate change mitigation pathways after 2020. It also adds significantly to the qualitative narrative literature by providing an insight into how and when experts, who attend the UNFCCC, may expect achieving peak emissions, reaching net zero emissions, and using sinks under the Paris Agreement. The analysis presented in this report suggests a number of additional areas for further research including increasing the diversity in the sampled respondents, expanding emission pathways to incorporate specific narratives for selected countries and exploring, in more detail, the variability in responses observed across the study.

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1 Introduction

PARIS REINFORCE is a stakeholder-led project to assess low-carbon transition pathways that are compliant with the goals of the Paris Agreement. A major focus of the project is to undertake detailed global and country-level energy system and integrated assessment modelling, to understand technically, economically, politically, and socially acceptable transition pathways within different major emitting countries.

A key objective of PARIS REINFORCE is to improve the legitimacy and transparency of the modelling processes by incorporating co-design principles into all stages of the project including, but not limited to, co-designing policy questions, modelling requirements for policy making, development of realistic scenarios and selection of key modelling variables.

A summary of the overall work plan for PARIS REINFORCE is set out in Figure 1. The first set of global modelling runs (WP7) using a suite of global energy system models and integrated assessment models was undertaken to explore reference scenarios (i.e., those without a high degree of mitigation over and above current levels of ambition) as well as those that are interpreted by the PARIS REINFORCE research teams to have mitigation in line with the Paris Agreement goal to limit global warming to "well below 2°C" above pre-industrial levels. This work has now been completed and reported in Deliverable 7.4. This global modelling exercise, and its results, were used to provide inputs into the country and regional level modelling contained within Work Package 6, as well as its sister Work Package 5.

Once the regional modelling work has been completed (WP5 and WP6), a further iteration of global and regional modelling will then be undertaken during the project to ensure that insights and results from regional modelling inform additional global modelling runs and vice versa. Within this second iteration of global and regional modelling exercises, particular attention will be given to exploring the scope and characterisation of increasing ambition under the Paris Agreement, including the modelling of scenarios that are identified by stakeholders as being consistent with the implementation of the Paris Agreement (the focus of this deliverable). A high-level schema for the modelling in PARIS REINFORCE, based on the detailed, whole-project workflow (see Figure 7 of the PARIS REINFORCE Grant Agreement) is shown in Figure 2.

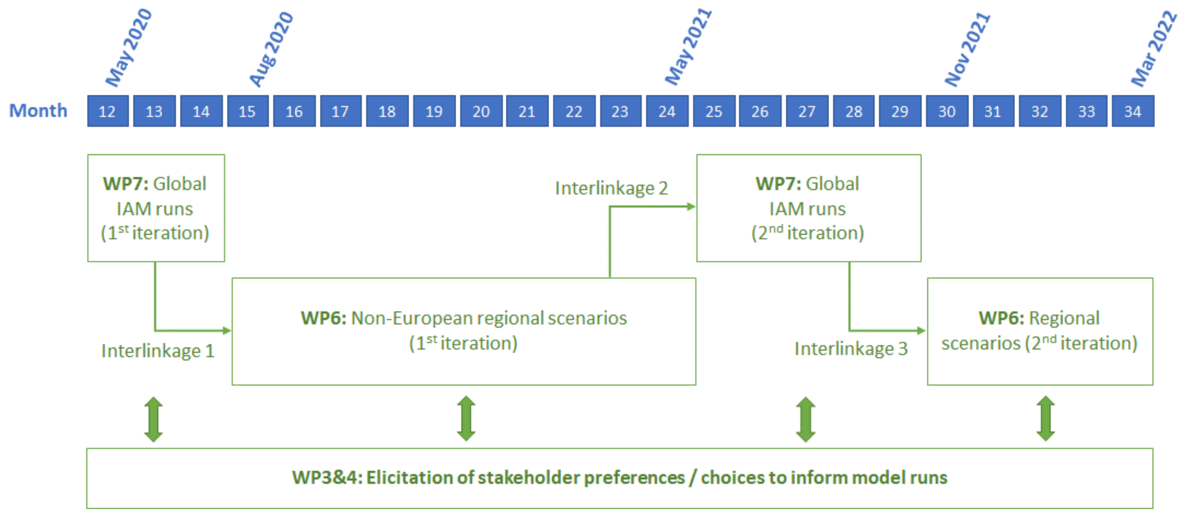

Figure 2: High-level workflow of interactions between global and non-European regional modelling and stakeholder co-design activities

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Each stage of modelling depicted in Figure 2 is fed by inputs from stakeholders consisting of policy and decision-makers from a range of countries relevant to the modelling exercises. An "Ongoing stakeholder dialogue" Work Package (WP3) is used to facilitate collaboration with stakeholders in a two-way exchange of information around modelling practices, assumptions and limitations, as well as to collect inputs from stakeholders on their particular modelling questions and views/preferences around modelling assumptions and scenario design.

The collaborative exercises conducted throughout the Project are intended to ensure that the modelling analysis around transition pathways is not undertaken in an analytical "vacuum" but rather co-created with stakeholders, to arrive at robust transition pathways. As the project proceeds, this interaction with stakeholders is facilitated through the use of a transparent and user-friendly modelling platform, "I^{2}AM PARIS".

1.1 Co-design of Paris Agreement Compliant Scenarios

Work Package 7, "Model Inter-Comparisons, Global Stocktake & Scientific Assessments", consists of designing and executing global modelled scenarios of future emissions pathways in the 1st and 2nd iterations of global modelling as described above. Inspired by the Talanoa Dialogue approach, this WP comprises of four stages of *Listening, considering, modelling and explaining*.

This Deliverable, D7.5, is part of Task 7.1 – Listening – with a specific focus on the research question: *How do expert participants of UNFCCC meetings interpret the PA mitigation goals (such as peaking of emissions and balance between anthropogenic emission sources and sinks), and what are the implications for modelling?* The purpose of Deliverable D7.5 is to present the work completed on this research question.

This research question is fundamental to the objectives of the PARIS REINFORCE project, which was designed, in part, to address a key criticism of IAMs: the lack of involvement by policymakers in the design of modelling scenarios (Doukas et al., 2018). PARIS REINFORCE seeks to address this criticism through two inter-related strategies:

- Opening up the 'black box' of IAMs to make the modelling assumptions transparent to policy makers (for example Deliverable 3.3); and
- Drawing in all relevant actors into the modelling activities by actively seeking their inputs into the design and specification of modelling assumptions – drawing on their local and professional knowledge (WP3).

This Deliverable is one set of activities that focus on the second of these strategies. As such, it is a key component of the co-design agenda within PARIS REINFORCE that seeks to share power with end-users to jointly set the research agenda and shape the outcomes to reflect the needs and interests of end-users.

This Deliverable D7.5 builds on the Deliverable D7.4, *1st Report on model inter-comparisons: Informing scientific assessments and the GST* (submitted November 2020). The focus of the Deliverable D7.4 is on estimating climate change outcomes under a so-called "where are we headed?" (WWH) scenario. The WWH scenarios are based on modeller/expert interpretations of current levels of mitigation ambition and related policy actions and near-term goals in the world's different countries and regions and provides a valuable contribution through a focus on post-2030 emission trajectories. The purpose of the D7.4 modelling exercises was, first, to understand where and how different countries and regions could "close the emissions" gap between pathways that represent current levels of mitigation ambition and the required effort. Second, to provide a novel and critical input into the scientific literature through an exploration of 'where are we heading' given that the world is no longer on a "business as usual" pathway towards greater than 4°C of global warming (above pre-industrial levels) by 2100.

This report, Deliverable D7.5, builds on the work of D7.4 through generating an initial dataset and interpretation of it to build post-2030 scenarios of emissions pathways, *based on UNFCCC experts' interpretations* of how the

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Paris Agreement may be implemented over the period 2020-2100. By shaping these expectations into storylines and quantifiable variables, this current work becomes a 'boundary object' that draws together expert stakeholders and researchers to facilitate and direct collaboration into a tangible output (see, for example, Clark et al., 2016) – in this case co-created data with its interpretations suitable for future modelling runs under Deliverable D7.6.

This deliverable contributes to project outcomes through:

- Collating and analysing UNFCCC participants' interpretations of the implementation of the Paris Agreement as a pre-cursor to co-designing Paris Agreement-compliant scenarios for the remaining tasks in WP7; and
- Providing a contribution to the scientific literature by developing the first attempt at articulating a UNFCCC participants' interpretation of the Agreement focusing on what is likely to happen post-2020, rather than what is considered desirable.

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2 Development of Paris Agreement Compliant Scenarios

2.1 A Narrative approach to understanding the implementation of the Paris Agreement

While the Paris Agreement (UNFCCC, 2015) established a global framework for climate action, the way people, including negotiators, interpret its goals can vary. For example, Articles 2 and 4 set out the objectives that frame future mitigation actions (temperature goal, timeframe for peaking and rapid reduction of emissions, burden differentiation and the use of sinks) but do not give specific detail and leave these open for further interpretations by UNFCCC participants.

These interpretations go on to form an internal personal storyline or "narrative" (Dryzek, 1997) held by UNFCCC participants. Understanding the content and shape of these internal narratives is important because their use, and the development of shared narratives amongst UNFCCC participants, are instrumental in shaping what constitutes acceptable ideas, standards and behaviours within the UNFCCC. In turn, these standards and behaviours shape future approaches to problem-solving, future negotiations and future policy-making (Backstrand and Lovbrand, 2019; see also Wamsler et al. (2020) for their discussion on the importance of paradigms or 'world views' in the UNFCCC).

The use of narratives plays an important role in the quantitative and qualitative climate change policy research. From the qualitative research, scholars have applied a narrative approach to the UNFCCC negotiations to gain a better understanding of the evolving climate negotiations and global climate governance architecture. For example, Backstrand and Lovbrand's (2019) work examines how evolving (multiple) discourses used to describe the 'problem' of climate after the Copenhagen COP in 2009 has driven a change in governance arrangements from the 'top down' approach of the Kyoto Protocol to the 'bottom up' architecture of the Paris Agreement. They argue that concepts around the central role of governments in framing climate change problems and solutions ("techno-managerial" or "green governmentality") remains dominant within the UNFCCC. However, their argue that alongside this, other ideas from competing discourses ("ecological modernisation") have embedded themselves into the global approach, resulting in an 'opening up' of climate governance to incorporate inclusive networks and partnerships with non-state actors, industry, vulnerable groups, etc. (Backstrand and Lovbrand, 2019). They also note that this dominant narrative is substantially challenged by the 'climate justice' narrative which links climate governance to broader systemic issues around the ongoing role of capitalism and which seeks to transfer decision making power from government and business elites to marginalised groups (*ibid.*, see also Gach (2019) for further discussion).

Other scholars have applied a narrative approach to analysing the first round of NDCs as a tool to unpick the power dynamics of climate negotiations (e.g., Tobin et al.., 2018). Jernnas and Linner (2019) undertake a narrative type of analysis of NDCs to identify specific policy storylines used within them, which Parties use similar narratives and how narratives vary by geographical location, income group and negotiation coalition membership. They observe that conventional geopolitical patterns only partly explain similarities in narratives used by different Parties and that understanding the tensions and difference between them gives insight into potential future conflicts within the negotiation process. A third variation of applying a narrative approach comes from Fuglestvedt et al. (2018) who analyse the key text of the Paris Agreement from a scientific viewpoint and discuss how different approaches and metrics can influence climate outcomes. Of particular interest in Fuglestvedt et al. (2018) is the scientific ambiguity that the authors find in a close reading of the Agreement Text. For example, it identifies four different ways in which the term "balance" could be interpreted in Article 4 of the Paris Agreement.

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From the quantitative tradition, several streams of narrative relevant work have been established or are emerging. A prominent example amongst these are the qualitative and quantitative narratives that have been developed as part of the Shared Socio-Economic Pathways (SSPs) framework developed collaboratively within the modelling and related academic communities (O'Neill et al. 2017, Riahi et al. 2017). These narratives provide a complex, detailed and shared set of descriptions of possible futures, characteristics of society (e.g., demographics, human development, economy and lifestyles, institutions, technology and resources) and the potential consequences of different mitigation scenarios which, taken with the Representative Concentration Pathways (RCP) analysis, forms a core component of IAM policy modelling (*ibid)*. The SSPs therefore provide the crucial common language around which the modelling community can develop a shared view of the future and investigate mitigation policies, impacts and adaptation policies in a coherent and consistent way (Riahi et al., 2017) that is capable of being aggregated or compared.

Conventionally, the modelling scenarios (narratives) developed from the SSP-RCP Framework have used 'back-casting' methods where emission pathways and mitigation strategies are "reverse-forecasted" from the long-term goal to the present to give insight to what near term decisions are required to align with longer term socio-economic and environmental objectives (O'Neill et al., 2020; Waisman et al., 2019; Sognnaes et al., 2021). More recently a new approach has emerged that takes the current developments in transition towards a low-emissions future and extends these beyond 2030 to see where the path the world is already on might lead in terms of GHG emission reductions and corresponding temperature change (Sognnaes et al., 2021; Deliverable 7.4 Paris Reinforce). These so called "Where are We Headed" modelling approach is a new type of narrative evolving from the literature but remains, essentially, expert driven (see Deliverable 7.4).

This current study draws two main lesson from these qualitative and quantitative literatures. Firstly, the importance of having a shared understanding of the core features of potential alternative futures as the basis for creating new knowledge about viable policy options. Secondly, the central role of textual interpretation– i.e., the creation of "narratives" - has in shaping potential models of implementation of the Paris Agreement. Yet both literatures draw primarily on the voices of academic researchers. Using qualitative research, we build these insights to provide a third stream of narrative building through identifying and analysing the implementation narratives that are held by the experts within the UNFCCC itself – i.e., those that are central to the shaping and implementation of the future international climate governance regime.

2.2 From Paris Agreement text to variables for modelling scenarios

To convert expert narratives around the implementation of Article 2 and 4 of the Paris Agreement into a set of numerical variables, capable of being modelled, requires a high level of interpretation. For example, take the following phrase: "Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter…." (Article 4 (1)). For this to be quantitatively modelled, the concept of "reach[-ing] global peaking" would need to be quantified with respect to a time frame (i.e., when global peaking would occur), and the concept of "taking longer for developing country Parties" will need a specific timeline over how much longer 'developing countries' could take. In addition, it is likely that different developing countries would require or request different time frames and articulation of which countries are allotted different timeframes would be necessary.

To start the research, wording related to important mitigation milestones presented within the Paris Agreement Article 2 and 4 were identified (Table 1) and corresponding research questions were identified to guide the data collection process (Table 1). As noted in Section 2.1 we build on existing climate change narrative research by interpreting the scenario building task for this deliverable as describing the *participant defined* forward-looking emissions pathway between the current period (2020) and 2100 using interpretations of the Paris Agreement

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phrases in Table 1 as "pathway milestones": the timing of peak emissions and the timing of achieving net zero GHG emissions. The later, in turn, comprises of the rate of emission reduction over time after peak emissions and the amount of negative emissions used to achieve net zero.

In addition to the "peaking" concept, paragraphs 23 and 24 of the UNFCCC decision FCCC/CP/2015/10/Add.1 (to which the Paris Agreement is an Annex) requests that Parties to submit NDCs every 5 years from 2025 or 2030 (UNFCCC, 2015). Consequently, emissions projections in 2030, alongside timing of 'peak emissions', are commonly used within the climate modelling literature (and in the IPCC) (e.g., Rogelj et al., 2018a; Rogelj et al., 2018b; Schleussner et al., 2016) as a key short term indicator of whether the emissions levels provide a credible pathway to achieving this longer term target (OECD/IEA, 2020) and we add this as an additional milestone in our narrative descriptions. By measuring how each of these milestones are interpreted we can describe scenarios across different sub-groups of respondents, defined by geography, development status and role in the UNFCCC process.

We then conduct three consistency tests to determine whether the narrative described by the research participants has an internally consistent logic. This is important because the absence of an internal logic linked to policy objectives can results in higher than intended emission levels – and a greater change of missing emission targets consistent with limiting temperature rises to 1.5°C or even 2°C.

We are also interested in the attitudes of UNFCCC participants towards the use of sinks in achieving emission targets. Sinks form an integral part of modelled scenarios, so articulating their role in achieving temperature targets is an important part of this Deliverable's objectives. There is now a broad consensus within the academic literature that large-scale use of sinks carries a higher risk as a mitigation strategy (compared to abatement by emission sources) due to their natural limits, their vulnerability to disturbance (sinks from nature) (IPCC, 2018), or due to their unproven economic viability at scale or creation of adverse impacts (sink technologies) (e.g. Fuss et al., 2014; Smith et al., 2016) Therefore, measuring attitudes towards sinks gives insight into the extent to which respondents are willing to embrace riskier strategies for achieving stated objectives.

Finally, as a point of comparison with the UNFCCC expert participant narratives, we draw on the pathways presented in the IPCC Special Report on *Global Warming of 1.5°C* (IPCC SR1.5) which provides descriptions of a range of future emissions pathways that are consistent with achieving this Paris Agreement long term temperature goal. For this comparison task, we interpret these IPCC SR1.5 pathways as the following:

Limiting the temperature increase in 2100 to1.5°C or less will require meeting global milestones for peaking emissions and achieving net zero emissions (emission reductions plus use of sinks) that limit total future GHG emissions to around 420Gt – 840Gt (+/- 250Gt) (Rogelj et al., 2018a). According to the pathways presented in the IPCC SR1.5 high overshoot scenario, global emissions need to peak in 2020, reduce to about 20.8Gt CO2 by 2030 and reach net zero after mid-century (reducing 1Gt/yr on average). Negative emissions of up to -10.2Gt per year (in 2100) will be required in the second half of the century.

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Table 2: Agreement Text, Research Questions and Survey Questions

Paris Agreement Text	Research Question	Summary of Survey Questions (see Appendix 1 for full text)
Article 2 (1) (a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels…	How far below 2ºC is required to meet this objective? How close to 1.5ºC is required to meet this objective? At what point between 2ºC and 1.5ºC would be acceptable and be considered as meeting this objective?	Q2. Given all the effort to transition to a low GHG future, to what extent do the following temperature increases constitute an acceptable, neutral or unacceptable outcome under the Paris Agreement? Given your professional experience in the UNFCCC, do you think the listed temperature targets could be realistically achieved?
Article 4 (1) In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, 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, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty	What year does "global peaking occur"? What year does "peaking" occur for major emitting countries? How does this differ between major developed and developing country emitters? How fast, in percentage or rate terms, would emissions need to reduce in order to be considered as 'rapidly' reducing? Does this rate change between developing and developed countries? To what extent should sinks be relied upon to achieve a 'balance of sources and sinks' to achieve net zero emissions? What year should net zero emissions be achieved globally? Does this date differ between developed or developing countries?	Q 4. Given the effort of transitioning to a low GHG future, what year do you *realistically* expect the world (or individual countries/regions) to reach global peak emissions? Q5. Given the effort of transitioning to a low GHG future, what year do you *realistically* expect the world (or individual countries/regions) to reach peak emissions for selected major emitters and regions? Q7. How do you interpret the phrase 'undertake rapid reductions? What will this mean in practice in terms of achieving average annual emissions reductions? Q9. What do you think is an acceptable share of sinks in achieving this net zero emissions target (i.e., mitigation versus use of sinks)? Q10. If sinks are to be used in achieving a net zero emissions target, what should be the balance between using sinks from nature (such as re-forestation and afforestation) and using sinks based on carbon dioxide removal technologies (such as Bioenergy with Carbon Capture and Storage (BECCS) and Direct Air Capture (DAC))? Q11. Given the current mix of political will, engagement from businesses and communities around the world, competing priorities and technological development, what year do you expect that the world will

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		realistically achieve net zero GHG emissions?
Article 4 (3) Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.	What change in emissions, relative to the current period, would be considered a 'progression' beyond the current NDC?	Q13. Given this phrase in Article 4(3), what do you think will be the change in GHG emissions, globally, by 2030, compared to today's (2021) level of emissions? Q14. Given this phrase in Article 4(3), what do you think will be the change in GHG emissions by 2030, compared to today's (2021) level of emissions for selected major emissions and regions?

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3 Research Methods

3.1 Survey Design

The data in this study was collected through an online qualitative data survey of experts who attend UNFCCC meetings. The survey comprised of 19 questions using open and closed answer formats and was run during March, April and May 2021 using the Qualtrics propriety software (https://www.qualtrics.com/uk/core-xm/survey-software/). Survey was conducted in English – one of the official languages of the UNFCCC. The question schedule is in Appendix 1.

An opening question – designed to be an 'icebreaker' and capture overall attitude towards the Paris Agreement – was included to establish the tone of the survey and rapport with participants. Participants were then asked to provide answers on nine closed format questions designed to elicit specific quantitative interpretations of the phrases within the Paris Agreement text in order to derive the variables described in Table 2. Closed format questions were chosen to make the survey taking and data analysis process more tractable - but the use of this format required the identification of specific ranges of numerical answer options for each question. The format of the answer options designed for each closed answer question is set out in Appendix 1, while Appendix 2 provides the relevant sources used to support the answer formats and question design.

A further six open ended questions invited participants to comment on their answers to the closed format questions – and thereby provided an opportunity for them to reflect on their interpretations of the Paris Agreement.

The final three questions were asked to cover broad demographic characteristics of the participant – the first to identify the broad geographical region where the participant is located, while the second and third asked participants to self-identify the number of UNFCCC COPs they have attended and their professional role within the UNFCCC. Both questions deliberately used very broad categories of classification to ensure that participants understood that their privacy was to be maintained and that no other material could be used to identify them post survey. These demographic categories were then used to underpin the sampling protocol (see Sampling Protocol below).

With the exception of Questions 2, 11 and 12, question construction was based on identification of respondents' beliefs on what they considered to be likely or realistic – or conversely unlikely or unrealistic (De Vaus, 2014) - responses to the Paris Agreement by ratified Parties. This focus on expectations of what is *likely* to occur, rather than on respondents' attitudes of what they would prefer to happen, was selected on the basis that the current scientific literature around limiting global temperature increase to 1.5°C or below (e.g., IPCC SR1.5) can be interpreted as embodying the 'desirable' scenario.

To measure the *preferred* temperature targets, Question 2 asks respondents to specify their attitudes (range: strongly acceptable to strongly unacceptable) on specific temperature targets between 1.5^{0}C or below and 2^{0}C or above. Question 11 and 12 measure attitudes towards the use of sinks in achieving an emissions target – which as noted above, is used as a measure of risk attitudes in meeting Paris Agreement mitigation objectives.

A variety of question formats were used to engage participant attention and encourage survey completion. We predominately used various forms of matrix questions, sliders and multiple choice which form the standard toolkit for survey questions (De Vaus, 2014). We also used a 'pick, group and rank' format available in the Qualtrics platform to allow respondents to place specific items in broad categories through a 'drag and drop' motion. This did not provide additional information vis a vis the use of another format but added format variety to the survey

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which is considered important in retaining participant interest (De Vaus, 2014). Closed answer formats were structured to reflect best practice from the methodological literature (e.g. Krosnick, 1999) with the full survey, in the format used with participants set out in Appendix 1 and a detailed explanation of question structure set out in Appendix 2. To preserve anonymity, the software blocked the tracking of individual IP addresses and participants were asked to supply an email contact (voluntarily) only if they wished to be kept informed of research progress.

Surveys are particularly well suited to the collection of quantitative data and allows for data collection from a much wider range of individuals. However, to maintain a reasonable response rate, and analytical tractability, a number of survey design trade-offs were made:

- Survey tools do not allow for the use of follow up questions or exploratory questions with respondents – which, in an interview context, is an important mechanism in exploring case details, particularly in understanding underlying motivations for specific and unexpected responses.
- To achieve a balance between question specificity, question validity and survey length, the survey tool limited the level of detail that was collected, compared to using face to face interview techniques (which we rejected as a methodology due to the impact of COVID).
- Analytical tractability and respondent retention required the use of closed answer formats which, by definition, introduced a level of bias in responses as participants were not free to formulate their own. To compensate the survey included a series of open-ended questions inviting participants to comment on their response.
- Given the potential political sensitivity of the topic, a level of anonymity was considered appropriate to encourage honest responses. However, this meant that follow-up/probing questions and investigations with specific individuals and their responses was impossible. This explicitly traded off depth and detail of responses with quantity of responses.

