

Science-Based Targets: On Target? Supplementary Materials

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S1. Development of the Science-Based Targets Initiative

Further to Sections 1 and 2 of the main article, this section contains additional information on the development of the initiative, its uptake and consideration in the academic literature to date.

S1.1 Development of Initiative Requirements and Guidance

When initially launched, the SBTi had a limited range of generic criteria, resources and methodologies, which have been significantly expanded upon over subsequent years, incorporating additional detail, such as sector-specific guidance and further target criteria. For example, following the IPCC Special Report on global warming of 1.5 °C [1], the SBTi announced a number of substantial changes to the target validation criteria and associated technical resources [2]. The additional resources [3] included an updated version of the Science-Based Target Setting Manual (v4.0), validation Criteria and Recommendations (v4.0), Target Validation Protocol (v1.0) and a new Target Setting Tool (v1.1), as well as discussion papers defining climate neutrality and the ‘conceptual foundations’ for net-zero corporate target setting [4,5]. These changes to the initiative included a requirement that from October 2019, targets must be compatible with a “well below 2 °C” pathway. As well as requiring greater ambition for new entrants to the initiative, this change entails increased ambition from current participants as they periodically review existing targets, with “well below 2 °C” alignment becoming mandatory by 2025. The corresponding level of ambition of each company’s target was also made publicly available from October 2019 (i.e., 2 °C, well below 2 or 1.5 °C targets, where previously this information was not tabulated on the SBTi website). However, in the absence of readily available decarbonisation pathways in line with 1.5 °C [6], this change has resulted in an increasing dependence upon the International Energy Agency’s (IEA) Beyond 2 °C Scenario (B2DS) which translates to a 1.75 °C temperature rise by 2100 and energy sector carbon neutrality in 2060 [7].

The SBTi has also released a range of sector-specific guidance packages since its initial launch, with target-setting resources available for the following sectors: transport and apparel and footwear (both released in 2018), electric utilities (published June 2020), ICT companies (April 2020), and financial institutions (October 2020). Similar resources are also under development for the chemical and petrochemical, oil and gas, aluminium, and forest, land oil agriculture sectors. In April 2020, the initiative also announced the development of a streamlined target-setting route for small- and mid-sized companies (SMEs) [8].

Once committed to setting a SBT, many companies experience difficulty gathering the requisite data and developing targets. Though target approval rates have been increasing over time, they were typically below 50% in the early years of the initiative. Even once such a target has been set there are challenges in communicating that target, engaging employees and suppliers, and delivering carbon reduction activities. For instance, in a recent survey of large UK companies, only one-quarter of junior-level employees were aware of what their organization’s carbon reduction target was, or whether one had even been set [9].

S1.2 Consideration in the Academic Literature

As noted in Section 1 of the main article, a small body of academic literature touches upon SBTs. These predominantly consider SBTs as one of a range of absolute environmental sustainability assessment methods [10,11]; introduce specific target-setting methodologies [12–14]; address their application to a particular sector (e.g., industry [15], construction [16,17] or aviation [18]) or a particular organization (e.g., IKEA [19] or Mars Incorporated [20]); discuss shortcomings in the underlying data and accounting [21]; or provide general commentary on their role in corporate climate action [22,23]. SBTs have also been utilized in guiding decision making around low-carbon investments [44, 45]. Some studies simply refer to SBTs in passing, to provide context or an exemplar [24–28], or to discuss their relationship with other concepts or agendas, such as green growth [29] or societal life cycle costing [30].

Proponents of the initiative argue that setting SBTs “spurs ambitions”, “encourages innovation”, “helps create and penetrate new markets”, “makes companies more resilient to developing climate

regulation and policy”, “helps identify risk and exploit opportunities”, and “enhances corporate reputation” [e.g., 31]. Participants in the scheme also perceive SBTs as more rigorous, robust and defensible, and a helpful tool to mitigate potential regulatory risks [32]. Meanwhile, critics have argued that SBTs are a form of “voodoo economics” that serve as a “costly distraction” which could delay progress in adopting the public policy measures that are needed to tackle climate change [33]. Some have argued that the ‘rigorous’ target-setting process confuses the simple reality that all companies should be spending their time working out how to become ‘net zero’ or ‘carbon positive’ and that SBTs in their current form are “limiting corporate ambition” [34]. Meanwhile, others have argued that the mere notion of setting a SBT is undermined by the poor quality of current corporate carbon accounting and reporting [21].