The data outputs of the survey are a set of variables that, together, describe a narrative of the future implementation of the Paris Agreement: “global net zero year”, “global peak year”, global rapid reduction between peak year and net zero year”, “emissions in 2030” and “use of sinks” (see Table 2 and Appendix 1 for the full survey questions and the answer formats).

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Table 3: Survey questions and variables used in the analysis

Survey Questions	Variables used in analysis of survey data
Question 2: "acceptable temperature increase outcomes in 2100"	Human induced temperature increases above the preindustrial levels in 2100 (t_a), which is then summed across all respondents to provide the range of temperature goals that are considered "strongly acceptable, acceptable, neutral, unacceptable and strongly unacceptable" (T_a)
Question 2: "Are the temperature increases realistic"?	Answers are provided in a yes or no format.
Question 4: Year of global peak emissions and Question 5: Year of peak emissions for selected countries/regions	Year(s) of peak emission identified by ith individual respondents in the survey (y_P(i)) e_P is the estimated emissions in the peak year Years of peak emissions/emissions at peak year averaged across all respondents and respondent groups (Y_P and E_P) respectively. Year(s) of peak emission/emissions at peak year identified by ith individual respondents in the survey for the jth major countries/regions (y_P(i,j)) and $e_P(i,j)$. Years of peak emissions averaged across all respondents and respondent groups for the jth country/region ($Y_P(j)$) and ($E_P(j)$)
Question 7: "rate of rapid reduction"	Percentage rate of annual emission reductions identified by the ith respondent in the survey between year of peak emissions and year of global net zero emissions. (r_{P-Z}(i)) for each respondent i Percentage rate(s) of annual emission reductions averaged across all respondents and respondent groups (R_{P-Z})
Question 9: role of sinks in getting to net zero emissions	Percentage of sinks as a total percentage contribution to the total net emissions reduction effort. (s(i,k) is the share of sinks identified by the *i*th individual for the *kth* qualitative ranking response provided for in the answer format. S_k is the total share of sinks in the total emissions reduction effort averaged across all respondents and all respondent groups.
Question 10: preference for nature-based sinks versus sink technologies	$s(i,n,t)$ is the share of nature based sinks or sink technologies respectively in the total sink mix identified by the *ith* individual, and S_n or S_t is the average survey responses across all respondents.
Question 11: Year of achieving global net zero emission	Year(s) of global net zero emissions is achieved by the ith individual in the survey ($y_z(i)$). Year of global net zero emissions averaged across all respondents and respondent sub-groups (Y_z)

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Question 13 and 14: Progress in 2030 globally and for selected countries and regions.	Emissions in 2030 (expressed as a percentage change relative to 2020) identified by the ith individual in the survey ($r_{2020-2030}(i)$). Level of emissions in 2030 ((expressed as a percentage change relative to 2020) averaged across all respondents and respondent groups ($R_{2020-2030}$)
Additional Notation	Additional notation used in the data analysis (Section 3.4.1) are as follows: $w(i,j)$ is the weight attached to the jth category by the ith individual and is used when calculated the weighted averages of $r_{P-Z}(j)$, $r_{2020-2030}(i)$) e_{2030} (i) is the level of emissions in 2030 relative to 2020 for the ith individual Averaged across all respondents gives E_{2030} E_{2020} is emissions in 2020 and taken as an exogenous variable from IPCC SR 1.5.

The upper- and lower-case convention is adopted, whereby the lower case of a letter refers to a variable from an individual answer and upper case refers to the value of the variable averaged across all respondents.

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3.2 Data collection methodology

During the development of the data collection tool (Section 3.1) it became apparent that respondents to the key research questions required the participants to have undertaken a technical reading of the Paris Agreement. This requires significant background knowledge of both the technical elements of future climate change action and intimate experience in the negotiations themselves. Such perspectives could only be developed by individuals with experience in the UNFCCC process over an extended period of time. As such it became apparent that many of the participants in the Paris Reinforce Stakeholders Council – who were recruited on the basis of their expertise in national policy making and general interest in climate change policy– did not have the requisite background to contribute substantially to data collection for this task. In response, participant targeting strategies was pivoted from use of the Stakeholder Council (WP3) to seeking respondents from the UNFCCC negotiating delegations (contacted through the existing professional networks of the researchers) and through contacting the formal UNFCCC Focal Points for different networks of observer groups (called constituencies). Within the UNFCCC system, 9 formal constituencies and 2 informal constituencies are recognized and were contacted as part of this research (Table 3).

Table 4: Observer Constituencies in the UNFCCC

Network or Sector	Name of UNFCCC Constituency
Business and Industry Group	BINGO and Farmers
Environment Non-Government Groups	ENGO
Indigenous Peoples Organisations	IPO
Local Government and Municipal Authorities Groups	LGMA
Research and Independent Non-Government Organisations	RINGO
Trade Union Non-Government Organisations	TUNGO
Women and Gender Organisations	Women and Gender
Youth Non-Government Organisations	YOUNGO
*Faith Based Organisations**	*FBO*
*Economic Non-Government Organisations**	*ECONGO*

**Denotes an informal UNFCCC Constituency.*
Source: UNFCCC, 2019

In developing this data collection protocol, it was recognized that our research questions - elaboration of the temperature targets, emissions levels and the timing of peaking and reaching net zero emissions - goes to the core of Party negotiation strategies (Stephenson et al., 2019) making the research politically sensitive. In addition, reaching 'insider' negotiators and senior members of Constituency groups can be difficult because, due to their political positioning, these groups have a tendency to resist participation in order to protect knowledge and political interests (Chamberlain & Hodgets, 2018; Dimitrov, 2016). From a practical viewpoint, this population of negotiators follow extremely busy schedules and securing time for research purposes with them is rare (Pers comm.). Together these two factors make our target group of stakeholders a 'hard to reach' population.

Co-design, done well requires iterative, face to face interaction between stakeholders who develop a relationship of mutual trust - and this becomes particularly important when dealing with political sensitive material and 'hard to reach' populations (Clark et al., 2016). Therefore, the original intention of Deliverable D7.5 was to collect qualitative data through a series of consultations and interviews with targeted stakeholders and policy makers through attendance at UNFCCC meetings, to seek addition primary material from meeting participants.

Over the last quarter of 2020, the impact of the COVID pandemic made this approach unfeasible and a 6-month

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extension was granted for this Deliverable while an alternative research strategy was developed. In response, the primary data collection tool pivoted from a face-to face interview techniques to online survey collection using an anonymous online survey tool (Qualtrics). This was deemed appropriate because the inability to meet face to face meant that trust could not be built up between the research team and the participants. With the absence of trust, it was determined that a phone/skype interview would not be an adequate substitute for face-to-face interviewing, and the only option to encourage participation was through providing anonymity in the data collection tool. It is recognised that this created some limitations in the scope and representatives of the data collected – a point that is discussed in the Results section and in the discussion on further work.

3.3 Sampling Protocol

Experienced Party negotiators, as core agents within the Paris Agreement process, were the natural focus for this research. We expanded the survey scope to include experienced participants from official UNFCCC observer organisations from business, industry, environmental and social justice constituencies on the grounds that these groups, over the longer term, influence the negotiating positions of Parties – either through domestic politics or formal UNFCCC or related international programs (e.g. Torstad et al., 2020; Van Asselt, 2016; Kuyper et al., 2018; Hjerpe et al., 2015)– so how they interpret the Paris Agreement will increasingly matter.

Organising access to so-called hard to reach groups (Bengry, 2018) requires compromise, flexibility and negotiation with targeted individuals (Bengry, 2018) and often necessitates working with existing networks of contacts. As such, use of random sampling protocols is impractical because it is unlikely that randomly selected individuals will consent to respond to the survey (Teddlie and Yu, 2007). Instead, we deployed a purposeful sampling strategy with sampling tactics (sampling guide, snowballing, information rich samples and criterion selection) designed to balance the need to select and recruit respondents that have the 'insider' knowledge to answer our research questions, with respondents who are willing to share their views on these politically sensitive topics and with our aim of producing a data set that is broadly representative of the UNFCCC meeting population (Schreier, 2018).

Sample sizes are not fixed in qualitative research and depend on the context and research intention (Stephenson et al. 2019). There were 13,600 or more Party Negotiators attending COP25 in 2019 and a about 10,000 representatives of observer organisations (UNFCCC, 2019). Of these attendees there are approximately 500 who participate in the UNFCCC process with explicit and measurable power to alter the direction and content of the negotiations (Pers. Comm, 2021). Therefore, we adopted a prior heuristic of aiming to recruit 50 individuals – 10% of this population- to respond to this survey using a targeted a sampling guide (Figure 3) that was designed to capture a range of professional roles and country's of origin of the participants.

Sample selection process is described as follows:

1. A sample guide (frame) was developed using a matrix of UNFCCC roles (party negotiator, observer groups) and geography (developing country, developed country etc…) set out in the questionnaire (taken from question 18). See Figure 3).
2. For recruitment of negotiator participants, we used targeted approaches from existing professional networks with the aim of recruiting information rich respondents.
3. For recruitment of observer participants in each of the observer constituencies (UNFCCC, undated), we distributed the survey via email to the listed constituency contacts. Each contact was invited to participate and also to distribute the survey to colleagues who have worked with them at the UNFCCC COPs, and who may be interested in participating in this research (i.e. we 'snowballed' the invitation list).

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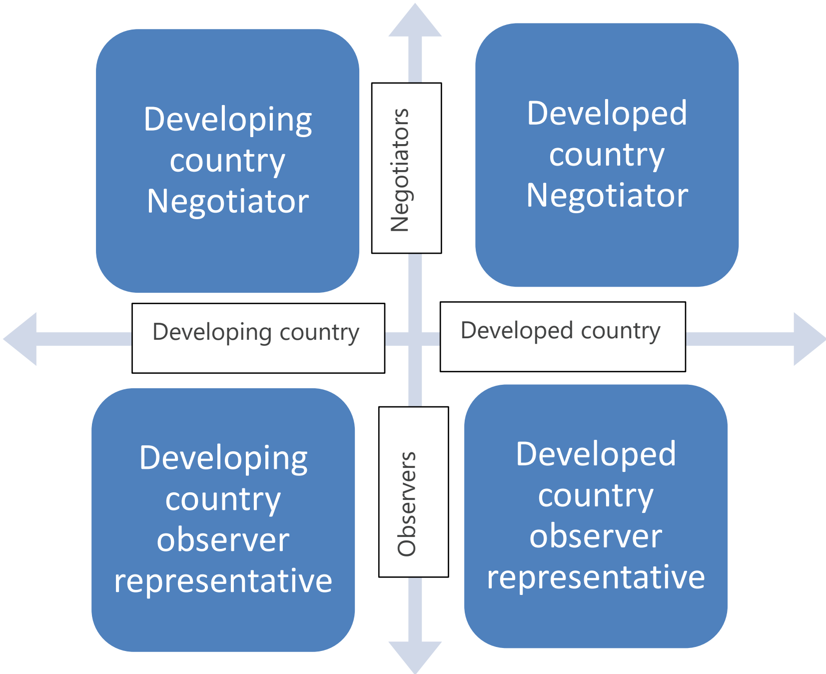
Figure 3: Survey Sampling Guide



3.4 Methods for Data analysis

The survey was designed so that each individual question yielded data and information on specific variables that are suitable for further analysis and suitable for use in a modelling exercise. Variables developed from each question are set out in Table 3 and the mechanics of the analysis are described in this section. Data from each question was downloaded from the Qualtrics web platform into excel spreadsheets where data was cleaned and divided into separate questions. For each question, data was divided into 4 groups based on the sampling guide (Figure 3): 'negotiators only', 'observers only', 'developed country' respondents only and 'developing country' respondents only to capture responses from individuals who fall within each of these groups. Where respondents did not identify their geographical origin or professional role, their results were included in the "all respondents" group but excluded from the analysis undertaken for each sub-group.

To begin, basic descriptive statistics (mean, mode, median etc.) for the total respondents ("all respondents") for the analytical variables of "global net zero year", "global peak year", the rate of global rapid reduction in emissions between peak year and net zero year", "emissions in 2030", "use of sinks" and "priority objectives". The summary descriptive statistics for are presented in the results section.

To interrogate the data in line with the research questions set out in Table 2, the following steps were taken.

1. Average data and weighted average data were calculated for each variable (Table 2) and each respondent group to establish overall pattern of responses on the narrative data.
2. IPCC 1.5°C high overshoot scenario data was summarised, and average rates of change were calculated.
3. Three 'consistency' tests were undertaken to test the coherency of respondent narratives.

3.4.1 Average and weighted average data

For survey questions about nominating year of global net zero, year of global peak emissions and emissions in 2030 (relative to 2020) respondents were asked to rank or indicate their answers using one of eight categories of potential years as described in the answer formats in Appendix 1. To simplify the analysis, the mean value of each category was used in the analysis that follows (e.g. for the range 2031-2040, the year 2035 was used in any

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calculations).

The average "Year of peak emission" (Y_P) and the average "Year when net zero is achieved" (Y_Z) was calculated using a generic average over *n* individual respondents:

$$Y_P \text{ or } Y_z = \frac{\sum_{i=1}^{n} x(i)}{n}, \qquad (1)$$

where and $x(i)$ is the (generic) mean value of the range of years in the survey response selected by the *i*th individual (i.e., $y_P(i)$ or $y_Z(i)$)

For the variable "rate of emissions reduction" (R_{P-Z}) between " year of global peak emissions" and "year of global net zero emissions", respondents were asked to rank linear rates of reduction (specified in categories with values ranging between 1% and 7% per year) using a scale of 1 to 10 (with 1 representing "highly unrealistic" rates of emissions reductions and 10 representing "highly realistic" rates – see in Appendix 1). This normative scale of 1-10 was then combined with the value of the answer categories (i.e., 1% to 7%) to calculate a representative rate of reduction ($r_{P-Z}(i)$) for each respondent using a weighted average:

$$r_{P-Z}(i) = \frac{\sum_{j=1}^{k} w(i,j) r_{P-Z}(j)}{\sum_{j=1}^{k} w(i,j)}, \qquad (2)$$

where $w(i,j)$ is the weight (scale number of 1-10) attached to the *j*th category by the i th individual, and $r_{P-Z}(j)$ is the category value selected by the respondent. Once the representative rate was calculated for each respondent, a simple average was taken across all respondents, and all respondent groups to determine a value for R_{P-Z}

A similar process was used to obtain respondents answers to their estimate of the "level of emissions" in 2030, relative to 2020 (i.e., $r_{2020-2030}(i)$). Here, respondents were asked to rank changes in emission levels (specified in answer categories with values ranging from >10% to >-50%) using a qualitative ranking of "Highly Unrealistic", "Unrealistic", "Neutral", "Realistic" and "Highly Realistic". This normative scale was converted into a numerical score of 1 to 5 (i.e., highly unrealistic = 1 etc) prior to being combined with the value of the answer categories to calculate a representative change in emissions in 2030 ($r_{2020-2030}(i)$).) for each respondent using equation 2. Again, once the representative rates of change were calculated for each respondent, a simple average was taken across all respondents, and all respondent groups to determine a value for $R_{2020-2030}$.

3.4.2 Use of IPCC data

As discussed in Section 2, we draw on IPCC data as a comparison point for the data provided by survey respondents. Here we use data derived from IPCC SR1.5 1.5°C "High 1.5-degree overshoot" because it provides an estimate of the emissions path that broadly aligns with emissions pathways implied by the current NDCs (Rogelj et al, 2018) and could be interpreted as a 'high risk' approach to limiting global temperature increase to 1.5°C. (Table 5).

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Table 5: IPCC Data from IPCC SR 1.5°C high overshoot scenario

Name of Variable	Value
Net missions in 2010 (used for calculations of $R_{2020-2010}$) Gt CO2e	50.4
Year of peak emissions	2020
% Rate of emissions reduction between year of peak emissions and year of net zero emissions $r_{P-Z}(IPCC)$	2.33%
Year of net zero (Yz)	2063
Net emissions at Base year 2020 Gt C02e	53.00
Net emissions in 2030 CO2e	40.4
Emissions in 2030 (% change base year)	-31%
Average annual rate of change in emissions 2010-2020 (%/yr) $R_{IPCC\ 2010-2020}$	0.5%

Source: Table 2.4 from Chapter 2 IPCC SR 1.5oC Repot (Rogelj et al 2018)

The rate of change in total emissions between 2010-2020 is calculated by:

$$RC_{2010-2020} = \frac{(E_{2020} - E_{2010})}{E_{2010}}, \qquad (3)$$

where……. E_{2020} and E_{2010} is defined as emission levels (Gt CO2e) reported by the IPCC for 2020 and 2010 respectively.

This variable is used in the "consistency tests" (Table 6), to calculate the rate of change in emissions between the 2020 base year (i.e. Y_{2020}/E_{2020}) and emission levels expected at the respondents nominated year of global peak emissions

The variable "rate of emissions reduction between year of peak and year of net zero" is assumed to be linear and calculated using equation 4. The linear assumption significantly simplifies a realistic emissions reduction pathway but provides a conservative estimate of the rate of change between these two milestone years.

$$RC_{P-Z} = \left(\frac{\frac{E_Z}{Y_Z - Y_P}}{E_Z} \right), \qquad (4)$$

Where RC_{P-Z} is the calculated rate of emissions reductions given the data for the "global peak year" and "global net zero year". The "RC" is used to differentiate this number from the rates of reduction between peak and net zero year nominated by survey respondents (i.e., $r_{P-Z}(i)$) and discussed above. RC_{P-Z} is applied year on year to the emissions levels at global peak year (i.e., E_p) until zero emissions is reached. The year at which zero emissions is reached is interpreted as the "year of net zero":

$$Y_z = \left(\frac{1}{RC_{P-Z}} \right) + Y_p \qquad (5)$$

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3.4.3 Consistency Tests

To test whether the narratives held by experts are internally consistent, we apply three consistency tests to the survey data. These tests are designed to compare the specific values nominated by survey respondents for each variable, with a corresponding calculated value, described in Table 6 to determine whether the different 'elements' in the respondents narrative produce a logical emissions pathway post 2020.

Table 6: Consistency tests used to determine internal coherency in responder narratives (mechanics of calculations are below)

Consistency Test	Given responders answer to....	What is	Test
1. 2030 vs Peak Emissions	• Relative emissions in 2030 emissions (($r_{2020-2030}(i)$)); and • Peak Year ($y_P(i)$)	The level of emissions in 2030, implied by the responders survey answers? How does this compare to the emissions calculated for the nominated year of peak emissions?	• Calculate E_{2030} • Calculate E_P • Compare E_{2030} with E_P If the internal narrative was consistent, we would expect to see emissions in 2030 and emissions at the peak year to align in a consistent way – that is, if the nominated peak year was after 2030, then the emissions in 2030 are higher than the emissions in 2020 and vice versa.
2. Net Zero	• Peak Year ($y_P(i)$) • Rate of emissions decline after peak year $r_{P-Z}(i)$	The implied year for reaching global net zero emissions ($yc_z(i)$)? How does this calculated year compare to the year for global net zero emissions nominated by the responders?	• Calculate ($yc_z(i)$/ YC_z • *Compare* ($yc_z(i)$/ YC_z with the nominated year for reaching global net zero. If the internal narrative was consistent, we would expect that the calculated year of global net zero using equation 8 is approximately the same as the respondents nominated year(s) of net zero. These results are presented in X below.
3. Rate of Decline	• Peak Year ($y_P(i)$) • Net Zero Year ($y_z(i)$)	The implied rate of annual global emissions reduction between peak year and net zero year (i.e. $r_{P-Z}(i)$)? How does this calculated rate compare to the rate of emissions reduction nominated by the responders?	• Calculate $rc_{P-Z}(i)RC_{P-Z}$ • Compare to $r_{P-Z}(i)/R_{P-Z}$ If the internal narrative was consistent then the rates of decline between the nominated and calculated values would be broadly similar. .

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3.4.3.1 Test One: Peak year vs 2030

For this test, emissions in 2030 were estimated for each individual respondent using the respondents nominated change in emissions relative to 2020:

$$e_{2030} = E_{2020}.r_{2020-2030}(i), \quad (6)$$

Where E_{2020} is emissions in 2020 and $r_{2020-2030}(i)$ is defined by Equation 2. This valued was averaged across all respondents and respondent sub-groups to determine E_{2030}.

To calculate emissions at "year of global peak" for each individual respondent we assumed, as noted above, a linear increase in emissions between base year (2020) and the nominated peak year using equation (7) and the variable $RC_{2010\text{-}2020}$ from equation (3):

$$e_P = RC_{2010-2020}\, x + E_{2020,} \quad (7)$$

where:

$$\chi = y_p(i) \text{-} y_{2020}, \quad (8)$$

and where $E_{2020,}$ is the emissions at base year of 2020 (y_{2020}), $y_p(i)$ is defined by the respondent as the year of peak emissions, e_P is the estimated emissions in the peak year (Table 3). The value for e_P is averaged across all respondents and respondent subgroups to calculate estimates of E_P. The use of a linear increase between Y_p and Y_{2020} is a simplification use for ease of analysis. However, it can be interpreted as providing a 'conservative' estimate of the increase in emissions over this time period.

3.4.3.2 Test 2: Net zero

In this test, the respondents nominated year of peak emissions ($i.e. y_P(i)$ and nominated rate of decline of emissions beyond this year (i.e. $r_{P-Z}(i)$) are used to calculate the year in which net zero emissions may be achieved:

$$yc_z(i) = \left(\frac{1}{r_{P-Z(i)}}\right) + y_p(i) \quad (9)$$

$yc_z(i)$ notation is used to differentiate the calculated year of net zero for individuals from the year nominated by survey respondents ($y_z(i)$). The calculations for individuals are averaged across all respondents and all sub-groups to determine a set of YC_z . These YC_z are then compared to the respondents average nominated year(s) of when they expect global net zero emissions to occur to assess for consistency in the narrative.

3.4.3.3 Test 3: Rate of decline in emissions

Test 3 is the opposite of test 2. Here the test takes as a given the respondents nominated global year of peak emissions $y_P(i)$ and global year of net zero $y_z(i)$and calculates the rate of emissions reductions per year that is required on average to link the two in a linear form. That is:

$$rc_{P-Z}(i) = \frac{e_p}{(y_z(i) - y_p(i))} \quad (10)$$

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Where e_P is calculated from equation 7 and $rc_{P-Z}(i)$ notation is used to differentiate the calculated value from the value identified by survey respondents (given by $rc_{P-Z}(i)$). The calculations for individuals are averaged across all respondents and all sub-groups to determine a set of RC_{P-Z} for each respondent group. These RC_{P-Z} are then compared to the respondents average nominated rate of decline in emissions year(s) (i.e. R_{P-Z} of when they expect global net zero emissions to occur to assess for consistency in the narrative.

3.4.4 Analysis of sinks data

Survey respondents were asked their preferred share of sink use, as a total percentage of emissions reduction effort to reach net zero emissions against a qualitative ranking of strongly unacceptable, unacceptable, neutral, acceptable and strongly acceptable. Descriptive statistics across the full data set were prepared and are reported at Table 8b. The average 'share' of sinks (S), was calculated over *n* individual responses for each answer category, to give an overview of what is considered an acceptable and an acceptable use of sinks. Adapting Equation 1:

$$S = \frac{\sum_{i=1}^{n} s(i,k)}{n}, \qquad (11)$$

where s is the share of sinks identified by the ith individual for the *kth* qualitative ranking response provided for in the answer format (Appendix 1).

If sinks were used in reaching net zero emissions, respondents were asked to nominate the balance between the use of sinks from nature, versus the use of sink technologies. Adapting equation (11), an average was calculated over *n* individual responses to estimate an average share of each type of sink in the total sink mix:

$$S_n \; or \; S_t = \frac{\sum_{i=1}^{n} x(i,n,t)}{n}, \qquad (12)$$

Where $x(i,n,t)$ is the share of nature-based sinks or sink technologies respectively in the total sink mix identified by the *ith* individual, and $S_n \; or \; S_t$ is the average survey responses across all respondents.

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4 Results and discussion

In total 123 individuals engaged with the survey, with 74 respondents (58% of total engagement) completely or partially completing the survey (completion rate of 58%). All questions were voluntary and therefore not all were completed. Only 39 responders provided details on their role and geography of origin, with the distribution of respondent characteristics at Table 7 Of these 39 respondents 39% identified as being located in a developed country while 61% came from developing country locations. This is almost opposite to the attendance statistics for IGO/NGOs compiled by the UNFCCC (UNFCCC, 2019) who calculated that 68% of IGO/NGO admitted observers in December 2017 (latest statistics available) were from developed countries and 32% from developing countries (UNFCCC (b), undated). Further, 10 responders identified themselves as not having attended any UNFCCC meetings and were excluded from the analysis. The method of using anonymous snowball recruitment through outreach to the UNFCCC constituency contact lists prevent the ability to track the number of survey links distributed (see Section 3.3) and overall response rate.

Table 7: Geographical location and professional role of survey respondents

Which country group do you reside in?					
Role at UNFCCC Meetings	Total	**China, India, Russia, Brazil, Indonesia.**	**Other Developing Countries (excluding China, India, Russia, Brazil, Indonesia)**	**US, EU, Canada, Japan, UK**	**Other Developed Countries (excluding US, EU, Japan, Canada, UK)**
Party Negotiators	6	0	1	5	0
Observers	33	5	9	14	5
Other Respondents	33	Did not provide an answer on geographical location or professional role			

Source: Survey responses

The survey responses are presented and discussed in following sections.

4.1 Qualitative Perceptions of the Paris Agreement

Question 1 (Appendix 1) was designed to be an 'icebreaker' and yield insights into respondents' perspectives on the Paris Agreement at the time it came into force, and how their views have changed over time. This data was analysed using qualitative coding of the text with the NVIVO software (https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/try-nvivo) and grouped into core concepts ("nodes") that formed a verbal narrative (Figure 4) about initial perceptions of the Paris Agreement (when it came into force in 2016), how respondents feel about the intervening period of implementation, and their current perceptions of the Agreement.

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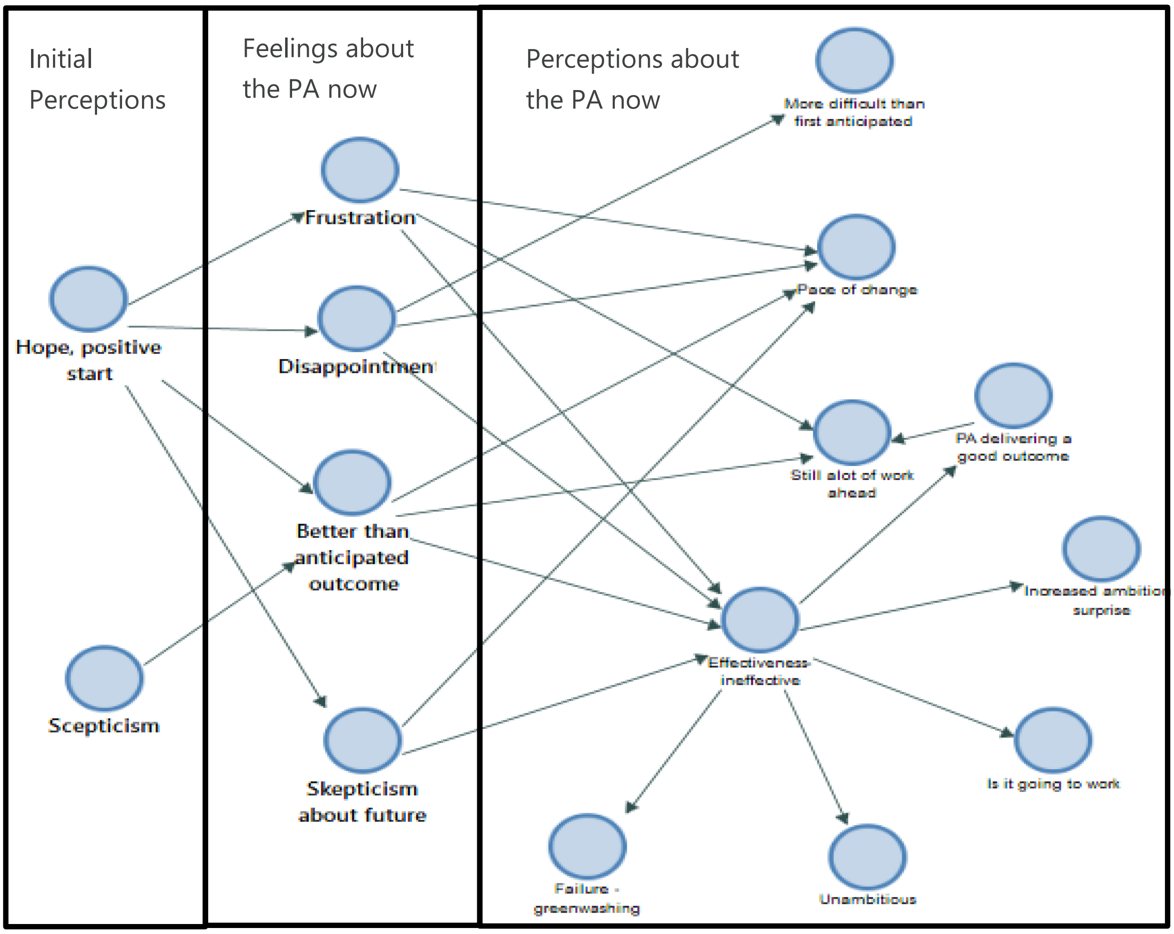
Figure 4: Respondents' perspectives on the Paris Agreement



Source: Authors' analysis of survey responses. Each circle is called a "node" in this analysis.

Figure 4 captures the key concepts ("nodes") raised by respondents in question 1 and the (one way) linkages between them. Initially, most respondents reported having a high level of hope and optimism associated with the Paris Agreement, seeing it as a major break-through on that would appropriately address climate change (node: "Hope, positive start"). For example, respondent R29 writes:

I remember being in the room with all the heads of state (after the terrorist attack in Paris) thinking that we can overcome the challenges and actually make a global effort in tackling one of the biggest problems confronting humanity and the planet. After disappointments in Copenhagen in 2009, and almost watching the process fall apart in Cancun, this was a moment to celebrate.

However, for the majority, most of this initial optimism has faded in the intervening 5 years and is replaced by a sense of frustration and disappointment (nodes: "frustration" and "disappointment"), driven by a perception that the implementation of the Agreement has been 'more difficult than expected' (node: "more difficult than first anticipated). For example, R37 commented:

I was hoping that it meant that the international community would begin to cooperative more effectively, more quickly, or at least less dysfunctionally, through the UNFCCC process. I've since been disappointed by the slow pace of cultural change. ....

And R36:

Overall a renewed sense of optimism after the disappointment that followed Copenhagen COP. My personal hope

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was that the UNFCCC had been 'solved' yet since then realize the substantial work still ahead of us.

Two respondents also expressed some skepticism about the future of the Agreement, citing weak enforcement mechanisms, the need for countries to implement short term action and the ongoing impact of the (then) USA withdrawal from the Agreement (node: skepticism about future). Nevertheless, one of these respondents expressed surprise at the better-than-expected performance of the PA (node: better than anticipated outcome).

I was sceptical that merely having an agreement would result in actual mitigation. I have been pleasantly surprised by countries' willingness to raise ambition since then... (respondent R5).

The negative emotions expressed by respondents coalesced into two dominant themes about their current perceptions of the Paris Agreement. First, as noted by R37 above, there was almost a universal frustration and disappointment at the slow pace of change within the UNFCCC (node: "Pace of change") and/or a sense that there is still much work to complete (node: "still a lot of work ahead"). For example, R19 writes:

I had hoped most nations would keep up with the ambitions that were signed onto in the Paris Agreement, specifically on the pledges for fast-track finance and special attention to adaption actions for LDCs, SIDS and Indigenous communities.

My views have not changed .... I have become more frustrated at the stunted pace at which the actions are taking place.

While R12 notes: *".... targets are nothing with efforts to achieve them, and this is lagging behind....*

This is consistent with the work of Wamsler et al. (2020) who find in their survey of UNFCCC participants that the UNFCCC culture is 'lacking a sense of urgency and action taking' (p229).

Second, there is active questioning of the effectiveness (or ineffectiveness) of the Agreement itself. Here, the answers varied significantly between respondents with some expressing comments that implied anger and disgust at the progress of the Agreement (node: "failure-greenwashing") and the lack of ambition (node: "unambitious"), while several expressed doubts about whether it was going to work (node: "is it going to work?"). For example, R41 writes:

.... Paris Agreement is more of a piece of evidence of how politicians currently only make empty promises to act accordingly to climate scientists. It is the piece of evidence which climate activists can always use to accuse the politicians to not have taken enough action...

While R1 writes:

My hopes were that the bottom-up approach would allow countries to engage and enhance ambition over time and that we would be on a pathway to 1.5. Now, with the synthesis report recently launched, we are far from both things. I now wonder if a bottom-up mechanism relative toothless will provide the response we need for the climate problem....

This change in perceptions from "hope" to "disappointment" was not universal amongst the respondents and several reported a sense of ongoing optimism and even surprise that it is working as intended (node: "increased ambition-surprise" and "PA delivering a good outcome"). In all cases these positive comments were tempered with a sense of frustration at the pace of change (node: still a lot of work ahead). For example, R15 writes:

When the Paris Agreement came into force, I thought that the 1.5C target was not reachable anymore but now it seems to be reachable although with substantive efforts. I was hoping that the Paris Agreement would trigger a lot of common efforts for ambitious climate action both on the policy side but also with private businesses and first indications seem to point that it is effective, but the pace still has to increase.

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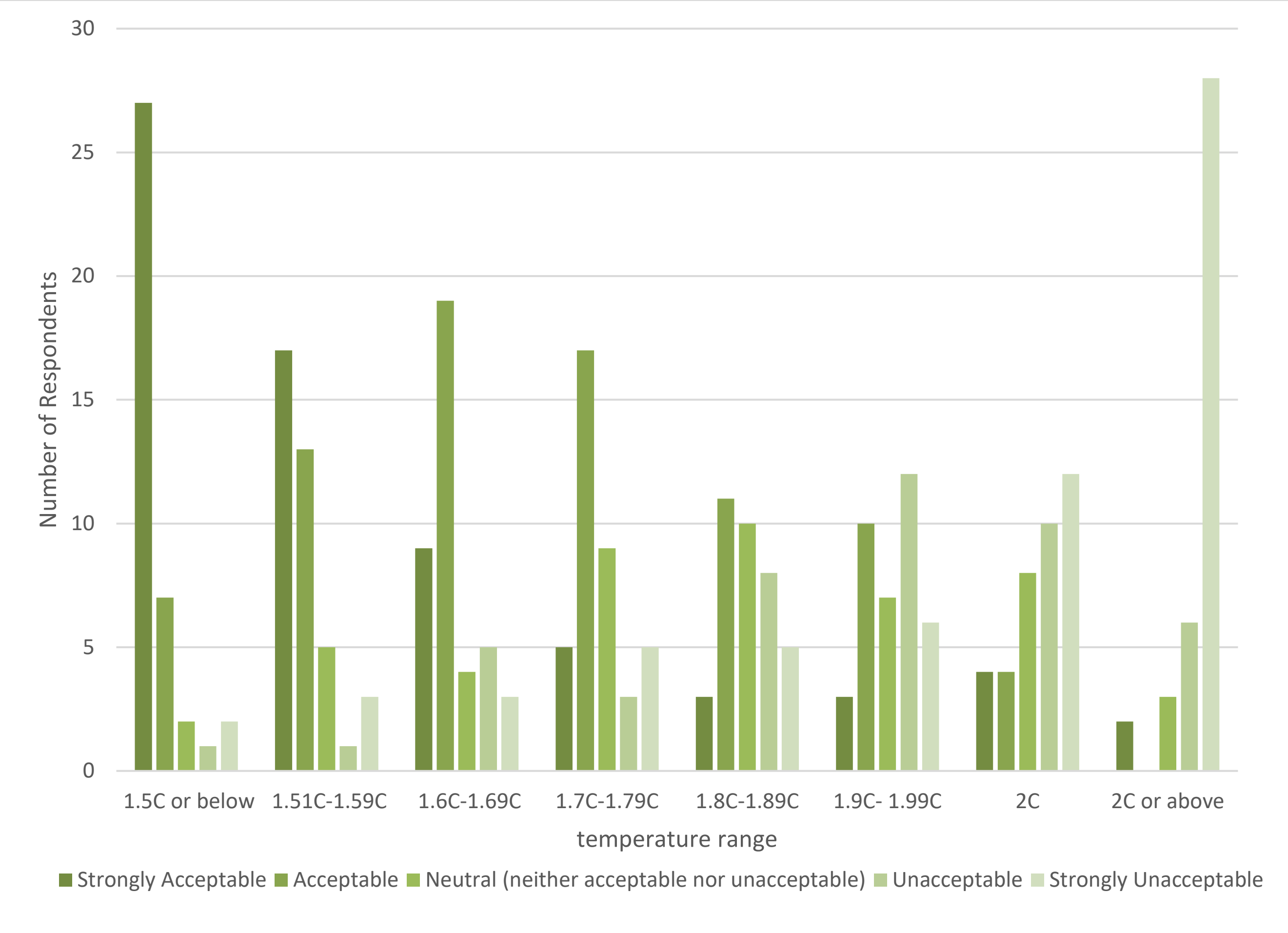
4.2 Global results

4.2.1 Temperature targets

Question 2 asked respondents to rank their desired temperature range for limiting global warming between 1.5⁰C or below and above 2ºC using a 5-point scale of Strongly Acceptable (5) to Strongly Unacceptable (1). The distribution of these responses is in Figure 5.

Figure 5: Ranking of temperature targets (sample: all respondents)



Source: Data from survey responses

Figure 5 suggests that:

- Respondents' views on acceptable temperature goals were skewed significantly to the lower end of the temperature range and displays a strong preference for limiting temperature increases to 1.5ºC or lower or to the range of 1.51ºC to 1.59ºC.
- Some respondents considered as 'acceptable' temperature increases in the range of 1.6ºC to 1.79ºC.
- Respondents' views on unacceptable temperature changes was skewed to the higher end of the temperature range, with an increase of 2ºC or higher clearly being considered as strongly unacceptable.

To gain a sense of overall attitude towards temperature outcomes in 2100, a weighted average score was calculated for each temperature range in the answer options by converting the qualitative ranking into numbers

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of 1 to 5 (where strongly unacceptable = 1 and strongly acceptable = 5). These numbers were then multiplied by the number of times respondents placed a specific temperature range into a specific rank to provide an overall 'score' (Table 8).

Table 8: Average ranking scores of acceptability for each temperature range

	Below 1.5°C	1.51C-1.59C	1.6C-1.69C	1.7C-1.79C	1.8C-1.89C	1.9C-1.99C	2C	Above 2C
Average score	4.44	4.03	3.65	3.36	2.97	2.79	2.42	1.51

Source: Authors' calculations from survey responses.

The ranks used for this calculation are "Strongly acceptable = 5", "Acceptable = 4", "Neutral = 3", "Unacceptable = 2" and "Strongly Unacceptable = 1".

Table 8 results are consistent with Figure 3 with the temperature ranges of below 1.5°C or and -1.5°C to 1.59°C attracting the highest score out of 5 (4.44 and 4.03 respectively). Table 8 scores for temperature outcomes between 1.6°C and around 1.79⁰C is in the "neutral" range (i.e., between 3 and 4 with neutral = 3) and contrasts slightly with Figure 5, where these temperature ranges have a strong mode of "acceptable". The format of the survey precluded the ability to conduct follow up questions around these acceptable or neutral responses, and we can only hypothesise as to why respondents have chosen this rank. Two potential interpretations are:

- That respondents consider temperature increases between this range (i.e., above 1.5°C but below 2°C) as acceptable outcomes – that is they adopt a strict reading[1] of the Paris Agreement text; and/or
- They recognise that there is significant scientific uncertainty and variability around 1.5°C target (IPCC SR1.5, Chapter 1, Allen et al., 2018)) and consider a range of temperature outcomes approximately around the 1.5°C target as an equally acceptable outcome of the Agreement.

4.2.2 Are the temperature outcomes realistic?

In addition to ranking temperature outcomes, respondents were asked to state whether they thought each was a realistic or not (using a yes/no format) (Figure 6).

Here the pattern of responses clearly indicates that higher the temperature outcome, the more realistic it is considered as a temperature outcome in 2100, and vice versa. Together with Figure 5, this suggest that while experts preferred the lower temperature ranges as an outcome of the Paris Agreement, a significant number also expressed it as being unrealistic. This pattern is broadly consistent with the observations made by several recent papers in the scientific literature that indicate that the emission pathways for achieving a 1.5°C temperature outcome is becoming less viable over time (e.g., Rogelj et al., 2018b)

In addition, some respondents unexpectedly answered the question with a "no" to the temperature targets of 2°C or above 2°C. This could be due to a mis-interpretation of the question or reflect a view that rejects this temperature range is an unacceptable state of the world in 2100.

[1] By this, we mean that respondents have used a literal interpretation of the Paris Agreement *range* of 1.5°C to 2°C as being the objective and this is reflected in their responses.

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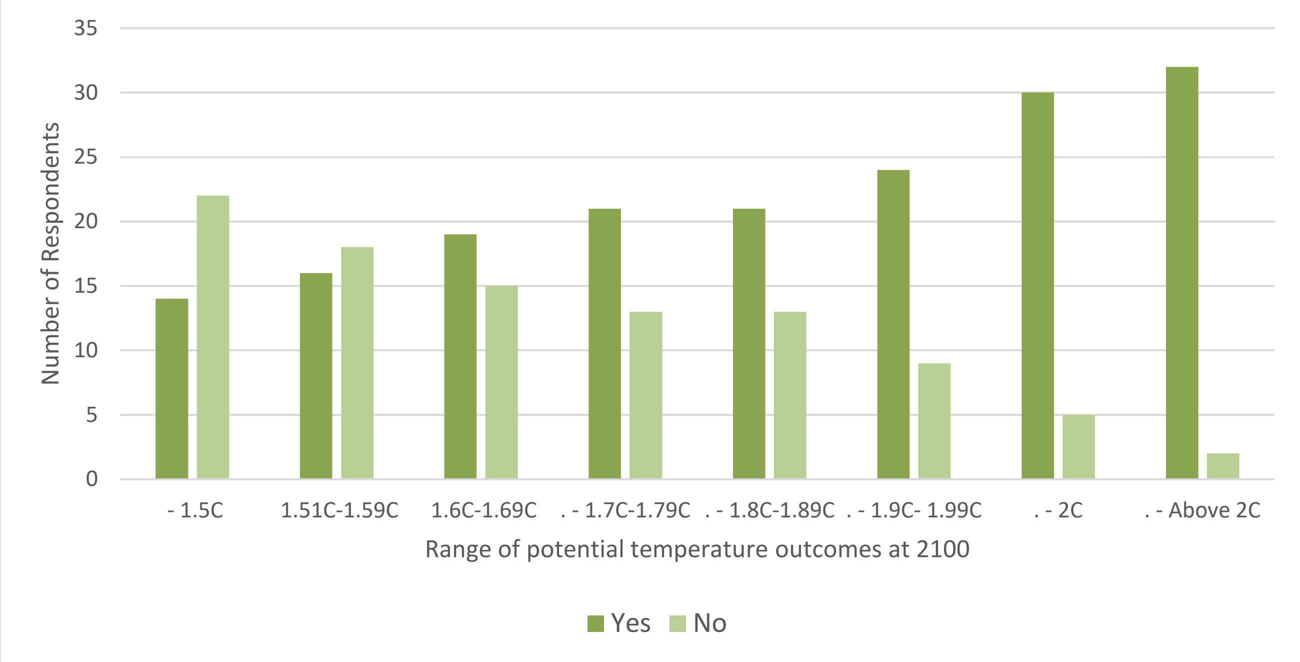
Figure 6: Are the following temperature targets in 2100 realistic to achieve? (sample: all respondents)



Source: Data from survey responses

4.2.3 Test 1: Emissions at the year of global peak emissions vs emissions in 2030

Question 4 asked respondents to nominate their expected year for global peak emissions. Averages of the responses are presented in row one of Table 9. The average year calculated for each group was combined with respective annual emissions (see Equation 7, Section 3.4.3.1) calculated based on the IPCC SR1.5 1.5ºC high overshoot scenario (Rogelj et al. 2018). For simplicity, a linear rate of change (increase) in emissions is assumed – which provides a conservative estimate of total emissions in the peak year.

Table 9: Average and calculated years for reaching peak emissions

Variable	IPCC	All Respondents	Negotiators Only	Observers Only	Developed Country Only	Developing Country Only
Average Year of Peak Emissions nominated by respondents *(Y_P)*	2020	2036	2035	2037	2036	2039
Calculated Emissions (Gt CO2e) at Peak Year *(E_P)*	53.00	62.84	62.21	63.60	62.53	64.93

Source: IPCC 1.5ºC high overshoot scenario Chapter 2, Table 2.4 (Rogelj et al. (2018a); Authors' calculations from survey responses

On average all respondents nominated a year of peak global emissions of 2036 with a broadly consistent average across all groups, with the exception of respondents from developing countries who, on average, nominated a higher peak year of 2039. However, all responses, on average, fall within a single answer range (2031-2040) used within the survey tool (see Appendix 1) and therefore the differences between the response groups should not be considered significant. In all respondent groups, the nominated year of global peak emissions for survey respondents is 15-19 years higher than the peak year suggested by the IPCC SR1.5 1.5ºC high overshoot scenario data.

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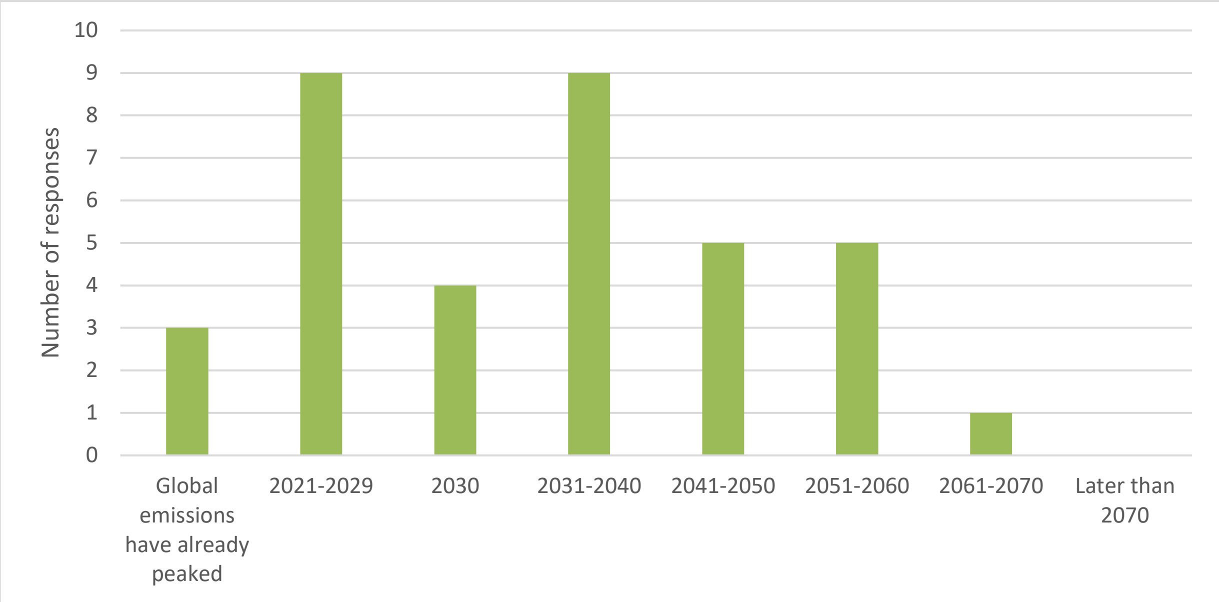
These averages mask a significant level of variability in the data. To explore this, Figure 7 visualises the distribution of nominated peak years across all answer categories. Here the data is bi-modal, with responses clustering around a year of peak emissions either between 2021-2029 or between 2031-2040. Exploring the data further, approximately 44% of respondents identified a global peak year at or before 2030 – with an average nominated year of 2023. Of those respondents who nominated a global peak year after 2030, the average nominated year is 2040. This pattern was broadly consistent across all respondent groups: approximately 1/3 to just over 40% of respondents in each group nominated a peak year that was at, or prior to, 2030.