S1.3 Uptake of Science-Based Targets

Further to Section 2 in the main article, this section considers uptake of the initiative by other characteristics, namely the region, sector and size of firms.

As can be seen in Figure S1, the majority of firms with approved SBTs to date are headquartered in Europe (190 companies), Asia (99) and North America (82)—collectively constituting 93% of all approved SBTs at the time of writing. Few companies headquartered in Africa, Latin America and Oceania have approved SBTs (19 in total), though there has been a modest increase in commitments of late (with 68 companies committed but not yet with approved SBTs).

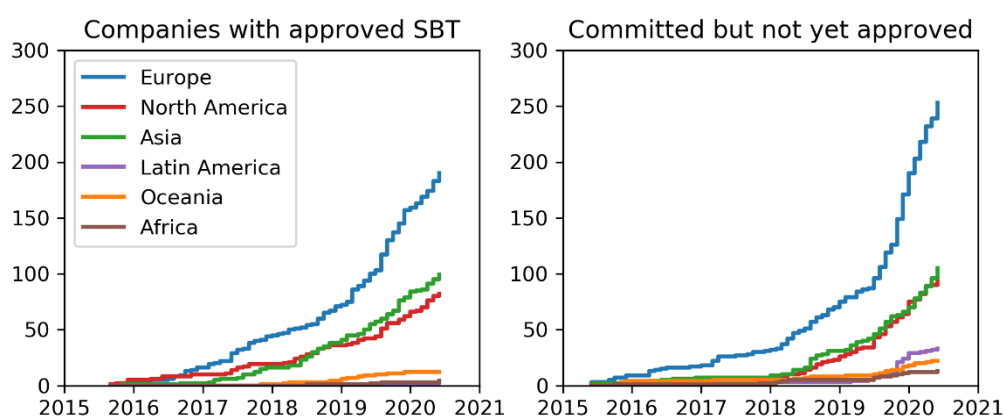


Figure S1. Companies committing to and setting SBTs by region.

As can be observed in Figure S2, certain sectors (e.g., ‘Banks, Diverse Financials and Insurance’) have received a large number of commitments that have yet to translate into approved SBTs. In the case of financial institutions, this has been attributable to challenges in developing an appropriate methodology, before the new ‘pilot version’ sector-specific guidance was launched in October 2020 [35]. Figure S2 also demonstrates that participation amongst sectors such as ‘Real Estate’ and ‘Professional Services’ has been increasing sharply of late.

The relative and collective magnitude of the companies adopting SBTs to date can be approximated using annual operating revenue (turnover) and employee numbers from the ORBIS database [36]. The ORBIS database includes turnover for 341 of the 398 (86% of) companies with approved targets and 376 of the 517 (73% of) companies that have committed to the scheme but not yet set targets. The combined annual turnover of companies with approved targets now exceeds \$5.6 trillion, with all firms participating in the initiative (identified in ORBIS) collectively exceeding \$9.6 trillion, as illustrated in Figure S3. Between them these companies employ over 27 million workers. The initiative has also been increasingly successful at securing participation of larger companies over the past 5 years, as illustrated in Figure S4. A growing number of smaller companies are also engaging with

the initiative. However, Figure S4 is unlikely to reflect this as turnover data for many smaller companies is not available from ORBIS.