Figure 7: Distribution of Nominated "Year of Global Peaking"



Source: Data from survey responses

Next, question 13 asked respondents to rank potential changes in emissions in 2030, relative to 2020. The average data across all respondents and respondents' sub-groups was then combined with emissions data for 2020 (IPCC SP1.5 Chapter 4 Cross Box 11 (de Coninick et al., 2018) to estimate the level of emissions in 2030 (Table 10).

Table 10: Rate of Change in Emissions 2020-2030, Emissions in 2030 and Global Peak Year Data

Variable	IPCC	All Respondents	Negotiators Only	Observers Only	Developed Country Only	Developing Country Only
Average change in emissions in 2030, relative to emissions in 2020 nominated by survey respondents ($R_{2020\text{-}2030}$) (middle values used for calculations)	-31%	-10.06%	-14.75%	-9.37%	-10.36%	-9.41%
Emissions (Gt CO2e) in 2030 (E_{2030})	40.4	48.15	45.18	48.03	47.51	48.01

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Emissions (Gt CO2e) at Peak Year *(E_P)*	53.00	62.84	62.21	63.60	62.53	64.93
Year of Peak Emissions nominated by respondents *(Y_P)*	2020	2036	2035	2037	2036	2039

Source: IPCC 1.5oC high overshoot scenario (Rogelj et al. 2018); Authors' calculations from survey responses

On average, respondents estimated that emissions in 2030 would be around 10% lower than the current period (i.e., relative to 2020). This varies across the groups from a 9.4% decline (observers only) to a decline of 14.8% (negotiators only). The respondents nominated average changes (reductions) in emissions in 2030 was significantly lower (approximately lower by up to 3 times) than the decline in 2030 emissions as suggested by the IPCC SR 1.5°C high overshoot scenario data. Consequently, calculated emissions in 2030 using respondents' data is significantly higher (approximately 5 GtCO2e to 8 GtCO2e) that the 2030 emission levels indicated by the IPCC 1.5°C high overshoot scenario.

Comparing the calculated level of emissions in 2030 with the calculated level of emissions at global peak year (i.e., Test 1 - see section 3.4.3.1), Table 10 shows that on average, the level of emissions in 2030 was expected by respondents in all categories to be lower than the emissions than at their nominated peak year. This implies that, at first, emissions decrease to 2030 and then increase to a final year of peak emissions around the mid-2030s. This contrasts with the IPCC SR 1.5C scenarios from Chapter 2 (Rogelj et al., 2018), which shows a 'smooth' unidirectional emissions pathway that decreases from 2020 to reaching net zero emissions in 2050 – and suggests that respondents hold an inconsistent narrative about future implementation pathways.

The format of the survey tool precluded the use of follow up questions to explore this observation. However, potential interpretations of these results include:

- There is a genuine inconsistency in the narrative held by these experts, who haven't considered the 'alignment of their interpretation of the Paris Agreement to 2030 and beyond; or
- Respondents genuinely expect emissions to decline to 2030 and then rise again to a peak in the mid-2030s; or
- There is a response bias whereby responders provided what they considered to be 'socially desirable' or 'acquiescent' responses that do not necessarily reflect their true opinions or be using 'satisficing' techniques to respond to the survey (e.g., Krosnick, 1999), although the design format was specifically selected to minimise this phenomenon (Schaffer and Presser, 2003).
- The use of averages to analyse the data hides a great deal of variability in responses – and that there may be more consistency in the responses provided by individuals than suggested by these results.

4.2.4 Test 2: Year of Global Net Zero

Question 11 asked respondents to nominate their expected year for reaching 'global net zero' using specified year ranges. Average values were calculated across all respondents and sub-groups and are reported in Table 11, while the distribution of responses is set out in Figure 8.

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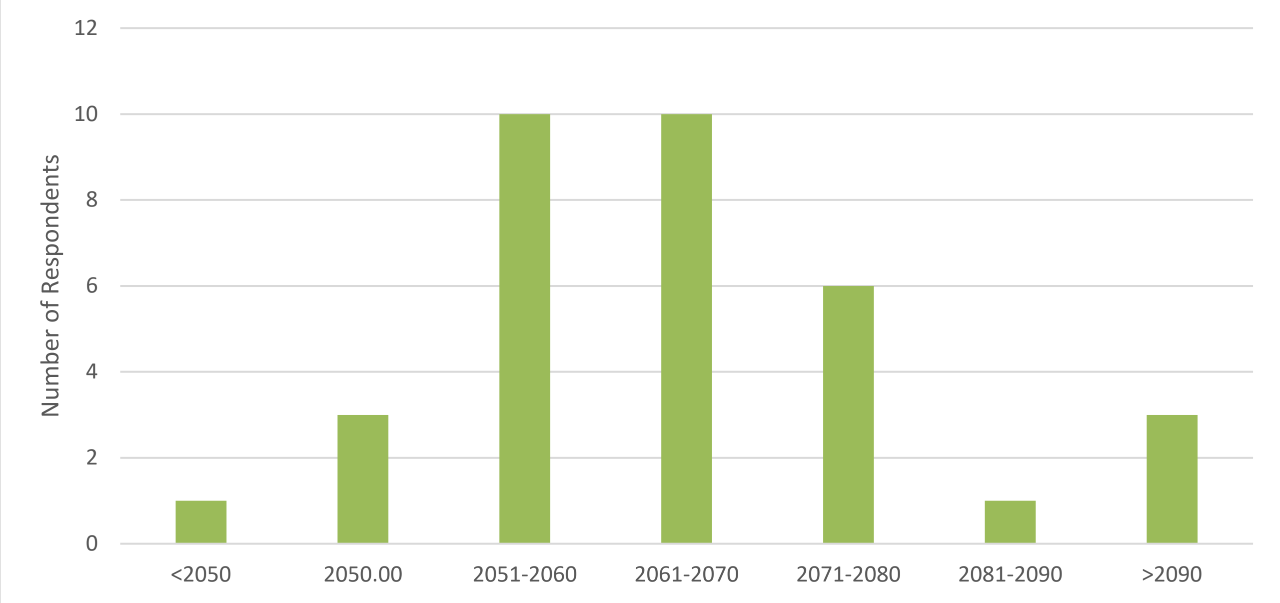
Figure 8: Distribution of nominated years for achieving global net zero (Sample: All Respondents)



Source: Authors' calculations from survey responses

On average, respondents identify 2065 as the year for reaching global net zero emissions – with all groups identifying years, on average, within a single category group (2061-2070) that is broadly similar to the global net zero year in IPCC SR1.5 1.5°C high overshoot scenario (Rogelj et al., 2018). However, there is some significant variation, with the most common year identified by respondents lying within a 20-year timeframe of between 2051 to 2070 (Figure 8). This pattern of variation in nominated net zero emission years is maintained within each respondent group – suggesting that the narrative for global net zero year is not linked to the professional role or geographical location of the respondent.

To test for consistency in the respondents' narrative, the year of global net zero was calculated using respondent' data for global peak year, and rate of decline in emissions using equation 8 – see section 3.4.3.2. The average net zero years calculated for all groups and each subgroup was then compared to the IPCC SR 1.5°C high overshoot scenario data (Table 11).

Table 11: Nominated and calculated years for achieving global net zero (sample: all respondent groups)

	IPCC	All Respondents	Negotiators Only	Observers Only	Developed Country Only	Developing Country Only
Year of global net zero (survey respondents)	2063	2065	2067	2067	2069	2063
Year of global net zero (Calculated based on stated emission reduction rate after peaking of emissions)		2065	2065	2066	2064	2071
Difference		0	-2	-3	2	-12

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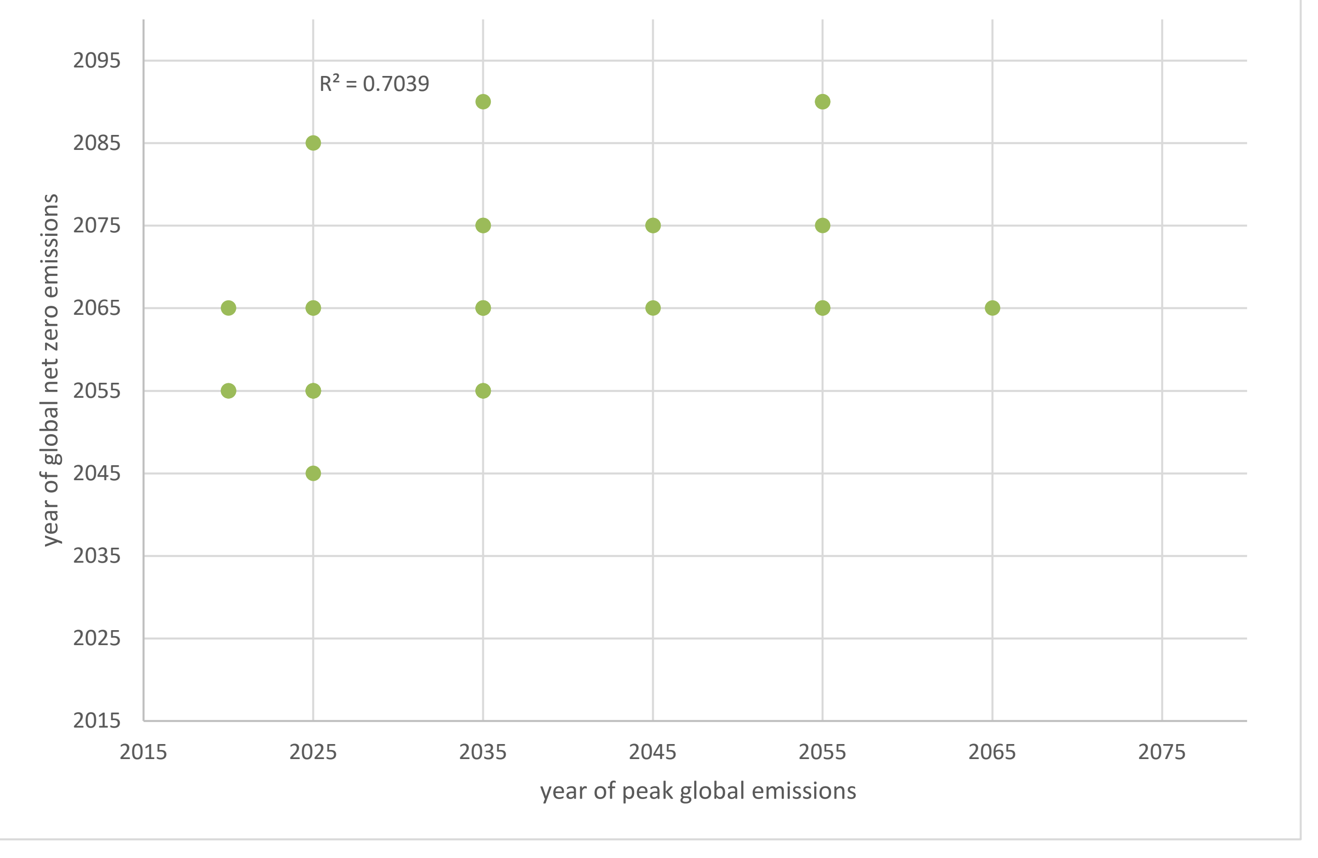
Source: Authors' calculations from survey responses except for IPCC which is taken from the 1.5^{0}C high overshoot scenario of the IPCC SR1.5 (Rogelj et al., 2018).

On average, there is consistency between the nominated and calculated year of reaching global net zero emissions across all respondents and three of the respondent groups. The exception to this is the responses from developing country survey participants who underestimated their global net zero year (given their nominated year of global peak emissions and rate of emissions reduction) by 12 years. In all cases, the nominated (and calculated) years for reaching global net zero emissions is higher than the data from the 1.5^{0}C high overshoot scenario but not significantly higher.

To explore the results for global net emissions further, the relationship with nominated years for global peak emissions was calculated and presented in Figure 9. Here there is a moderately strong relationship between global net zero emissions and global peak emissions (R^2= 0.7039) indicating that the later a respondents identify the year for global peak emissions, the later that the respondents, in general, have nominated a later year for reaching global net zero emissions.

Figure 9: Global peak year vs global net zero year



4.2.5 Test 3: Rate of Decline of Emissions from Peak Year to Net Zero Year

Question 7 asked respondents to nominate their expected rate of decline in emissions from year of global peak emissions to year of global net zero emissions.

Using the methodology described in Section 3.4.3.3, the average expected rate of decline in emissions between the nominate "year of peak emissions" and "year of global net zero" was calculated for all individuals ($r_{P-Z}(i)$) and respondents and across all respondent groups (R_{P-Z}), and compared to the respondents nominated rate of decline as a test of internal consistency. Results are presented in Table 12, with the data derived from the IPCC SR1.5 1.5°C high overshoot scenario data set provided for comparison. To test for variance within the results, Figure 9 plots

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the frequency of responses to the nominated rate of emissions decline.

Table 12: Nominated and calculate annual rates of emissions reductions between "peak year" and "year of net zero" emissions

	IPCC	All Respondents	Negotiators Only	Observers Only	Developed Country Only	Developing Country Only
Average emissions decline (weighted average of annual % decline in emissions per year) nominated by survey respondents (*R_{P-Z}*)	2.33%	3.48%	3.37%	3.44%	3.50%	3.19%
Calculated Rate of Emission Reductions from Peak to net zero (% decline in emissions per year) (*RC_{P-Z}*)		3.49%	3.16%	3.39%	2.99%	4.34%

Source: IPCC SR1.5 1.5°C high overshoot scenario (Rogelj et al., 2018); Authors' calculations from survey responses

For all respondents, and across three respondent groups, the nominated and calculated rates of decline are broadly similar (mean = 3.48%, median= 3.46% standard deviation for all respondents is 0.46%) and are within the same answer category provided for in the answer formats. The exception is the responses from the developing country group, where the nominated rate of decline is lower by 1.15% lower than the calculated rate.

The frequency distribution of answers (Figure 10) shows skewness towards the lower end of the answer range, with 52% of respondents anticipating a rate of decline between 1-3%. All the rates of emissions reductions nominated by survey respondents are below the rate of emissions decline implied by the IPCC data (Table 12), indicating that respondents underestimated the emissions abatement task required to move from global peak emissions to global net zero. However, as this rate depends on the emission levels and years of "global peaking" and "global net zero", the respondents' rate of emissions decline, relative to the IPCC SR1.5 1.5°C high overshoot scenario rate of decline, does not provide much analytical insight.

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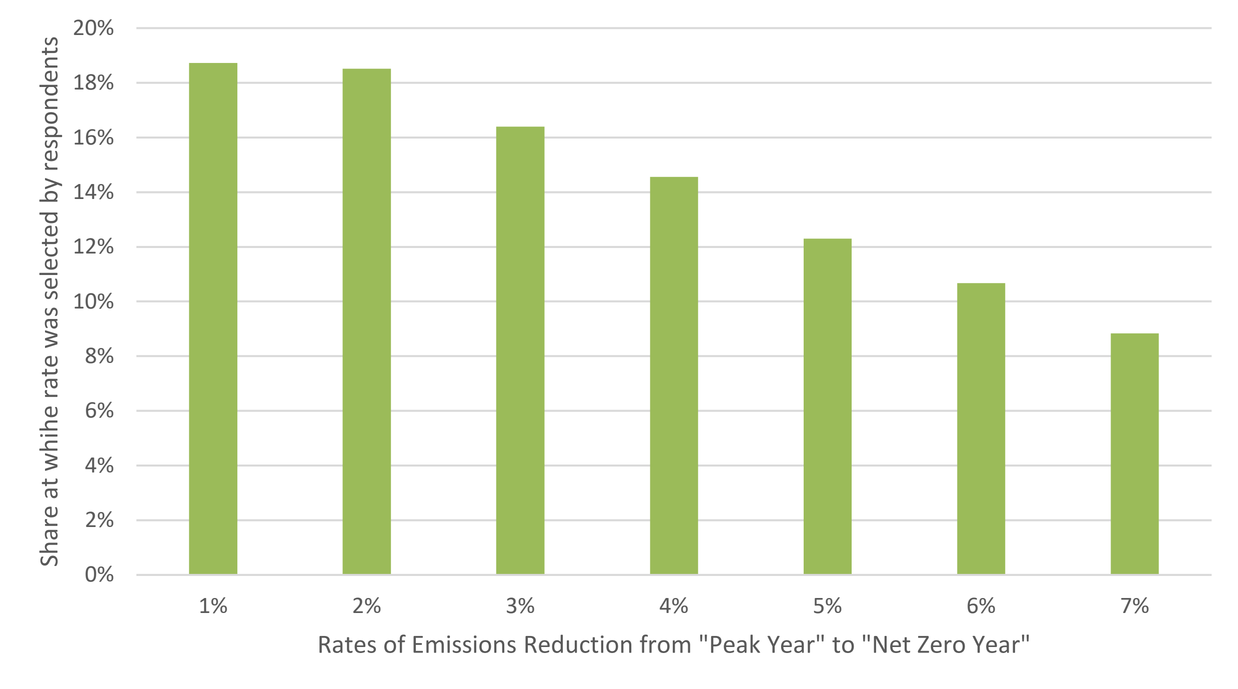
Figure 10: Distribution of Nominated Emissions Reduction Rates Sample: All Respondents



Source: Authors' calculations from survey responses

4.3 Role of sinks in reaching global net zero emissions

Question 9 asks respondents to identify what constituted an acceptable share of sinks in achieving the net zero emissions target described in Test 2 (i.e., mitigation versus use of sinks) using a qualitative ranking of "strongly unacceptable" to "strongly acceptable" of specified shares (see Appendix 1) of sinks. A summary description of all responses is in Table 13.

Table 13: Share of Sinks in total emissions reduction effort (sample: all respondents)

Share of sinks in total effort to reach net zero emissions	*Strongly Unacceptable*	*Unacceptable*	*Acceptable*	*Strongly Acceptable*
Mean	26.88%	22.47%	21.07%	20.19%
Median	35.00%	25.00%	20.00%	13.13%
Mode	0.00%	25.00%	5.00%	2.50%
Standard Deviation	20.91%	13.48%	14.06%	17.00%
Skewness	-0.31	-0.13	0.25	0.41
Range	50.00%	45.00%	45.00%	47.50%
Minimum	0.00%	0.00%	0.00%	0.00%
Maximum	50.00%	45.00%	45.00%	47.50%
Count	25	25	28	28

Source: Authors' calculations from survey responses

On average, survey respondents considered that an "acceptable" or "strongly "acceptable" share of sinks in the total emissions reduction effort of around 20-21% (range 0% to 47.5%). This is significantly higher than the mode for the "acceptable" and "strongly acceptable" categories (5% and 2.5% respectively), due to the significant number of responses across all response categories (Figure 11) – indicating a wide range of acceptable outcomes across all survey participants.

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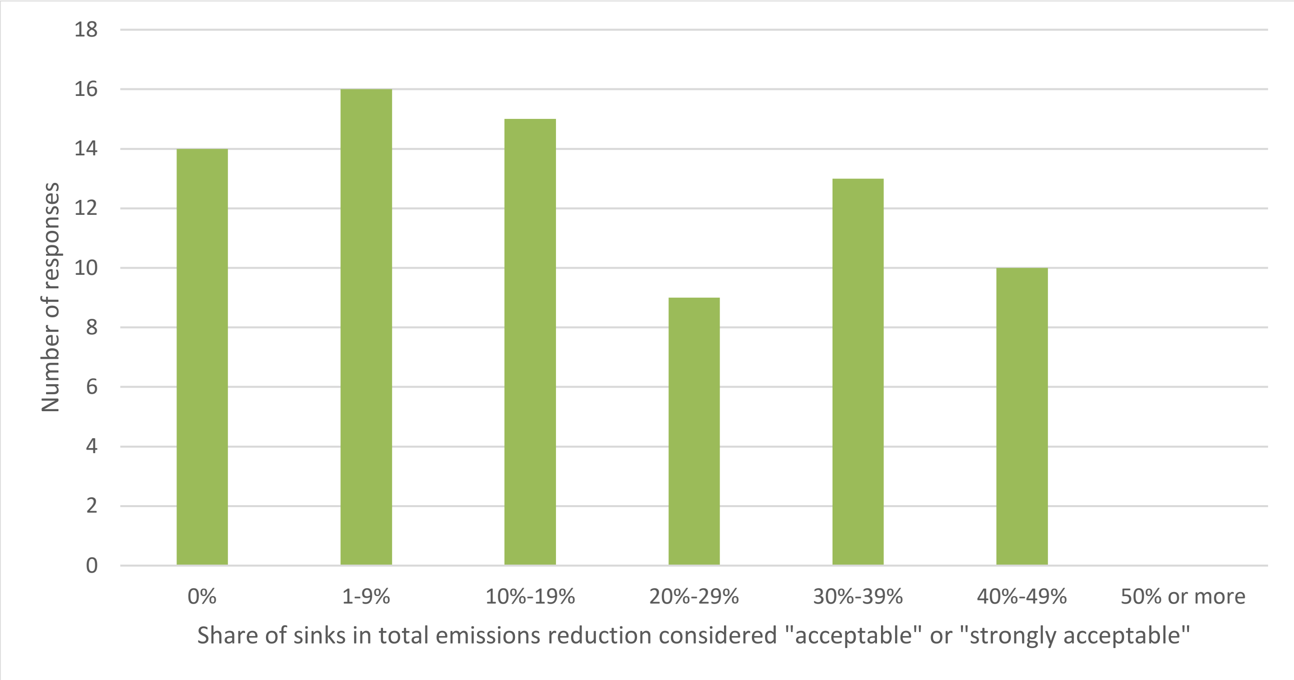
Figure 11: Share of sinks in total emissions reduction effort that is considered "acceptable" or "strongly acceptable" (sample: all respondents)



Source: Authors' calculations from survey responses

Question 10 asked respondents that if sinks are to be used in achieving a net zero emissions target, what should be the balance between using sinks from nature (such as re-forestation and afforestation) and using sinks based on carbon dioxide removal technologies (such as Bioenergy with Carbon Capture and Storage (BECCS) and Direct Air Capture (DAC)). The response format for the question allowed for respondents to nominate a share of each sink type that added up to more than 100%. A summary description of all responses is in Table 14.

Table 14: Use of nature-based sinks vs sink technologies

	Acceptable share of nature based sinks in total sink use(%)	*Acceptable share of carbon dioxide removal technologies in total sink use (%)*
Mean	76.76	37.35
Median	80.00	30.00
Mode	100.00	20.00
Standard Deviation	19.93	25.77
Skewness	-0.59	1.31
Range	69.00	91.00
Minimum	31.00	9.00
Maximum	100.00	100.00
Count	33	31

Source: Authors' calculations from survey responses

On average, across all respondents there was a clear preference for the use of nature-based sinks (76.6%) compared to the use of sink technologies (37.35%) – with a large range in responses of between 31% and 100%

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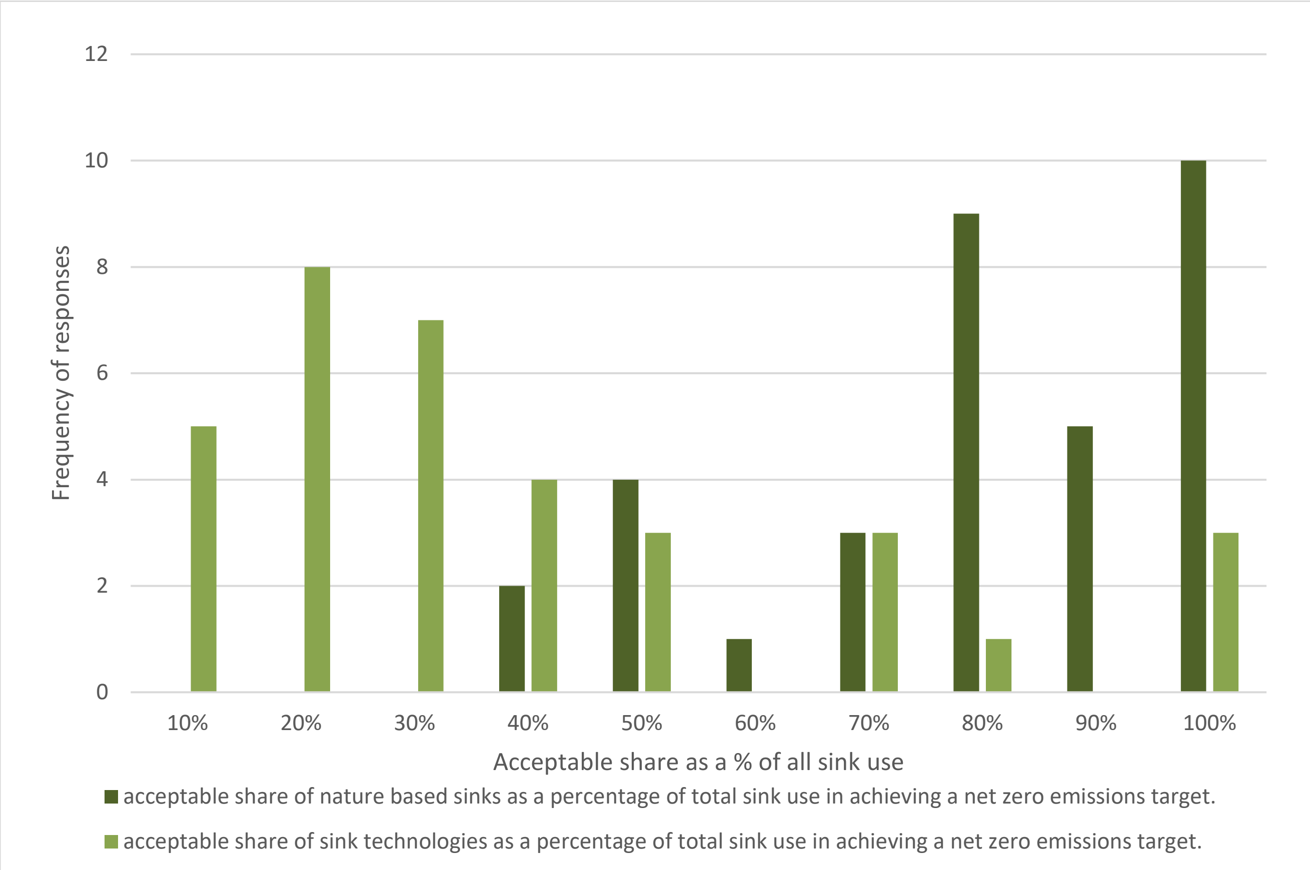
for nature-based sinks and between 9% and 100% for sink technologies (Figure 12). The pattern of responses in Figure 12 reinforce the preference for nature-based sinks, with 71% of respondents stating that nature-based sinks should constitute 80% or more of the sink mix, while the same number of respondents state that sink technologies should be limited to 40% or less of the sink mix. This pattern is replicated across all respondent groups, with negotiator groups having a slightly higher preference for nature-based sinks (in a ratio of 1: 0.47 nature vs technology) than the average across all groups, and respondents from developing countries have a slightly lower preference (a ratio of 1:0.55 of natural vs technology-based sinks).

This result is consistent with the findings of Fridahl and Lehtveer (2018) whose survey of 1600 UNFCCC participants shows that respondents prioritised or strongly prioritised renewable energy technologies over the use of BECCS in future domestic energy system investments and had a neutral ("neither agree/disagree") view on whether BECCS will make a substantial contribution to meeting global temperature targets. This study also found that government respondents, and respondents from "low capacity" countries had a slightly more favourable view of the role of BECCs than non-government representatives – a result that is not replicated in our data set. However, given the different methodologies involved and the types of question formats used between the Fridahl and Lehtveer (2018) study and this study, the extent to which these differences is an open question for a future study.

Figure 12: Acceptable share of nature-based sinks vs sink technologies as a percentage of total sink use in achieving a net zero emissions target.



Source: Authors' calculations from survey responses. This figure shows the "responses" categories provided in the survey, while the text uses the specific averages calculated using survey data.

This overall pattern of preferring only a small amount of sinks in the total emissions reduction effort, combined with a strong preference for nature based sinks, where they are used, is supported by the small range of comments made by respondents – who questioned both the technical capacity of sinks and the ethics of them. For example, R15 writes:

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I am for using every sink that could be used but realistically I don't think we will be able to use them as much as we think we will.

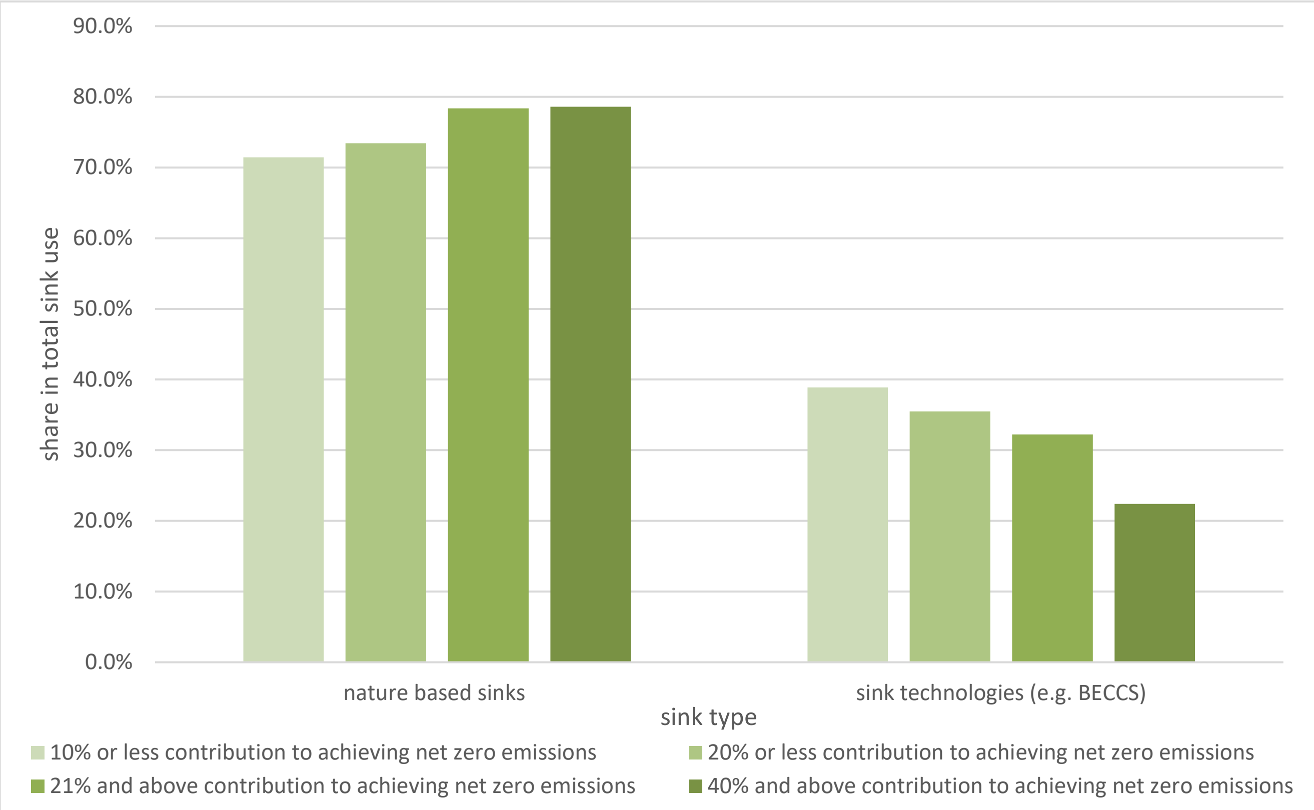
While R11 commented:

Nature based sinks are an acceptable way to deliver neutral/negative emissions pathways, but removal technologies will (as mentioned previously) only allow fossil fuels to continue to be in production ……

…….. and only prolong the inevitable cessation of fossil fuels, but at a much greater cost to vulnerable communities.

To further gain insight into respondent's views on the role of sinks, individual responses for the share of sinks was compared to their preference for nature-based sinks and for sink technologies (Figure 13). Respondents were divided into four categories: those who nominated a less than a 10% share and 20% share of sinks in overall reduction effort (9 and 14 respondents respectively), and those who nominated a 21% or 40% or more contribution of sinks (5 and 14 respondents respondents) to compare their responses with their preference for sink types. This was done to test whether a lower preference for the use of sinks in total emissions reduction effort was correlated to a stronger preference for nature based sinks (and vice versa) (Figure 13). Here, the results are opposite to what was expected: with respondents who prefer a small share of sink use nominating a slightly smaller share of nature based sinks and a higher share of sink technologies in the overall sink mix than those who nominated over 40% use of sinks.

Figure 13: Relationship between sink share and sink type preferences (sample: all respondents)



Source: Authors' calculations from survey responses

Next, preferences for sinks shares where compared against respondents selection of global peak years (Figure 14) and global years for net zero emissions (Figure 15) to test whether a later date associated with either of these milestones was associated with a higher share of sinks deemed acceptable/strongly acceptable in meeting the emissions reduction effort. Overall, only a weak relationship was found between peak years and sink share

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(R^2=0.0491) and a very weak relationship between global net zero and sink share (R^2=0.0004) indicating that these issues are not linked in the narratives of respondents.

Figure 14: Global net zero year (median value) vs share of sinks in total emissions reductions

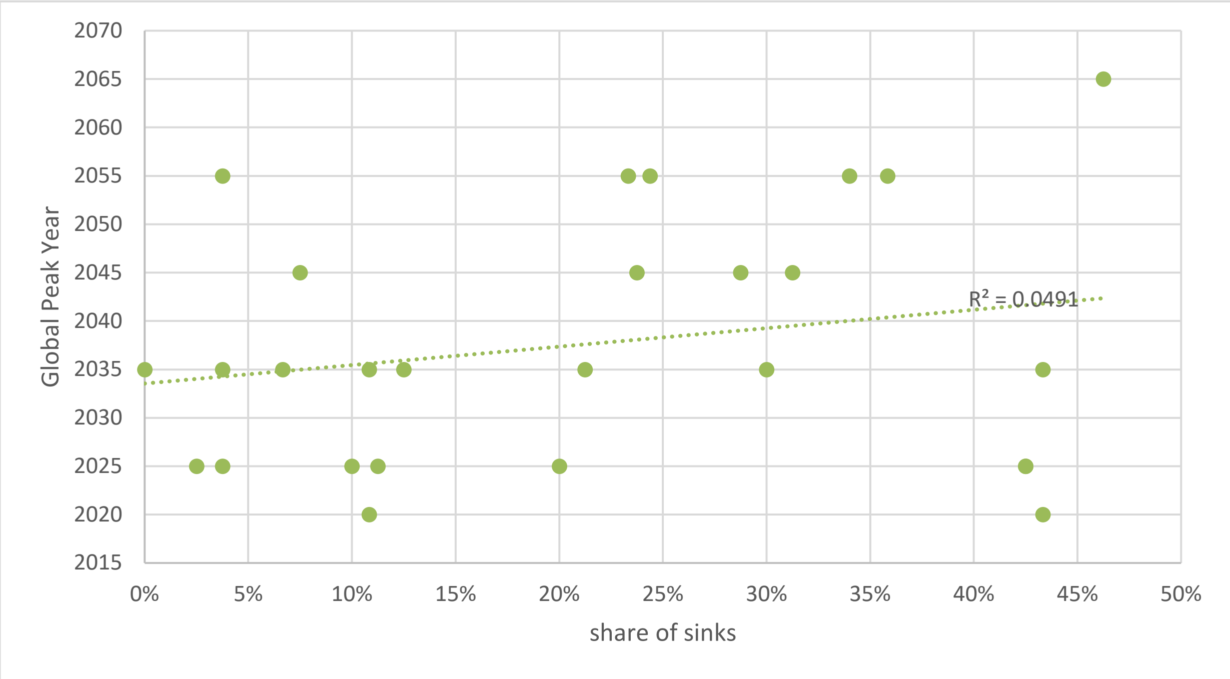
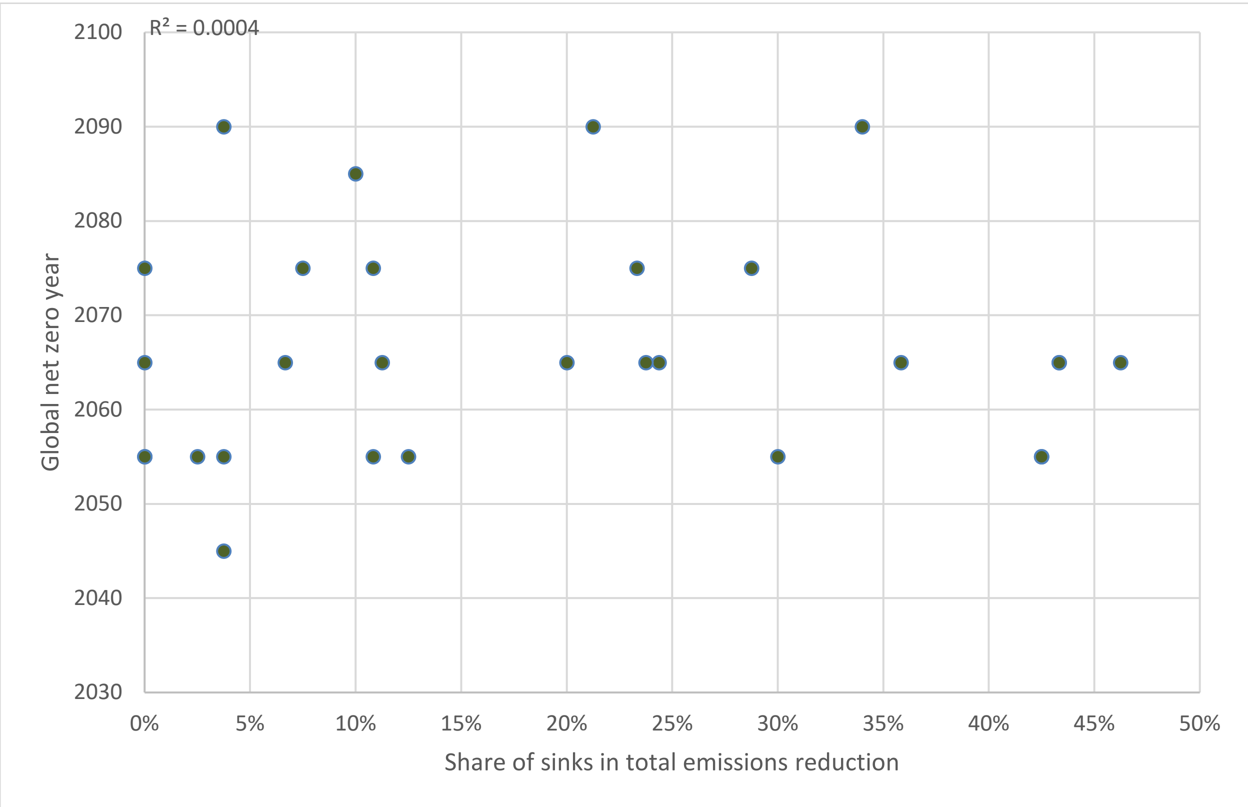


Figure 15: Relationship between global peak year and share of sinks in total emissions reduction



Finally, the survey data was compared to the data drawn from the IPCC SR 1.5C and the amount of sinks used in the 1.5ºC high overshoot (Table 15).

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Table 15: IPCC SR1.5 use of sinks (BECCs/land based sinks) in the 1.5°C high overshoot scenario

	2010	2020	2030	2050
Sinks - total (Gt CO2e)	3.2	3.2	1.3	8.9
BECCS (Gt CO2e)	0.00	0	0.1	6.8
AFOLU (Gt CO2e)	3.20	3.20	1.2	2.1
Sinks as a share of total net emissions	5.97%	5.69%	3.12%	51.45%
BECCS as a share of total sinks	0%	0%	8%	76%
AFOLU as a share of total sinks	100%	100%	92%	24%

Source: (Rogelj et al. 2018). Authors' calculations. Note: 2050 is prior to reaching global net zero emissions in the IPCC SR1.5 1.5°C high overshoot scenario and therefore shares are calculated for the use of sinks to reach net emissions for that year.

Taking the survey results for sinks as a whole (Figure 11, Figure 12, Table 13, Table 14) and the IPCC data in Table 15 there is a misalignment between what the respondents consider as an acceptable use of sinks, the role of sink technologies (particularly BECCS) and how sink use is incorporated into policy modelling and, consequently, the in policy debates. Specifically, the survey results suggest:

- The overall average level of sinks that is considered 'acceptable' or 'highly acceptable' by survey respondents (~20%) is less than half of the implied sink task used in the IPCC SR1.5 1.5°C high overshoot scenario in 2050. The mode responses for sink share (between 5% and 2.5%, Table 13) represents an even smaller fraction.
- The share of sink technologies within the total sink mix (Table 14), on average, identified by survey respondents is the opposite pattern of the share of BECCS/AFOLU in the data from in the IPCC SR1.5 1.5°C high overshoot scenario. That is, for respondents the relative share of nature based sinks to sink technologies is (on average) 77%/37%[2], while for the IPCCSR1.5 1.5°C high overshoot scenario in 2050, the share of AFOLU/BECCs is 24%/76%.

The findings from this study are consistent with the ongoing debates within the academic literature on the role of sinks within the overall emissions abatement task. Core to this debate is the role of sinks – in particular bioenergy carbon capture and storage (BECCS) technologies used within the Integrated Assessment Modelling tools for policy analysis. Broadly, a consensus has developed that regard sinks in general as a necessary part of future emissions management, but that the significant technical uncertainties in their deployment and scaling up (Fajardy et al., 2019) and call into question the tendency for IAMs to rely on them to achieve emissions consistent with a 1.5°C target (Fuss 2014, Rogelj et al. 2018a, Anderson and Peters, 2016). In addition, several authors (e.g. Lenzi, 2018, 2020) and Shue (2017) have called into question the ethics of relying on negative emission technologies given the risks involved arguing that it transfers the risk of achieving emissions reductions onto the most vulnerable communities (see also Fantuzzi et al. 2019). Awareness of these debate may be the reason behind the

[2] The response format for the question allowed for respondents to nominate a share of each sink type that added up to more than 100%.

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pattern seen in Figure 13. Given the sample population, it is reasonable to assume that respondents understand the uncertainty over the future feasibility of BECC deployment Consequently, respondents could imagine a role for a limited amount of sink technologies if the overall amount of sink use was small, but, conversely, if the targeted amount of sink use was higher, then, respondents may recognise that only the use of nature based sinks could meet these abatement needs.

Within the context of the UNFCCC, the parallel between the survey data and the literature reinforce the ongoing need for IAMs results to emphasise the extent to which modelled outcomes rely on the use of sinks, particularly BECCS, and to place these results clearly within the context of the technical and ethical considerations of sink use. Moreover, it also suggests that IAMs should impose limits on the amount of BECCS (and sink use more generally) in line with the levels identified in this survey – a conclusion also drawn by Fridahl and Lehtveer (2018) from their study.

4.4 Regional Level Scenarios

4.4.1 Regional Results: Emissions in 2030

Question 14 asks respondents to identify expected rates of change in emissions in 2030 (relative to 2020) in selected major emitting countries (WRI, 2020) and across other developed and developing countries. This question provides a country/regional breakdown of the answers provided in Question 13 (Section 4.2.4) and is designed to identify how survey respondents interpret Article 4(3) phrase "……reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances". A summary description of all responses is in Table 16 and Figure 16, while Figure 17 compares average responses from developed country and developing country respondents, respectively.

Averaged across all respondents, developed countries are expected to reduce emissions by a greater rate (average of a 14% reduction), than developing countries (average of 1% reduction) in 2030, relative to 2020 (Figure 16). This largely confirms that the concept of differentiated responsibilities from Article 4(3), on average, has been incorporated into respondents' narratives. However, both these rates are significantly smaller than the estimated rate of reduction in emissions in 2030 (relative to 2020) suggested by the IPCC 1.5ºC high overshoot scenario (-31% reduction – Table 5).

For developing countries, only Indonesia is expected to increase its emissions in 2030 by 1.55%. However, there is a wide range in the responses (23% to 44.5% between minimum and maximum) and the mode for China, India, Brazil and Indonesia are all positive – suggesting that most respondents expect these countries to increase emissions over the next 9 years.

On average, for the developed country group, all countries are expected to decrease their emissions in 2030, relative to 2020. Again, there is a wide range of responses (ranges between 52.5% to 58% between minimum and maximum) and the "maximum" response across all groups is positive (i.e. there is an increase in emissions in 2030). In addition, the mode response for Canada and the "Other Developed Country Group" is 8% - indicating that most respondents anticipate that Canada and other developed countries will experience an increase in emissions.

Comparing responses from developed and developing countries groups Figure 16), overall, both groups expected that developed countries would experience a reduction in emissions in 2030 relative to 2020 with developed country respondents estimating on average a 15% decline in emissions, while developing country respondents estimate an 8% decline – suggesting that the former are more optimistic about short term emission reductions. A key difference between the two groups is the expectations that developing country respondents hold for the 2030 emissions for developing countries themselves. In contrast to the average result across all respondents (Figure

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16), developing country respondents expect that developing countries will experience a small to moderate increase in emissions (average +2%), while developed country respondents expect a small decrease (average -2%) in emissions. Overall, developing country respondents expected to see increases in emissions in 2030 in Indonesia, Brazil, Russia, India and China with only the "other developing country" group showing a small decline. While the overall concept of "developed countries" undertaking more emissions mitigation is retained, in selected major emitting countries and regions (sample: all respondents) Figure 17 does suggest that UNFCCC participants, based on their geographical location, may have distinct expectations of how this 'differentiated responsibilities' is interpreted for developing countries. The Paris Agreement is written in a way that can accommodate these distinct interpretations (e.g., Voigt and Ferreria, 2016) but, as pointed out by Jernnas and Linner (2018) divergence in narratives can be used to identify potential areas of tensions within the negotiating process. This suggests that this variation in interpretation of article 4 (3) may become a source of increased attention in future negotiations.

For developed country respondents, the pattern in Figure 17 replicates the pattern found in Figure 16. Surprisingly, the data from developing country respondents show an expectation that the US will experience a small increase in emissions in 2030 (1%). The survey format meant that it was not possible to conduct follow up questioning of why this may be the case – but potentially, the respondents provided answers to the survey prior to the recent announcements from the Biden Administration (Whitehouse Briefing Room, 2021).