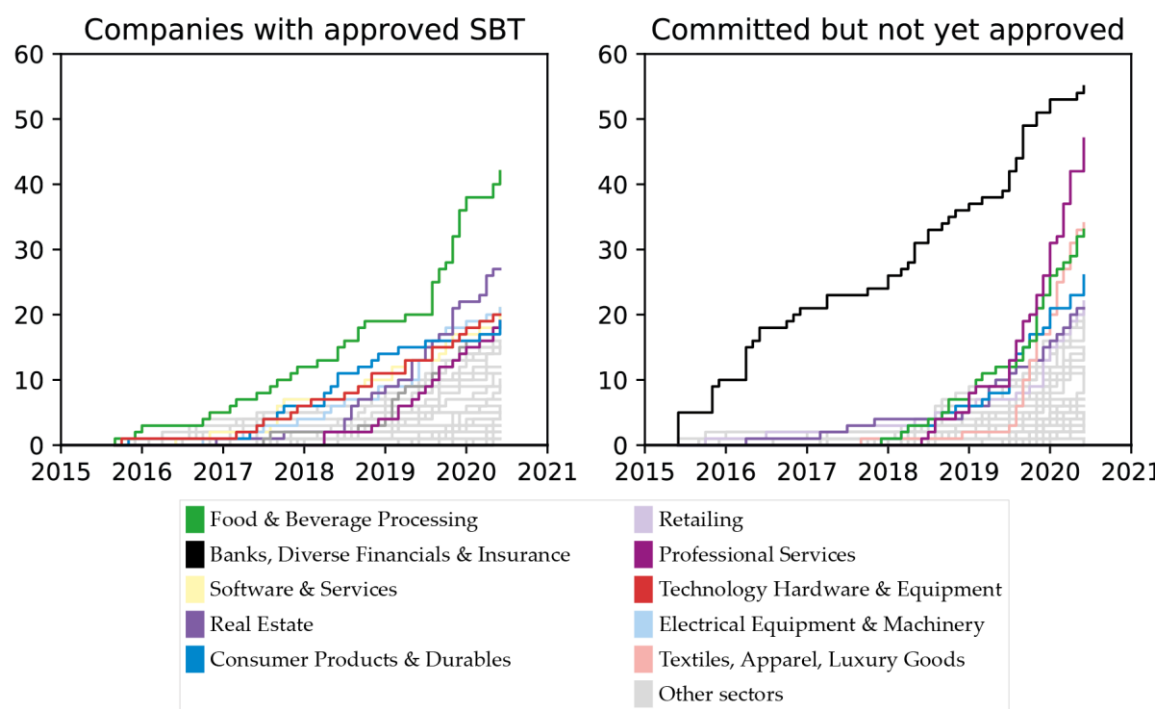


Figure S2. Uptake of SBTs by sector. Selected sectors highlighted.

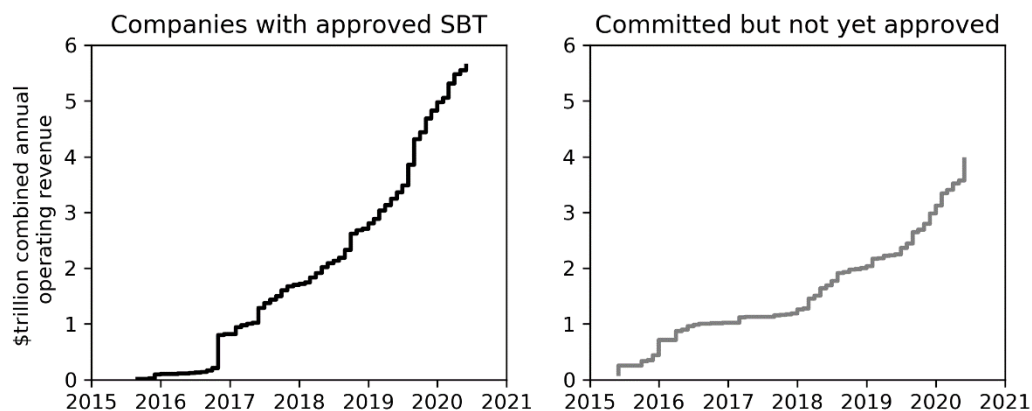


Figure S3. Combined annual operating revenue (turnover) of companies committing to and setting SBTs. Based on sample of 717 companies from ORBIS database, accessed on 29 June 2020.