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Table 16: Summary estimates of expected emissions changes in 2030 (relative to 2020 Emissions) for selected individual countries and regions (sample: all respondents)

	China	***India***	***Russia***	***Brazil***	***Indonesia***	***Other Developing Countries (excluding China, India, Russia, Brazil, Indonesia)***	***Canada***	***EU***	***Japan***	***USA***	***UK***	***Other Developed Countries (excluding EU, Canada, Japan, USA, the UK)***
Mean	-1.76%	-0.16%	-3.71%	-1.60%	1.55%	-1.36%	-5.73%	-20.83%	-12.00%	-11.09%	-21.24%	-10.31%
Median	3.00%	3.00%	-3.00%	0.00%	3.00%	0.00%	3.00%	-18.00%	-13.00%	-10.50%	-18.00%	-13.00%
Mode	3.00%	10.00%	-8.00%	3.00%	10.00%	-8.00%	8.00%	-24.50%	-13.00%	-13.00%	-18.00%	8.00%
Standard Deviation	11.44%	10.46%	9.65%	9.01%	8.59%	8.34%	18.31%	18.90%	14.39%	16.23%	17.03%	15.00%
Skewness	-1.417	-0.791	-0.576	-0.698	-0.460	-0.199	-1.367	-0.106	-0.860	-0.698	-0.562	-0.542
Range	44.50%	34.50%	34.50%	34.50%	23.00%	28.00%	58.00%	58.00%	52.50%	54.50%	58.00%	52.50%
Minimum	-34.50%	-24.50%	-24.50%	-24.50%	-13.00%	-18.00%	-50.00%	-50.00%	-44.50%	-44.50%	-50.00%	-44.50%
Maximum	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	8.00%	8.00%	8.00%	10.00%	8.00%	8.00%
Count	23	22	21	21	20	22	22	23	21	22	21	21

Source: Authors' calculations from survey responses

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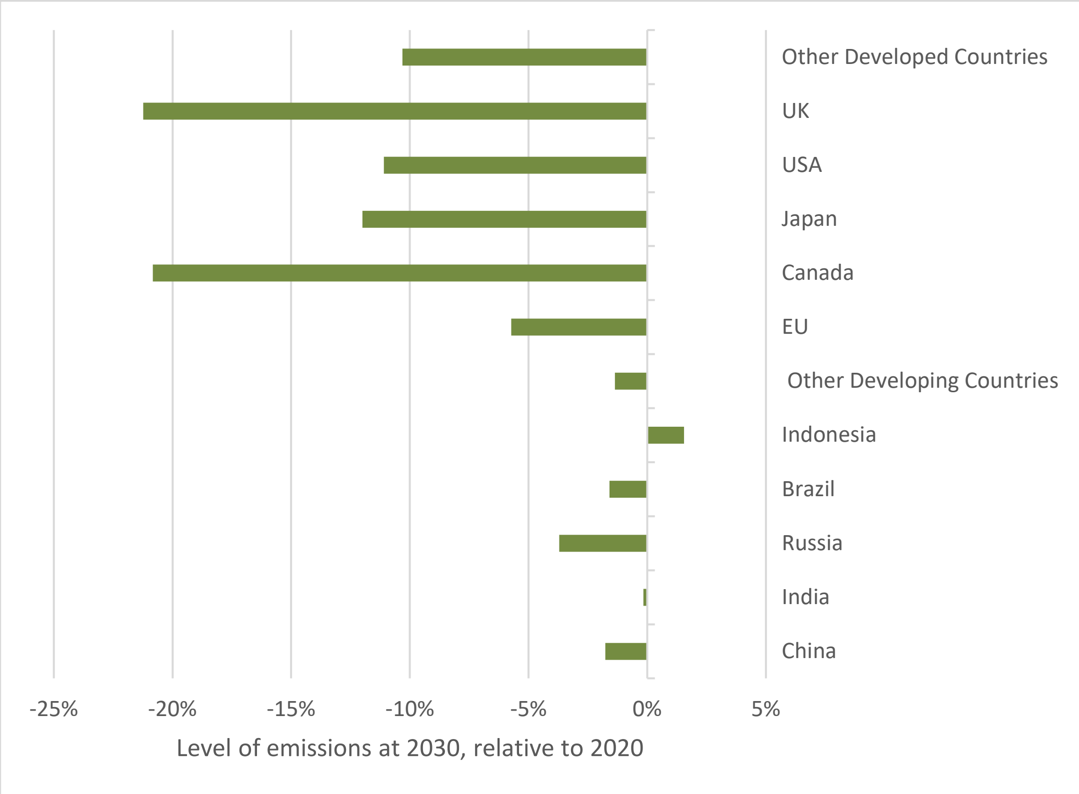
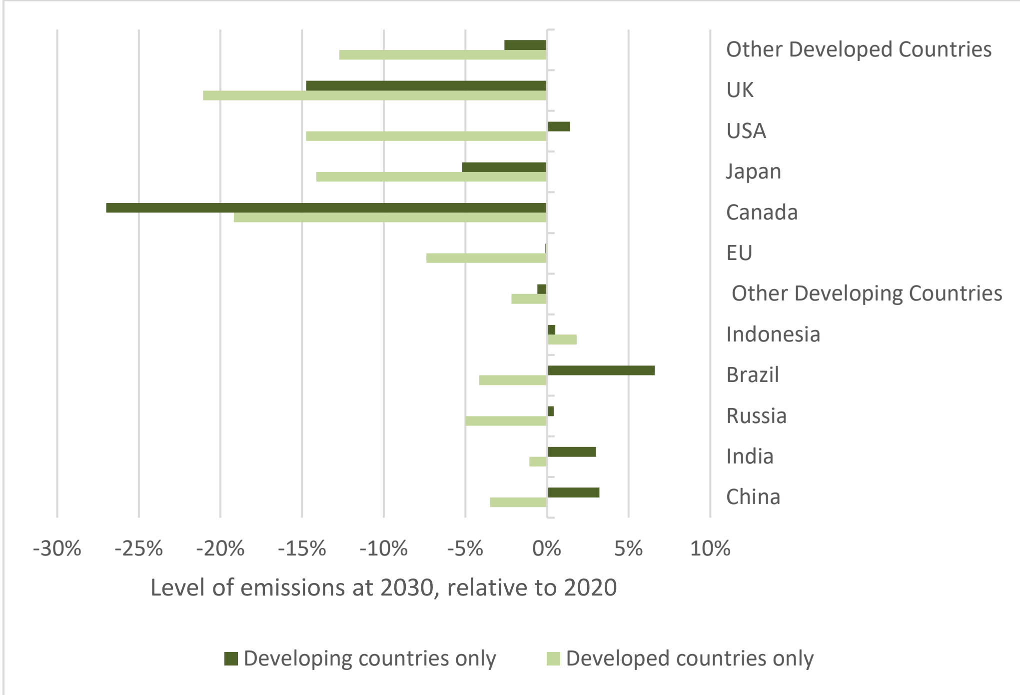
Figure 16: Average expected level of emissions in 2030, relative to 2020, in selected major emitting countries and regions (sample: all respondents)



Source: Authors' calculations from survey responses

Figure 17: Average expected level of emissions in 2030, relative to 2020, in selected major emitting countries and regions (sample: developing country and developed country respondents only)



Source: Authors' calculations from survey responses

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4.4.2 Regional Results: Year of Peak Emissions

Question 5 asks respondents to identify expected year of reaching peak emissions in selected major emitting countries as identified by the World Resources Institute (2020) and across other "developed" and "developing" countries. This question provides a country/regional breakdown of the answers provided in Question 4 (section 4.2.3) and is designed to identify how survey respondents interpret Article 4(3) phrase "...reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances". A summary description of all responses is in Table 19 and Figures 15, while Figure 16 compares average responses from developed country and developing country respondents, respectively.

Averaged across all respondents, developed countries are expected to reach peak emissions by 2030 (2026-2033 across individual countries), while developing countries are expected to reach peak emissions 11 years later in 2041 (2036-2045 across individual countries). Similar to the discussion in Section 4.4.1, this largely confirms that the concept of "differentiated responsibilities" from Article 4(3), on average, has been incorporated into respondents' narratives. However, both of these expected years of "peak emission" are later than the "peak year" identified by the IPCC (peak year estimated in 2020 – see Table 5).

For the "developed country group", the average estimate year for reaching peak emissions for 4 countries (EU, Canada, Japan, and the UK) is at, or before 2030. In combination with Table 16 (estimates of changes in emissions in 2030) suggest that survey respondents hold a consistent and logical narrative about the short-term emission pathways for these countries (i.e. peaking in/before 2030, a reduction in emissions in 2030 and a decline thereafter). However, the use of these averages across all respondents' masks two interesting features. First, there is significant variability in responses for each country (25.5 years for the EU and up to 50 years for the USA) with some respondents estimating peak years as late as the mid-2040s to 2070 – suggesting that some survey respondents hold a relatively pessimistic view about developed country emission profiles[3]. Second, the most common response (mode) for all developed countries estimates peak emission year before 2030 (except the USA, and for the "other developed country" group) with three of these countries in 2020. This suggests that while there is a high degree of variation, many of the survey respondents expect the short-term emission pathways for these countries to be broadly consistent with the narrative set out by the IPCC SR1.5 1.5ºC high overshoot scenario.

For the developing country group, on average, all are expected to reach peak emissions after 2030 (around 2041) with the range nominated years of between 35.5 years (China) and up to 50years (Russia, Brazil). These results are consistent with the expectations from the "developing country only" respondents that developing countries will experience an increase in emissions in 2030 (Figure 14). This suggests that this group of survey respondents hold a consistent narrative about emission in 2030 and the peak year(s) for developing countries.

Figure 19 compares the responses by respondents from developing countries and developed countries. Overall, both groups expected that developed countries would reach peak emissions at an earlier year that developing countries – thus replicating the of results in Figure 18. There are slight differences between the groups of respondents: developed country respondents estimating on average a peak year of 2029 for developed countries and a peak year of 2040 for developing countries. This contrasts with the developing country respondents who estimate a peak year of 2033 for developed countries and a peak year of 2043 for developing countries.

[3] Most responses were provided before the President Biden's Climate Summit, which may have had an impact on these views.

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Table 17: Summary estimates of expected year for reaching "peak emissions" for selected individual countries and regions (sample: all respondents)

Regional Peaking	*China*	*India*	*Russia*	*Brazil*	*Indonesia*	*Other Developing Countries (excluding China, India, Russia, Brazil, Indonesia)*	*EU*	*Canada*	*Japan*	*USA*	*UK*	*Other Developed Countries (excluding EU, Canada, Japan, USA, the UK)*
Mean	2036	2044	2039	2041	2043	2045	2026	2030	2029	2033	2028	2033
Median	2033	2041	2036	2036	2046	2046	2023	2025	2025	2030	2025	2025
Mode	2030	2036	2025	2036	2046	2056	2020	2020	2025	2036	2020	2025
Standard Deviation	10.15	13.88	16.69	13.55	11.67	14.05	8.16	10.17	9.41	13.22	9.80	13.82
Skewness	0.78	0.65	0.71	0.85	0.95	0.19	1.46	0.84	2.17	1.13	1.37	1.60
Range	35.5	45	50	50	45	50	25.5	35.5	45.5	50	35.5	50
Minimum	2020	2025	2020	2020	2025	2020	2020	2020	2020	2020	2020	2020
Maximum	2055.5	2070	2070	2070	2070	2070	2045.5	2055.5	2065.5	2070	2055.5	2070

Source: Authors' calculations from survey responses

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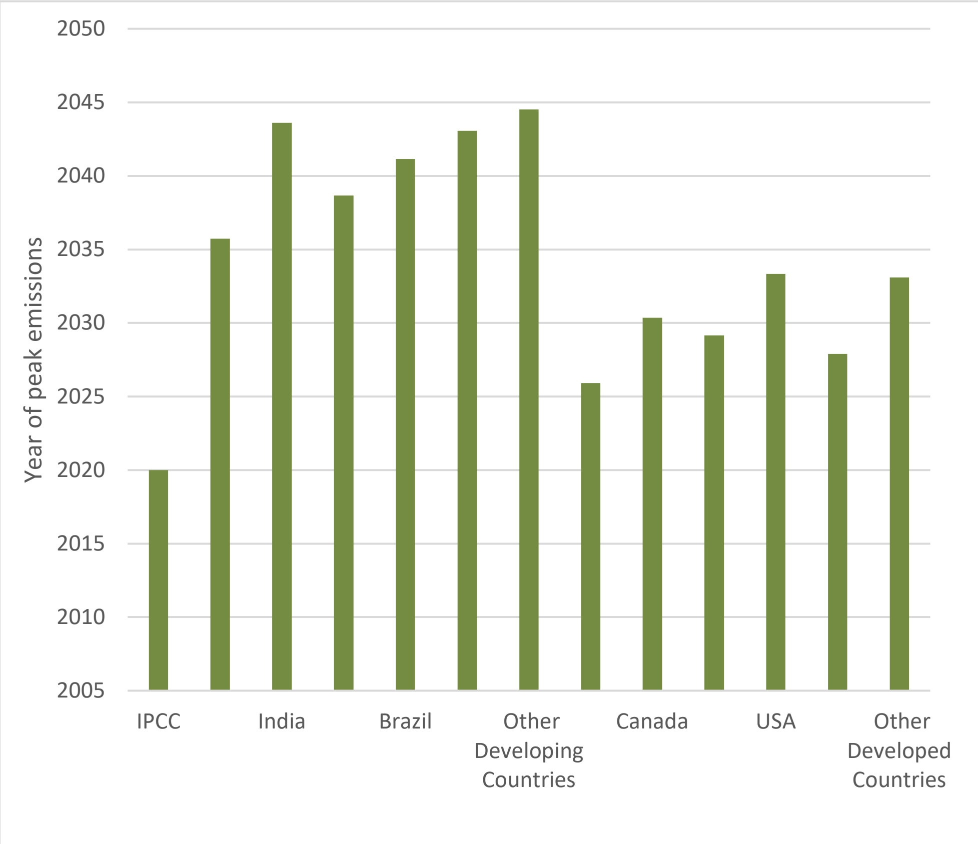
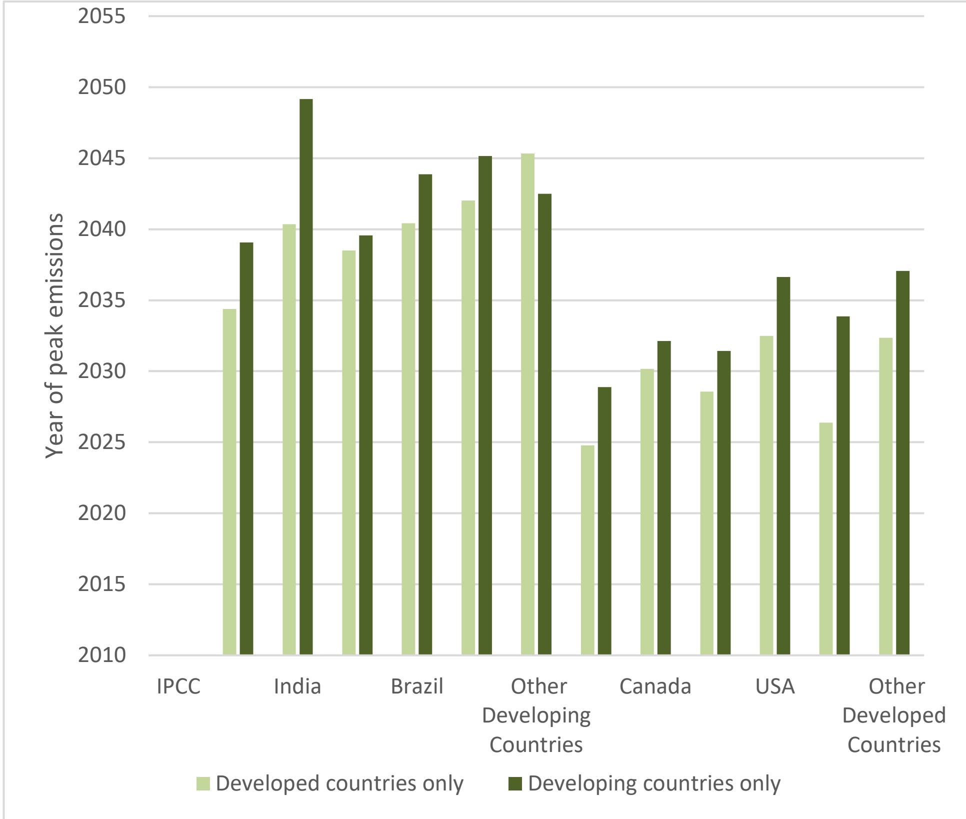
Figure 18: Average expected year respondent expect "peak emissions" are reached in selected major emitting countries and regions (sample: all respondents)



Source: Authors' calculations from survey responses

Figure 19: Average expected year for reaching "peak emissions" in selected major emitting countries and regions (sample: respondents from developing countries and developed countries respondents only)



Source: Authors' calculations from survey responses

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4.5 Ranking objectives with the Paris Agreement

Question 16 asked respondents to reflect on the relative importance of the Paris Agreement objectives that were covered in the survey and to rank them out of 5 (1 being the least important and 5 being the most important)[4].

The average ranking score across all survey respondents (Table 18) for all objectives was broadly similar (around a "3" score") suggesting, on average, that respondents expressed only mild preferences for objective 2 (score: 3.3) and objectives 4 and 1 (scores 3.07 and 3.04 respectively). A sharper difference between objectives is shown in the mode of responses (Table19, Figure 20). Here, respondents show a clear preference for objectives 2 (mode score: 4) followed by objective 3 (mode score: 3). Then, the pattern of responses displays more variation: objective 4 has a higher mean and mode than objectives 1 and 5, but responses for objective 1 display a strong bi-model pattern with a larger number of respondents (relatives to objectives 4 and 5) ranking objective 1 either as being most important (score 5) or of least importance (score 1). For objective 5, the mode of responses clearly shows a lower ranking of this objective compared to objective 4 (mode score: 2), but more respondents gave this a "5" ranking, than for objective 4.

Overall, the rankings attached to each of the objectives suggest that respondents placed great emphasis on the peaking of emissions and rapidly achieving net zero emissions – that is, short to medium term goals focussing on implementation with specific, quantifiable, emissions actions – relative to short term objectives of the NDCs or the longer-term temperature targets in 2100. This pattern of ranking between the overall results ("all respondents") and for each of the respondents' groups are responses are broadly similar (Table 18). A key difference is the results from the "negotiator only" group. Here, this group clearly stated a preference for the objective related to achieving the temperature targets as the most important objective to achieve, followed by reaching peak emissions and ensuring the NDCs represent a progression in emissions.

The format of the survey precluded any follow up investigation for the reasons why respondents provided these answers. However, this could reflect respondents' views that align with the increasing pressure – and need – for the negotiations to focus on implementation and shorter term actions, rather than on over-arching goals which have been (successfully) established (Kinley et al., 2020; Peters et al., 2019). In this interpretation, NDCs could be seen as a 'milestone' on the pathway to achieving peak emissions and net zero emissions – and therefore is considered less important than objectives 2,3 and 4.

[4] For the sake of clarity and conciseness, this section numbers the objectives in Table 17 and Table18 and refers to these numbers in the text when discussing the specific objective. This numbering is not used the Paris Agreement nor should any meaning or significance be attached to these numbers.

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Table 18: Ranking of Paris Agreement Objectives by respondent group

Objective Number	***1***	***2***	***3***	***4***	***5***
Objective Name	"below 2 °C above pre-industrial levels and pursuing 1.5 °C "	"Reaching Peak Emission"	"... undertake rapid reductions thereafter "	".... balance between anthropogenic emissions by sources and removals by sinks ..."	NDCs represent a progression of highest possible ambition
All respondents	3.04	3.30	2.93	3.07	2.67
Negotiators Only	4.67	3.17	2.33	2.33	2.50
Observers only	2.57	3.33	3.10	3.29	2.71
Developed Country only	3.06	3.22	2.94	3.06	2.72
Developing country only	3.00	3.44	2.89	3.11	2.56

Table19: Ranking of Paris Agreement Objectives, descriptive statistics

Objective Number	***1***	***2***	***3***	***4***	***5***
Objective Name	*"below 2 °C above pre-industrial levels and pursuing 1.5 °C "*	*"Reaching Peak Emission"*	*"... undertake rapid reductions thereafter "*	*".... balance between anthropogenic emissions by sources and removals by sinks ..."*	*NDCs represent a progression of highest possible ambition*
Mean	3.04	3.30	2.93	3.07	2.67
Median	3.00	4.00	3.00	3.00	2.00
Mode	1.00	4.00	3.00	3.00	2.00
Standard Deviation	1.81	1.35	0.96	1.30	1.57
Skewness	-0.06	-0.69	0.44	0.08	0.47

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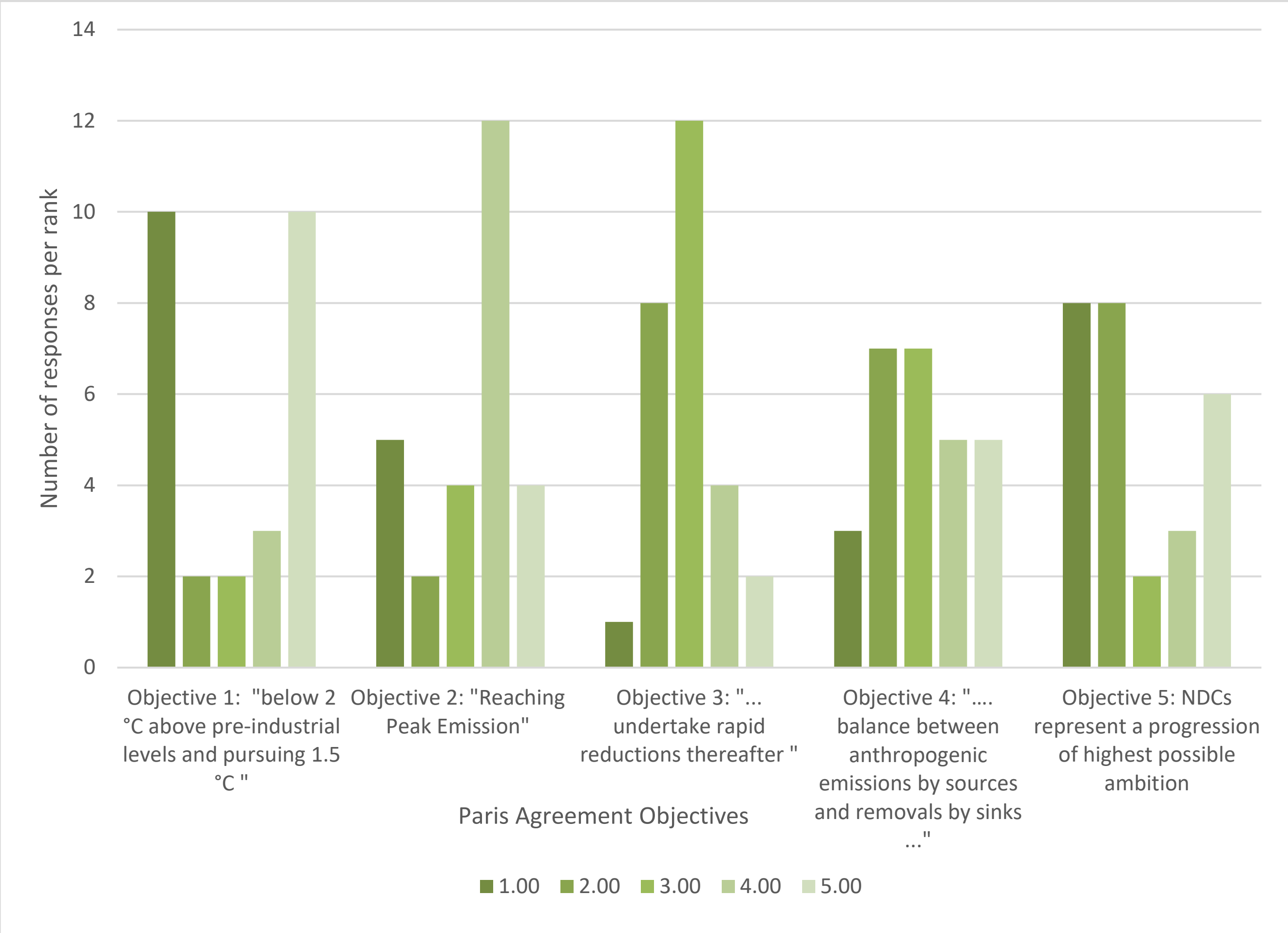
Figure 20: Ranking of issues – number of responses per rank per Paris Agreement objective (sample: all respondents)



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4.6 Global narratives from the survey data

This Deliverable presents the first data set for documenting UNFCCC policy makers and expert stakeholders' expectations on future emission pathways under the implementation of the Paris Agreement in the PARIS REINFORCE project. The data collected here will support future scenario design for global modelling analysis in the remainder of Work Package 7.

For the purpose of data presentation and discussions, Sections 4.2 to 4.5, use the average value of variables across all respondents and respondent groups as the basis to describe results. While the average values are important, it obscures a key feature of the data set: the high degree of variability within the responses and the large ranges for each variable (Table 20). For example, the nominated years of peak emissions varies up to 45 years, while the range of responses for preference for nature-based sinks varies over 91 percentage points. High variability is also a key feature of data set for regional level variables (Table 16 and Table 17).