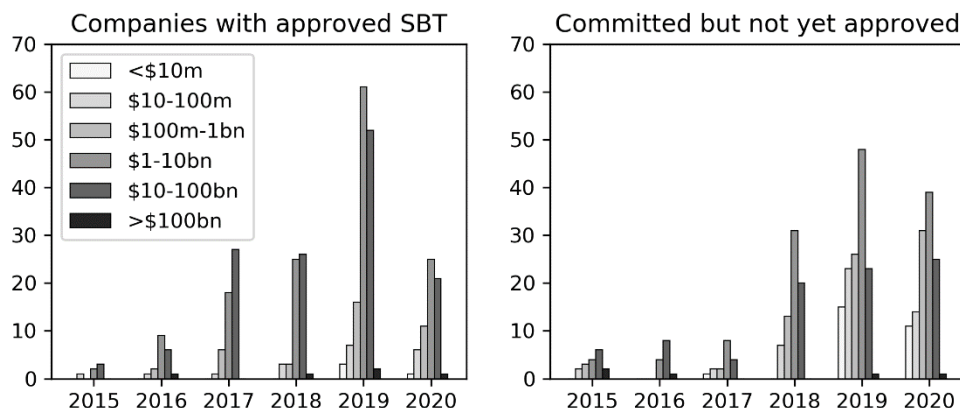


Figure S4. Distribution of companies adopting SBTs by annual operating revenue (turnover). Based on sample of 717 companies from ORBIS database, accessed on 29 June 2020.

S2. Challenges Encountered in Data Gathering

Further to Section 3 of the main article, this section contains further information on the typical challenges encountered when collecting data.

Despite recommendations from the SBTi and widespread implementation of standards such as the Global Reporting Initiative [37], a huge variety of reporting practices were observed. Common problems included the omission of baseline data from reporting; the omission of intensity-based metrics; progress being reported against net emission figures (i.e., including offsets); and changes in methodologies, boundaries and other factors between reporting cycles. Consequently, in some instances it was impossible to discern progress against a target from public reporting. The reasons for this are elaborated upon across the following paragraphs.

Several companies had been involved in mergers or made recent acquisitions and had not yet been able to calculate a new baseline, thus preventing comparison. One such example was the Dell-EMC merger in the 2015–16 period. Kesko Corporation and Las Vegas Sands also cited changing reporting boundaries after acquisitions and expansion. In some cases, the recency of target setting meant that a baseline had not been established at all, merely a commitment. One company (Level 3 Communications) had been acquired by another company that does not have a SBT, a few months after target setting in 2017. In some instances, companies had voluntarily updated their reporting methodology or boundary but not updated their baseline, also preventing comparison.

Some companies reported reducing net emissions by using offsets, and included these within their headline indicator, whilst gross emissions increased. SBTi guidance clearly states that “offsets should not be counted as reductions toward meeting an SBT” [38]. One such example is SAP SE, where emissions increased 16.4% in gross terms but reduced by 21.1% on a net basis (including offsets). Clearly the company are behind target if offsets are excluded but on target if included. In instances such as this, the authors’ assessment of progress is based on gross figures. If only net figures were reported, then the target was excluded from the final sample.

In many cases, the emissions data reported by a company were not in the target metric and insufficient supplementary information was available to calculate progress. This was a common problem for intensity-based metrics (e.g., emissions per m² floor area), where only absolute emissions were reported. Determining progress requires locating additional sources, which may not be consistent with those used internally to set and track the target. For example, underlying emissions data for a Husqvarna AB intensity target was lacking, but deriving the intensity values from the absolute emissions and company financial data did not align with company reporting. If all companies were meeting SBTi guidance on transparency, then it should be possible to discern progress purely from publicly available information.

In a few cases, results were reported only in percentage changes relative to a baseline, without accompanying underlying datasets. For instance, multiple targets set by Advanced Micro Devices, Inc were reported against solely in percentage terms. This could be partially corrected by inferring progress from reported percentage changes against a baseline (e.g., for Mars). However, there are clearly inaccuracies (such as rounding errors) in taking this approach, so it was avoided where possible.

In a handful of cases, comparable data was not yet available due to the company's reporting cycle. For instance, Carlsberg Group employ a 3-year rolling basis of assessment for their whole value chain target. Some companies even explicitly acknowledged that for certain targets current reporting was "not sufficiently accurate to report a reliable trend" (Hewlett Packard Enterprise Company).

In cases where company reporting was unclear or insufficient, data was often cross-referenced against values reported in CDP responses. Where it was not possible to reliably assess progress, these targets were excluded from the final sample.

Note that, although current science-based targets are verified against the latest SBTi criteria, targets validated prior to 22 May 2018 were validated against the second version of the SBTi criteria and targets validated prior to 16 April 2017 were validated against the first version of the SBTi criteria. Thus most targets being assessed within this sample were validated against earlier versions of the SBTi criteria. The exceptions were companies that had changed their targets since their initial commitment, for example those that recently upgraded to 1.5 °C targets from prior 2 °C targets. More recent targets may be simpler to assess progress against given the stricter requirements and better guidance in place.

S3. Methodological Limitations

Further to Section 3.5 of the main article, this section outlines additional limitations. These in turn relate to coverage of the ORBIS database, company reporting practices and the sample size.

The ORBIS database only included annual operating revenue for 75, and employee numbers for 70, of the 81 companies in the final sample. Though the majority of the data points were from 2019, a few ORBIS data points were based on 2018 reporting. Although data on turnover and employee numbers could have been collected from alternative sources (e.g., company annual reports), standardisation across the wide variety of units (e.g., different currencies) would have been highly laborious. Therefore, a single consistent source, albeit with only partial coverage, was preferred.

Variable emissions reporting practices proved a significant constraint upon data collection. Data was reported according to each firm's individual conventions and boundaries, affecting comparability. A lack of transparency in the methods used either to establish targets or report progress against them was a further limitation to the validity of data collected. For instance, whilst some companies explicitly stated the expectation to follow an exponential attainment of target emissions, others did not, in which case a linear trend was assumed. This assumption of a linear reduction trajectory is perhaps a key methodological limitation of our research, and could be an area where direct engagement with companies would be beneficial in establishing what their underlying assumptions around expected rates of progress are. A small number of companies reported why they were or were not on track, citing mitigating circumstances such as mergers and expansion, but few explicitly stated that they were assuming linear, exponential or other reduction pathways. The linear assumption may have consequently affected our designations of behind/on track/achieved, and therefore this presents a central limitation.

A further benefit to contacting companies where data availability was poor would be in avoiding exclusion of companies from the sample on the basis of inadequate data, thus increasing the sample size. This could also mitigate the issue of potential misinterpretation of the data provided by companies, particularly with reference to intensity-based metrics. It may also have facilitated gathering greater detail on the underlying methodologies behind target-setting processes, as this was an area that was consistently under-reported. A large number of stated methodologies were based on the SDA, but greater engagement with companies could determine whether any alternative practices were widespread. As is discussed in Section 6 of the main article, engagement with companies could form part of a future qualitative research project. However, if company reporting conformed to the

expectations of the SBTi, this data would already be in the public domain, which justifies the approach taken in this analysis of excluding companies from the sample which did not meet this expectation.

A final key limitation to the present research is the sample size. Although determined by the inclusion criteria of having had a SBT approved prior to March 2018, this resulted in a reasonably small sample. The only means of overcoming this limitation would be by conducting research in future years. A larger sample would allow more meaningful comparisons between the performance of different sectors to be made (as opposed to the current 81 companies across 24 sector classifications), as well as allowing greater comparative analysis of regional differences. However, due to the emergent nature of the initiative, the issue of sample size cannot be easily overcome in the near future. The authors highly encourage interested readers to engage in replication of this study in future years.