This high degree of variability in these results suggests that there is no one single narrative that is held by experts who attend UNFCCC meetings, but rather a suite of narratives, each with distinct features. Three distinct narrative groups emerge from the data:

1. Group 1: respondents who identify a year of global peak emissions prior to 2030 and a reduction of global emissions between 2020 and 2030.
2. Group 2: respondents who identify a year of global peak emissions after to 2030 and a reduction of global emissions between 2020 and 2030.
3. Group 3: respondents who identify a year of global peak emissions after to 2030 and an increase in global emissions between 2020 and 2030.

For each group, individual responses for the year of global peak emissions and year of global net zero emissions were averaged and then plotted (Figure 21) to visually represent the different interpretations – or narratives - of the Paris Agreement text. In addition, the year of global peak emissions and year of global net zero emissions from the mode and means of responses across all participants and the IPCC SR1.5 1.5°C high overshoot scenario data (Table 20) were added to the plot in Figure 21 to provide comparisons to each group.

Looking broadly across these results, 5 key global narratives can be drawn from this research (the corresponding groups in Figure 21 are in brackets):

1. ***Narrative 1: Respondents who estimate global emissions to peak prior to 2030 (Group 1).*** This subgroup of respondents (26%) has a narrative whereby global emissions are expected to peak in 2024 at 56 GtCO2e, with a 23% decrease in emissions from 2024 to 2030 and a 2030 emissions level of 43 GtCO2e. Global net zero emissions are achieved in 2057, and to deliver this, global emissions need to reduce per year by 5% between 2024 and 2057.
2. **Narrative 2: Respondents who estimate global emissions to peak after 2030, but expect a decline in emissions between 2020 and 2030 (Group 2).** This subgroup (44%) has narrative a whereby global emissions are expected to peak in 2045 at 62.21 GtCO2e, but also experience a 13.7% decrease in emissions between 2020 and 2030, for a 2030 emission level of 45.74 GtCO2e. Global net zero emissions are achieved in 2067, and to deliver this, global emissions need to reduce per year by 13% between 2045 and 2067
3. **Narrative 3: Respondents who estimate global emissions to increase to 2030 and to reach global peak emissions after 2030 (Group 3)**. This subgroup of respondents (30%) has a narrative whereby global emissions are expected to peak in 2044 at 67.47 GtCO2e, but also experience an increase in global emissions of 2.9% to 2030, for a 2030 emission level of 54.55 GtCO2e. Global net zero emissions are achieved in 2077 and, to deliver this, global emissions need to reduce per year by 6% between 2044 and 2077.

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4. **Narrative 4: Using the average results across all respondents** Using the average values across all respondents, this narrative sees global emissions peaking in 2036, with a 10.06% decrease in emissions in 2030 (relative to 2020). Global net zero will be achieved in 2065 and that, to achieve this, global emissions need to reduce per year by 3.48% between 2036 and 2065. Contribution of sinks to achieving this net zero emissions goal should be no more that 20% of total effort and, where sinks are used, there is an overwhelming preference for nature-based sinks which should make up about 76% of total sink use (or more) and sink based technologies make up, at most, around 37% of the total sink mix.
5. **Narrative 5: Using the modal results across all respondents.** Using the modal values across all respondents, this narrative sees global emissions peaking in 2025 and global net zero emissions will be achieved in 2055. Contribution of sinks to achieving this net zero emissions goal should be no more that 2.5%-5% of total effort and, where sinks are used, there is an overwhelming preference for nature-based sinks which should make up close to 100% of total sink, however up to 20% use of sink technologies within the total sink mix may be acceptable.

The use of averages in Narrative 4 may seem contradictory to the development of Narrative 1-3 and the focus on variability. However, it is included here to draw on the result from Sprinz et al. (2016) who found that the collective (average) predictions of experts in predicting negotiation outcomes were more accurate than individual predictions. This suggests that the averages presented in this report remains a valid basis for exploring future scenarios based on the data collected here.

This analysis suggests that 26% of respondents to the survey have an internal logical narrative that align Paris Agreement milestones the way it is described by IPCC SR1.5 1.5ºC high overshoot scenario (narrative 1 described above) while 44% of respondents' answers generated a storyline described by narrative 2 above, and 30% had answers that generated narrative three (total n=23). Each group in Figure 21 had a mix of respondents who identified as an 'observer' as well those who identified as 'negotiators' – implying that each group had heterogenous perspectives of the Paris Agreement. The remaining respondents – 74% - identified a year for global peaking of emissions, or a year for achieving global net zero emissions that have later – or significantly later-timeframes than the IPCC SR1.5 1.5ºC high overshoot scenario implying that respondents expect a larger amount of global emissions between 2020 and global net zero.

To explore these results further, the data for each of these narratives, along with the individual responses for year of global net zero emissions and year of global peak emissions are plotted in Figure 22. Overall, there is a moderate relationship between selection of year of global peak emissions and the selection of year of global net zero emissions (R^2=0.3467). There are two clusters of narratives – one centred around a global peak year before 2030 (i.e., the IPCC SR1.5 1.5ºC high overshoot scenario and N1 and N5) and other cluster loosely centred around a global net zero year of 2070.

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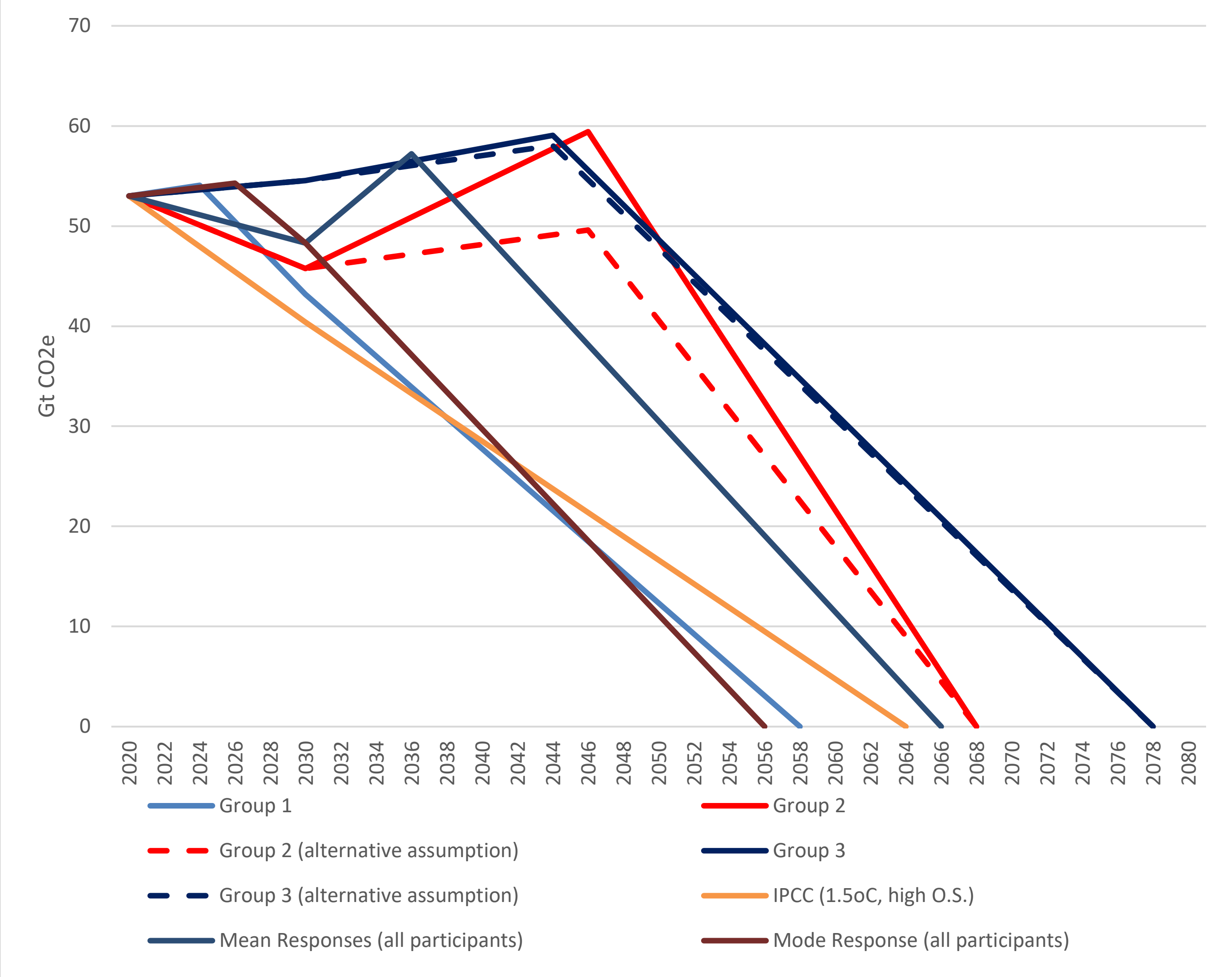
Figure 21: Emission curves - alignment between narrative milestones across all groups (sample: all respondents)



Source: Authors' calculations from survey responses. IPCC data from IPCC SR1.5 1.5ºC high overshoot scenario (Rogelj et al., 2018) *Individual responses to peak years, year of net zero and emissions in 2030 for each of the curves in Figure 16 are in Appendix 3. Emission pathways for Groups 2 and 3 were calculated under different assumptions. First, emissions at peak year were calculated using a year-on-year increase in emissions from 2020 (solid line, option a). Second, emissions at peak year were calculated using year on year increase in emissions from 2030 (dotted line, option b). While the different assumptions for calculating emissions at the peak year changes the amplitude of the "peak" the overall pattern remains the same.*

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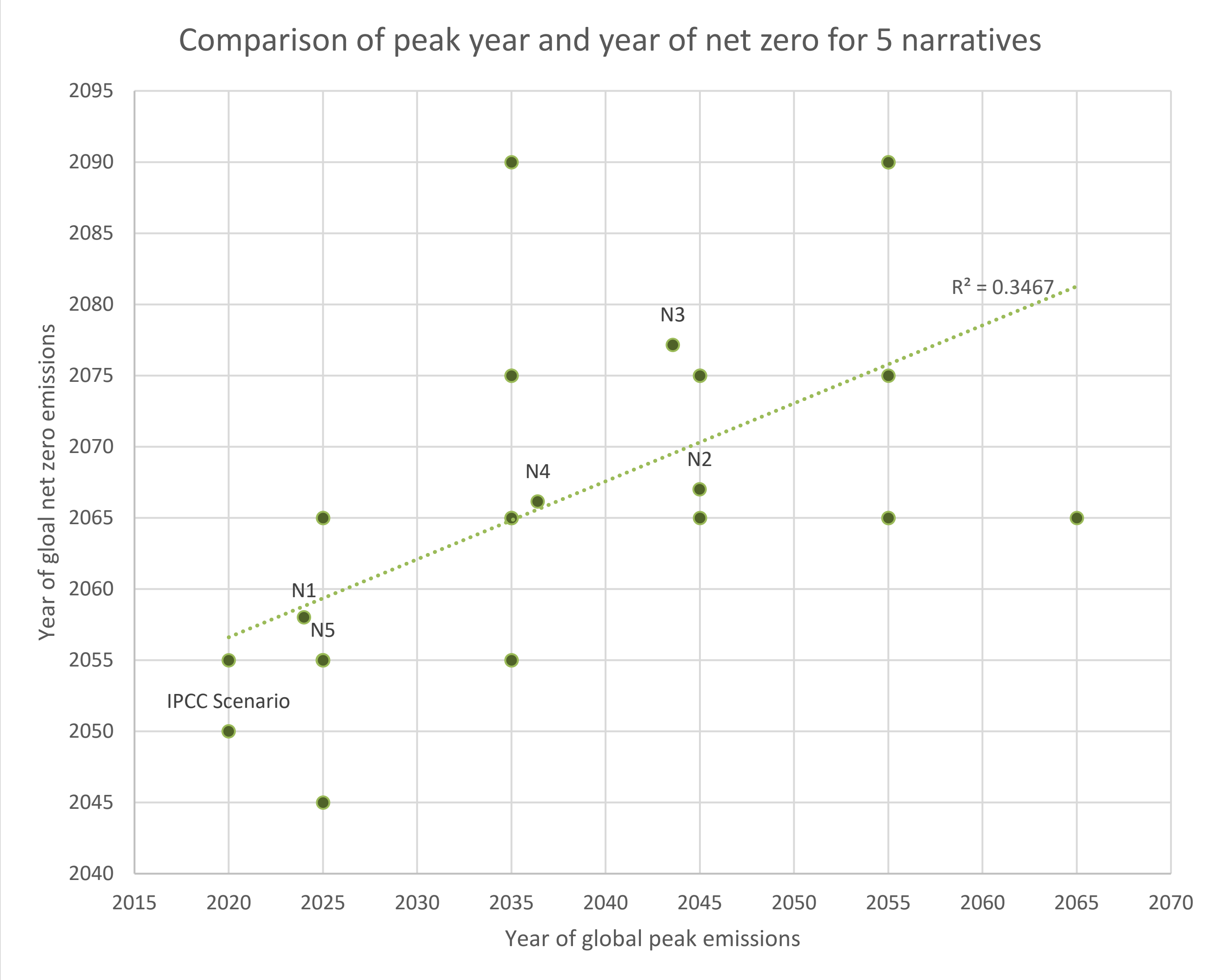
Figure 22: Comparison of peak year and year of net zero for 5 narratives



Source: Authors' analysis

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Table 20: Descriptive statistics of survey variables (sample: all respondents)

	Respondents Survey Data									
	IPCC Data	Mean	Median	Mode	Standard Deviation	Skewness	Range	Minimum	Maximum	Count
Global Net Zero Year	*2063*	2066	2065	2055	12	1	45	2045	2090	31
Global Peak Year	*2020*	2036	2035	2025	13	1	45	2020	2065	32
Global Rapid Reduction between Peak Year and Net Zero Year (% reduction/yr)	*2.33%*	3.48%	3.46%	N/A	0.46%	60.27%	2.11%	2.59%	4.70%	27
Emissions in 2030 compared to 2020 (% reduction)	*-31.19%*	-8.85%	-7.94%	N/A	11.28%	14.87%	42.48%	-28.84%	13.64%	24
Share of sinks in total effort to reach net zero emissions	51.45%									
Acceptable	N/A	21.07%	20.00%	5.00%	14.06%	25.23%	45.00%	0.00%	45.00%	28
Strongly Acceptable	N/A	20.19%	13.13%	2.50%	17.00%	41.02%	47.50%	0.00%	47.50%	28
Acceptable share of … in 2050										
nature based sinks in total sink use (%)	24%	76.76%	80.00%	100.00%	19.93%	-0.59%	69.00%	31.00%	100.00%	33
sink technologies in total sink use (%)	76%	37.35%	30.00%	20.00%	25.77%	1.31%	91.00%	9.00%	100.00%	31

Source: Authors' calculations from survey responses. NA = responses not available. IPCC Data IPCC SR1.5 1.5°C high overshoot scenario (Rogelj et al., 2018). Note: share of sinks for the IPCC in total emissions reduction effort is given for 2050 only and not for net zero year because the IPCC data used does not provide gross emission levels for the nominated net zero year in the high 1.5oC overshoot scenario (see Table 2.4, p117, Rogelj et al (2018).

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5 Conclusions

This study demonstrates the value of using milestones from the Paris Agreement to (re)construct and analyse the narratives that participants have about potential implementation pathways after 2020. By comparing these narratives against the IPCC SR1,5 1.5°C high offshoot scenario provides another dimension to the 'emissions gap' and 'ambitions gap' (e.g., UNEP, 2020; Peters et al., 2020) discussion within in the literature. It also adds significantly to the qualitative narrative literature by providing an insight into how experts, who attend the UNFCCC, may approach future policy making about peak emissions, reaching net zero emissions and the use of sinks under the Paris Agreement.

If the results in this study are interpreted to represent an insiders' view of the future of the Paris Agreement, then, overall, the conclusion to be drawn is that this future is mixed. On the positive side, a sizeable number of respondents considered that the Paris Agreement is a good framework for building future consensus on climate action as is working as intended in developing government and industry responses – although not fast enough. In this interpretation of the results, the emission pathways in Figure 21 are encouraging because the curves for "Group 1" and the curve that captures the modal responses across all respondents aligns Paris Agreement milestones the way it is described by IPCC SR1.5 1.5°C high overshoot scenario and reaches net zero in a time frame prior to the IPCC scenario year of 2063. This suggests that, at least in these cases, respondents consider that the near- and medium-term pathways for global emissions may be on track to deliver an outcome consistent with limiting temperature increase to 1.5°C by 2100.

However, on the negative side, many survey participants expressed an overall pessimistic opinion of the future of the Paris Agreement and an anxiety about its effectiveness and future implementation – as well as the view that the 'pace of change' is too slow. In this interpretation, Figure 21 can be read as showing that the majority of respondents (Groups 2 and 3 – or 74%) and narrative constructed from the average responses across all participants expect global peak emission years and global net zero years that are later – or substantially- later than the years implied by the selected IPCC SR1.5 1.5°C high overshoot scenario. If scenarios using the 1.5°C low or no overshoot was used as a basis for comparison, then the gap to respondents' narratives would be even larger. This suggests that the level of emissions from the current period (2020) to the year of reaching net zero (i.e., the areas under the emissions curves) are also substantially higher. Within the current study, the climate implications of this are unclear because the survey did not ask for respondents views on emissions levels, or the use of negative emissions, after the year of global net zero. However, placing these results in the context of respondents preferred temperature outcomes (question 2, Section 4.2.1 – a strong preference for limiting temperature increase to 1.5°C or lower) these narratives imply that achieving this outcome will require a heavy reliance on the use of negative emissions (BECCS/nature based sinks) after reaching global net zero emissions. Moreover, this reliance on negative emissions is likely to be greater than that implied by the IPCC scenario, because the implied emissions under each narrative are greater.

Given the substantial logistical and ethical considerations and resource constraints in scaling up sinks, discussed extensively in the IPCC SR1.5 (IPCC, 2018) and in the academic literature, this raises the question of whether this (potentially unstated) assumption around the use of sinks in these future emissions pathways is feasible. The potential role of negative emissions in limiting temperature increases to 1.5°C within these narratives is also at odds with the respondents' preferences for a relatively small use of sinks in achieving net zero – around about 20% of the overall emissions reduction target – and their strong preference for nature-based sinks over sink technologies. Overall, this suggests that this increased role for sinks after reaching global net zero emissions has not been explicitly considered by respondents.

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The results on sink use and the relative preference for nature-based sinks versus sink technologies in this study underscores the importance of continuing to improve the transparency of sink use in future IAM modelling exercises – one of the objectives of the Paris Reinforce Project. It also suggests that future modelling exercises should limit the role of BECCS in achieving modelled temperature outcomes in line with respondents' preferences.

The regional results in this study suggest that the survey respondents have incorporated the principle of common but differentiated responsibilities and respective capabilities into their narratives. For both measures used – emissions in 2030 and year of peak emissions – all respondents identified developed countries as implementing more emissions reductions in a more rapid timeframe. However, the results in this study also show that UNFCCC participants, based on their geographical location may have different views on the short to medium term pathways for developing country emissions. This difference in outlook and interpretation aligns with Wamsler et al. (2020) observations of the clear divide between developed and developing countries felt by UNFCCC participants and warrants further investigation.

The IPCC SR 1.5^{o}C scenarios are often assumed to represent the only type of narratives that are consistent with achieving the Paris Agreement objectives. This report suggests that respondents have absorbed much of the key messages in the IPCC SR1.5 scenarios but that there is a dynamic interpretation of the concepts around peaking, net zero, sinks, rapid reduction and differentiated responsibilities as explore in this study.

5.1.1 Further Work

The analysis presented in this Report suggests a number of additional areas for further research to explore the narratives in more detail and to increase the robustness of the results. Key areas for future work include:

1. Increasing the representatives of the data through an additional round of surveys and face to face interviews, once COVID restrictions allow in-person meetings to recommence. In particular, face-to-face interviews will facilitate the participation of more negotiators into the survey- particularly those from developing countries.
2. The current narratives focus on global emission pathways. Future work could extend these narratives to include emission pathways for specific countries or regions and to develop a more detailed treatment of sink use within the narratives.
3. Several points within this study have raised hypothesis to explain the observed variability of the data. Future work could test these hypothesis through the collection of a second round of data, ideally through face-to-face interviews. In addition, variations in responses between developed and developing country participants could be explored further.

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Appendix 1: Survey Questions

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Welcome to the Paris Reinforce Survey: Interpreting the Paris Agreement Text.

This survey has been prepared as part of the PARIS REINFORCE Project funded by the EU Horizon 2020 Research and Innovation Programme under grant agreement No 820846 (http://paris-reinforce.eu/). This survey aims to support climate policy making through the development and visualisation of potential climate change scenarios arising from the Paris Agreement.

If you would like detailed information about this project, our ethics framework or privacy of data collected, please click here (opens in a new window).

Continuing with this survey from this point indicates that you:

- Consent to the processing of the information you provide for the purposes of the research under PARIS REINFORCE. All data will be anonymised and will not be attributed to any individual.
- Understand to your satisfaction the information provided to you about your participation in this research project.
- Understand that your participation is voluntary, that you can choose not to participate in part or all of the project, and that you can withdraw at any stage of the project without being penalised or disadvantaged in any way.
- Understand that such information will be treated as strictly confidential and handled in accordance with United Kingdom Law and the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

If you have any further questions please contact: Dr Hannah Parris, hrp44@cam.ac.uk

We anticipate that the survey will take you around 15-20 mins to complete.

○ I understand, take me to the survey

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1. Start by thinking back to the moment when the Paris Agreement officially came into force in 2016. What were **your personal hopes** for the Paris Agreement at that time? Have you changed your view over time? Would you like to share some thoughts below? If not, please move onto Q2.

.

2. Article 2(1) states "......Holding the increase in the global average temperature to **well below 2°C** above pre-industrial levels and **pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels**, recognizing that this would significantly reduce the risks and impacts of climate change....."

Imagine you could pick what the future temperature increase will be at 2100. **Given all the effort to transition to a low GHG future**, to what extent do the following temperature increases constitute an **acceptable, neutral or unacceptable outcome under the Paris Agreement?**

Do you think the listed temperature targets could be **realistically achieved?**

	1. Strongly Acceptable	2. Acceptable	3. Neutral (neither acceptable nor unacceptable)	4. Unacceptable	5. Strongly Unacceptable	Is this temperature target realistic? Yes	No
1.5C	☐	☐	☐	☐	☐	☐	☐
1.51C-1.59C	☐	☐	☐	☐	☐	☐	☐
1.6C-1.69C	☐	☐	☐	☐	☐	☐	☐
1.7C-1.79C	☐	☐	☐	☐	☐	☐	☐
1.8C-1.89C	☐	☐	☐	☐	☐	☐	☐
1.9C- 1.99C	☐	☐	☐	☐	☐	☐	☐
2C	☐	☐	☐	☐	☐	☐	☐
Above 2C	☐	☐	☐	☐	☐	☐	☐

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. 3. Are there any other comments you would like to add to your answers to Question 2?

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4. Let's turn to the phrase from Article 4(1) which states: "Parties aim to **reach global peaking of greenhouse gas emissions as soon as possible**, recognizing that peaking will take longer for developing country Parties……."

We define "global peaking" as the time period **after which there is an observed long term downward trend in GHG emissions released into the atmosphere each year,** although there may be annual fluctuations around an average.

Given the effort of transitioning to a low GHG future, **what year** do you ***realistically*** expect the world to **reach global peak emissions?**

- Global emissions have already peaked
- 2021-2029
- 2030
- 2031-2040
- 2041-2050
- 2051-2060
- 2061-2070
- Later than 2070

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5. Article 4(1) also states: "Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that **peaking will take longer for developing country Parties......"**

We define "global peaking" as the time period **after which there is an observed long term downward trend in GHG emissions released into the atmosphere each year,** although there may be annual fluctuations around an average.

Given the effort of transitioning to a low GHG future, please indicate, **by dragging and dropping each country or group label into the appropriate box, your expectation for when each country or group will *realistically* reach peak emissions.**

China

India

Russia

Brazil

Indonesia

Other Developing Countries (excluding China, India, Russia, Brazil, Indonesia)

EU

Canada

Japan

USA

UK

Other Developed Countries (excluding EU, Canada, Japan, USA, the UK)

Emissions have already peaked

2021 - 2029

2030

2031-2040

2041-2050

2051-2060

2061-2070

Later than 2070

. 6. Are there any other comments you would like to add to your answers to questions 4 or 5?

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7. Now consider the next phrase in Article 4(1):.... "Parties aim to reach global peaking .... **and to undertake rapid reductions thereafter in accordance with best available science...."**

How do you interpret the phrase 'undertake rapid reductions? What will this mean in practice in terms of achieving average annual emissions reductions?

A list of potential **annual average global rates** of reduction in global emissions is listed below. With **1** representing "highly unrealistic" rates of emission reduction and **10** representing "highly realistic" rates of emission reduction, **indicate how realistic (or unrealistic) you consider each rate by sliding the bars across to your chosen value.**

	1	2	3 Highly Unrealistic	4	6	7	8 Highly Realistic	9	10
1%									
2%									
3%									
4%									
5%									
6%									
7%									

. 8. Are there any other comments you would like to add to your answers to Question 7?

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9. Article 4(1) goes on to state: ".... [reduction in emissions] 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, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty."

What do you think is **an acceptable share of sinks in achieving this net zero emissions target** (i.e. mitigation versus use of sinks)? For example, should a maximum of X% (see below) of the effort come from the removal of GHG by sinks, and the remainder through reduction in emissions?

Below is a list of percentages that represent the share (X%) of sinks used in achieving a net zero emissions target. For each percentage share listed below, please tick the box to indicate whether you **consider as being strongly unacceptable, unacceptable, neutral (no preference), acceptable and strongly acceptable**.

	Strongly Unacceptable	Unacceptable	Neutral (no preference)	Acceptable	Strongly Acceptable
0% use of sinks	☐	☐	☐	☐	☐
1-9%	☐	☐	☐	☐	☐
10%-19%	☐	☐	☐	☐	☐
20%-29%	☐	☐	☐	☐	☐
30%-39%	☐	☐	☐	☐	☐
40%-49%	☐	☐	☐	☐	☐
50% or more	☐	☐	☐	☐	☐

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10. If sinks are to be used in achieving a net zero emissions target, what should be the **balance** between using **sinks from nature** (such as re-forestation and afforestation) and using sinks based on **carbon dioxide removal technologies** (such as Bioenergy with Carbon Capture and Storage (BECCS) and Direct Air Capture (DAC))?

Slide the bars across to indicate what, on average, you consider an **acceptable share** of each type of sink **as a percentage of total sink use** in achieving a net zero emissions target. For example, of the total contribution made by sinks in Country A, the government considers it appropriate that 70% comes from afforestation projects, while 30% of the sink contribution is sourced from BECCs.

Please note that, taken together, the shares on the sliders must add up to at least 100% - but may be more. For example, if you consider that use of either type of sink is 100% acceptable, then please indicate 100 on both sliders.

% share of natural vs carbon removal technologies in total sink use

	0	10	20	30	40	50	60	70	80	90	100
Acceptable share of nature based sinks in total sink use											

% share of natural vs carbon removal technologies in total sink use

	0	10	20	30	40	50	60	70	80	90	100
Acceptable share of carbon dioxide removal technologies in total sink use											

. 11. Given the current mix of political will, engagement from businesses and communities around the world, competing priorities and technological development, **what year** do you expect that the world will ***realistically* achieve net zero GHG emissions?**

- Before 2050
- 2050
- 2051-2060
- 2061-2070
- 2071-2080
- 2081-2090
- After 2090
- The world will never achieve net zero emissions

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. 12. Are there any other comments you would like to add to your answers to questions 9, 10 or 11?

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13. Let's turn next to the phrase from Article 4(3), which states: "Each Party's successive nationally determined contribution **will represent a progression** beyond the Party's then current nationally determined contribution and reflect its highest possible ambition…."

Given this phrase in Article 4(3), what do you think will be **the change in GHG emissions, globally, by 2030, compared to today's (2021) level of emissions** ?

Below is a list of potential changes expressed as a **percentage increase or decrease in global emissions in 2030 compared to today's levels.** For each percentage change in emissions listed below, please tick the box to indicate whether you expect these to be a **highly unrealistic, unrealistic, neutral, realistic, or highly realistic outcome for 2030.**

	Highly Unrealistic	Unrealistic	Neutral (neither unrealistic/realistic)	Realistic	Highly Realistic
Higher than +10%	O	O	O	O	O
+6% to +10%	O	O	O	O	O
+1% to +5%	O	O	O	O	O
No change in GHG emissions	O	O	O	O	O
-1% to -5%	O	O	O	O	O
-6% to -10%	O	O	O	O	O
-11% to -15%	O	O	O	O	O
-16% to -20%	O	O	O	O	O
-20% to -29%	O	O	O	O	O
-30% to -39%	O	O	O	O	O
-40% to -49%	O	O	O	O	O
-50% or lower	O	O	O	O	O

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14. Article 4 (3) also states that "....[each NDC ....will reflect its] **highest possible ambition**, reflecting its common but differentiated responsibilities and respective capabilities, in the light of **different national circumstances**."

Given this phrase in Article 4 (3) above, what do you think will be the **change in GHG emissions**, **for individual countries or country groups listed below, by 2030, compared to today's (2021) level of emissions**?

Below is a list of potential changes expressed as a **percentage increase or decrease in emissions in 2030 compared to today's level.** Please select the percentage change in emissions that you consider as being ***realistic*** **for each country or group by dragging and dropping the country or group label into the appropriate box.**

Note: Some countries have already made public statements regarding their emissions targets for 2030. If you consider these targets as unrealistic, please select an answer that reflects your view.

China

India

Russia

Brazil

Indonesia

Other Developing Countries (excluding China, India, Russia, Brazil, Indonesia)

Canada

EU

Japan

USA

UK

Other Developed Countries (excluding EU, Canada, Japan, USA, the UK)

More than +10%

+6% to +10%

-11% to - 15%

+1% to +5%

-21% to -29%

No change in GHG emissions

-1% to -5%

-30% to -39%

-6% to -10%

-50% or more

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15. Are there any other comments you would like to add to your answers to questions 13 or 14?

16. You have reflected on a range of different objectives within the Paris Agreement. We are now interested in how important you think each one is.

Below are extracts from the Paris Agreement text setting out these different objectives. Please rank on a scale of 1-5 **(1** being the **least important** and **5** being the **most important) the order of priority you give to each objective.**

Article 2 (1) (a): "Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels,..."

Article 4 (1): Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties,.....

Article 4 (1):........ and to undertake rapid reductions thereafter in accordance with best available science......

Article 4 (1): ......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..."

Article 4 (3): "Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition…."

. 17. Which country group do you reside in?

- China, India, Russia, Brazil, Indonesia.
- Other Developing Countries (excluding China, India, Russia, Brazil, Indonesia)
- US, EU, Canada, Japan, UK
- Other Developed Countries (excluding US, EU, Japan, Canada, UK)

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. 18. How many UNFCCC COPs have you attended?

- I have not attended any UNFCCC COP meetings
- 1-3
- 4-6
- 7-9
- 10 or more

. 19. Which description best fits your professional role in the UNFCCC negotiations?

- Party Negotiator representing my country or group of countries
- An observer/participant from the business and industry non-governmental organisations (BINGO)
- An observer/participant from environmental non-governmental organisations (ENGO)
- An observer/participant from farmer organisations
- An observer/participant from indigenous peoples organisations (IPO)
- An observer/participant from local government and municipal authorities (LGMA)
- An observer/participant from research and independent non-government organisations (RINGO)
- An observer/participant from trade unions non-governmental organisations (TUNGO)
- An observer/participant from women and gender organisations
- An observer/participant from youth non-governmental organisations (YOUNGO)
- An observer/participant from faith based organisations
- An observer/participant from education and capacity building and outreach NGOs (ECONGO)
- Other, please specify

. 20. Thank you for taking part in this survey for the Paris Reinforce Project.
If you would like to receive updates on this research, please provide your email below.
Please note, that providing your email is completely voluntary and your details will be managed in accordance with our privacy and ethics guidelines, which can be read here.

.

Clicking on the NEXT button will complete the survey and you will not be able to change your answers.

If you wish to review your responses, **please hit the "BACK" button** to go to the relevant question.

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Appendix 2: Survey Questions and Design Justification

Survey Questions	Justification for question design
Question 1: "personal hopes for the Paris Agreement"	Designed to be an 'icebreaker' to establish the tone of the survey and rapport with respondents. It also captures respondents' overall attitude towards the Paris Agreement at the time the Agreement came into force and how this has changed over time.
Question 2: "temperature increase outcomes in 2100"	Temperature range taken from Article 2 of the Paris Agreement. The temperature range was broken down into 5 response categories that balanced providing sufficient range of options for respondents to feel that there is a relevant option for them, with the need to keep answers tractable (Gehlbach and Artino, 2018).
Question 3: "Are the temperature increases realistic"?	There is a growing discourse within the scientific literature that is actively questioning the plausibility of achieving a 1.5oC temperature target, given the existing global emission profiles and growth rates (e.g., Peters et al. 2020, UNEP, 2020). This questions tests the extent to which respondents agree or disagree with this view regarding future temperature outcomes under the Paris Agreement.
Question 4: Year of global peak emissions and Question 5: Year of peak emissions for selected countries/regions	Range of peak emission years designed to be consistent with Table 2.4 in Chapter 2 of IPCC SR 1.5. (Rogelj et al. (2018) In line with good survey design, range was broken down into 8 response categories that balanced detail with maintaining tractability for respondents (see Gehlback and Artino, 2018)
Question 7: "rate of rapid reduction"	Scale range calculated to broadly reflect the change in global CO2 emissions between 2010-2030 associated with different temperature ranges as reported in Table 2.4 of the IPCC SR 1.5°C Report (Rogelj et al. (2018).

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Question 9: role of sinks in getting to net zero emissions	Percentage shares of sinks as a total proportion of the effort to reach net zero emissions are designed to be broadly consistent with the use of negative emission technologies (from AFOLU and BECCS) in the four illustrative model pathways set out in figure SPM 3B in the IPCC 1.5°C Report. Interpreting the attitudes towards the use of sinks as a more risk approach to achieving emissions reduction is based on the analysis of sinks within global abatement strategies by Fuss et al. (2014), Andersen & Peters (2016) and Rogelj (2018)
Question 10: preference for nature-based sinks versus sink technologies	Sink based technologies are widely recognised as having significant technical, political, resource limitations and ethical barriers to their widespread adoption and that their use raises significant risk in future emission pathways (e.g., Fantuzzi et al., 2019, de Coninck et al., 2018, Lenzi 2019 and Shue, 2017). Despite this, the use of sinks, and BECCS in particular, play a major role in several scenarios discussed in the IPCC SR 1.5oC Report (Rogelj et al. 2018). Given this, this question is included to measure the relative share of nature-based sinks versus sink technologies that respondents belief is appropriate in the total sink mix. Given the increased risks involved in the use of sink technologies, the results represent a proxy measure of the risk attitudes adopted by respondents.
Question 11: Year of achieving global net zero emission	Dates for achieving net zero emissions are designed to be broadly consistent with Table 2.4 of the IPCC Special Report on 1.5°C. (Rogelj et al. (2018) In addition the option of "The world will never achieve net zero emissions" was added to test whether respondents believed that, in total, the global emissions will never hit a milestone critical to limiting global emissions to no more than 2^0C temperature increase.
Question 13 and 14: Progress in 2030 globally and for selected countries and regions.	Choice of percentage rate is as follows: For the negative range of percentage values in the question: • Estimated emissions levels in 2030 for different temperature targets (below 1.5^0C to above 2^0C) were taken from Table 2.4 from IPCC SR1.5oC Chapter 2, p119 (Rogelj et al. 2018). • This was compared to the total global CO2 emissions recorded for 2020 IPCC SP1.5 Chapter 4 Cross Box 11 (de Coninick et al., 2018). A straight-line simple percentage change in emissions was calculated using 2020 as the base year. The positive range of percentage values reflects expected changes in emissions levels under current policy settings or assessments of unconditional NDCs as summarised in Cross Chapter Box 11 in Chapter 4, IPCC (2018). Here, the the 25th percentile value for the unconditional NDCs in 2030 is estimated to be a global emissions of 58 Gt CO2e – or an increase of around 9.5%. This figure was divided into even intervals in the answer categories with an additional 10% or more category to test whether respondents expected an increase in emissions in 2030.

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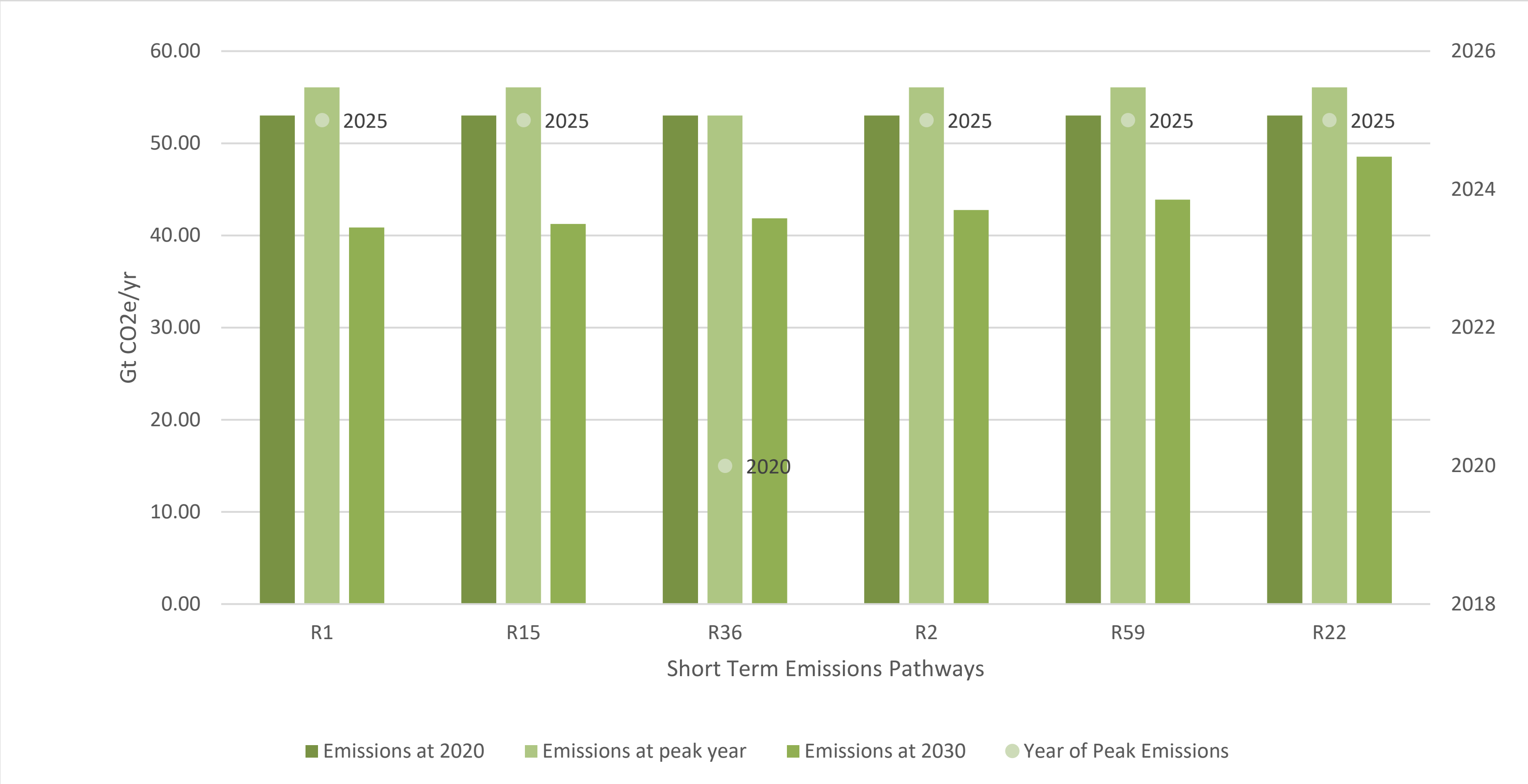
Appendix 3 Individual Responses to Emissions in 2030, Peak Year and Year of Net Zero

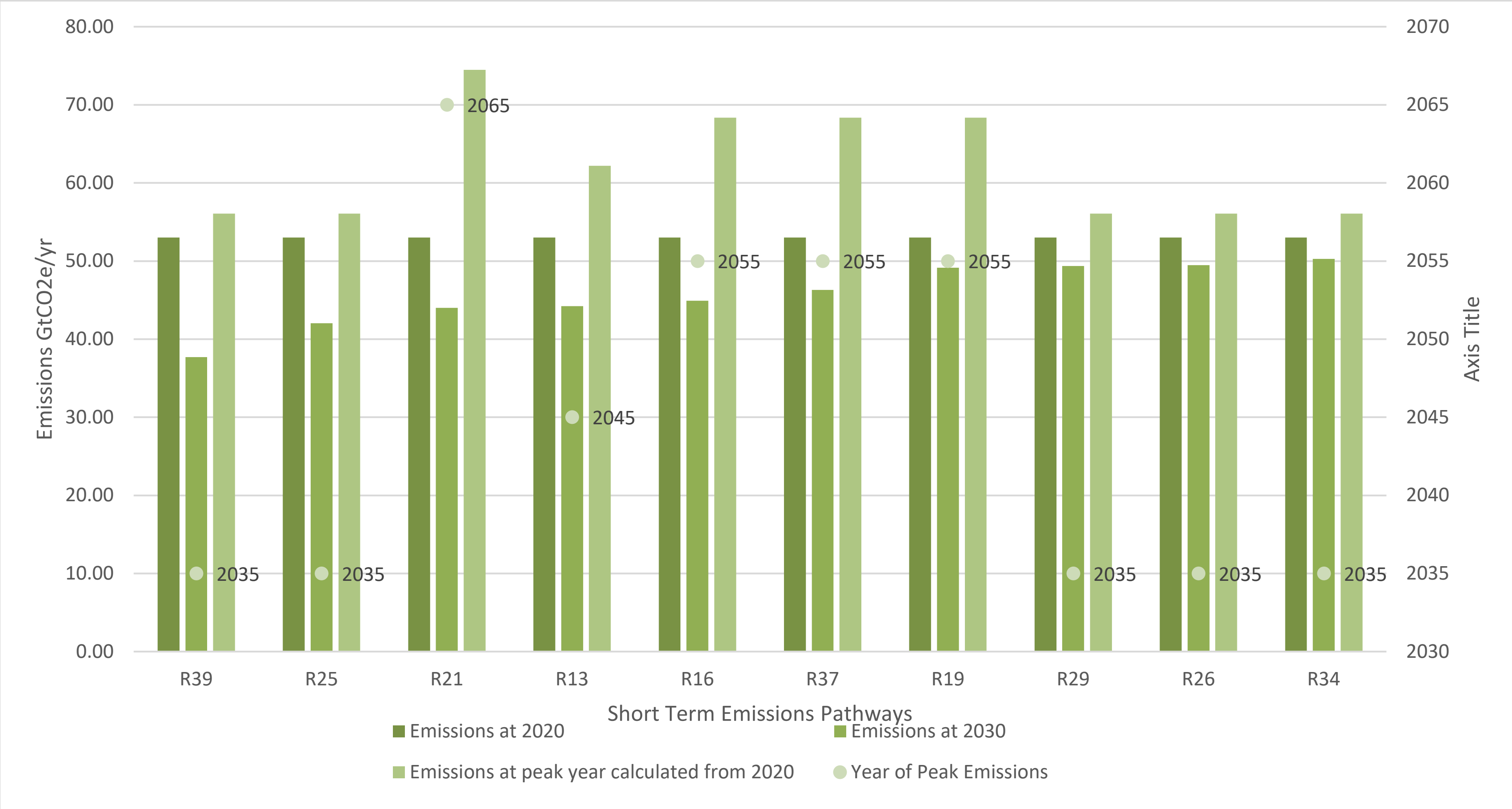
Figure 23: Alignment between narrative milestones (sample: respondents with a peak year before 2030)



Source: Authors' calculations from survey responses

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

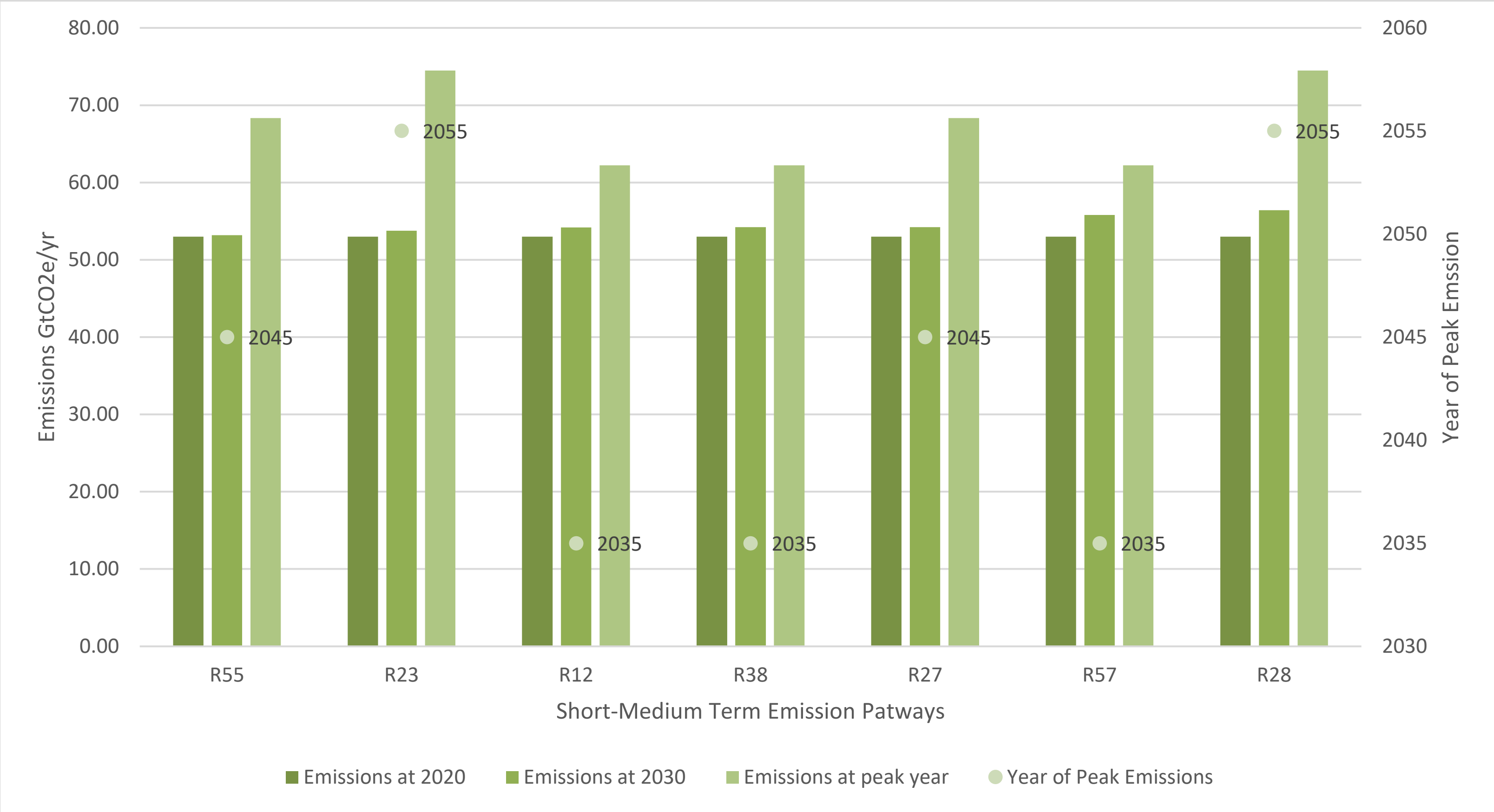
Figure 24: Alignment between narrative milestones (sample: respondents with a peak year after 2030/emissions reduction in 2030)



Source: Authors' calculations from survey responses

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Figure 25: Alignment between narrative milestones (sample: respondents with a peak year after 2030/emissions increase in 2030)



Source: Authors' calculations from survey responses

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