S4. Further Results

This section includes tabulated versions of results presented graphically in Section 4 of the main article and results by additional characteristics such as region, latest CDP score, and operating revenue.

S4.1 Tabulated Results

Tables S1–3 contain tabulated results of Figures 4, 5 and 8 from the main article.

Table S1. Progress against primary and secondary targets.

Progress against Target	All Targets		Primary		Secondary	
	Number	% of Sample	Number	% of Primary	Number	% of Secondary
Behind target	47	35	24	30	23	44
On target	58	44	39	48	19	37
Target achieved	28	21	18	22	10	19

Table S2. Progress of early adopters.

Company Progress		Companies	
		Number	
Against SBT			% of sample
Behind target on all targets		19	23
Behind on 1+ target and on target for 1+ target		14	17
Behind on 1+, on target for 1+ and achieved 1+ target		2	2
Behind target for 1+ target and achieved for 1+ target		6	7
On target for all targets		24	30
On target for 1+ target and achieved 1+ target		7	9
All targets achieved		9	11
Against Primary Targets			% of sample
Behind target on all targets		24	30
Behind on 1+ target and on target for 1+ target		0	0
Behind on 1+, on target for 1+ and achieved 1+ target		0	0
Behind target for 1+ target and achieved for 1+ target		0	0
On target for all targets		39	48
On target for 1+ target and achieved 1+ target		0	0
All targets achieved		18	22
Against Secondary Targets			% of Companies With Secondary Targets
Behind target on all targets		17	39
Behind on 1+ target and on target for 1+ target		4	9

Behind on 1+, on target for 1+ and achieved 1+ target	0	0
Behind target for 1+ target and achieved for 1+ target	1	2
On target for all targets	14	32
On target for 1+ target and achieved 1+ target	1	2
All targets achieved	2	4

Table S3. Progress against targets by target scope.

Target Scope	Behind Target		On Target		Target Achieved	
	Number	% of Sample	Number	% of Sample	Number	% of Sample
Scope 1 only	1	1	4	3	1	1
Scope 2 only	0	0	1	1	1	1
Scope 3 only	16	12	10	8	5	4
Scope 1 and 2 combined	17	13	32	24	15	11
Scope 1, 2 and 3 combined	13	10	11	8	6	5

S4.2 Progress against Tertiary Targets

Progress was also assessed for 22 tertiary targets across 15 companies (summarized in Table S4). It was generally difficult to assess progress on these targets, with only 7 of the 22 individual targets being reported against. The majority of the targets (16) were based on ‘supplier engagement’, that is, encouraging suppliers and contractors to manage emissions or set SBTs. Only 4 out of the 7 targets were on track, following an assumption of continued linear progress.

Table S4. Tertiary target types and progress reported against them.

	Total	No. of Measurable Targets	No. of Targets Tracked
No. of companies with tertiary target	15	–	–
Total no. of individual tertiary targets	22	18	7
No. of companies with supplier engagement targets	12	–	–
Total no. of supplier engagement targets	16	14	6
Total no. of customer engagement targets	1	0	0
Total no. of product and service design targets	2	2	1
Total no. of operational policies targets	2	2	0
Total no. of procurement policy/investment strategy targets	1	1	0

S4.3 Progress by Region

In addition to one company in Oceania, the sample included 46 companies with 80 targets from Europe; 14 companies with 24 targets from Asia; and 20 companies with 28 targets from North America. Their targets are summarized in Figure S5. The initial targets set by European companies are typically shorter term (target year often 2025) than those for Asian companies (mostly 2030). Companies from North America in the sample were typically tending to set lower reduction targets (median target

reduction of 28.5%, compared with 30% for Asian and 35% for European companies). Progress by region is summarized in Figure S6 and Table S5 below. Some difference in progress between regions was observed, with 68% of European targets on target or already achieved, compared with 58% for Asia and 61% for North America. However, given the sample size and the differing target periods, these generalized results may be skewed by the performance of a small number of companies.

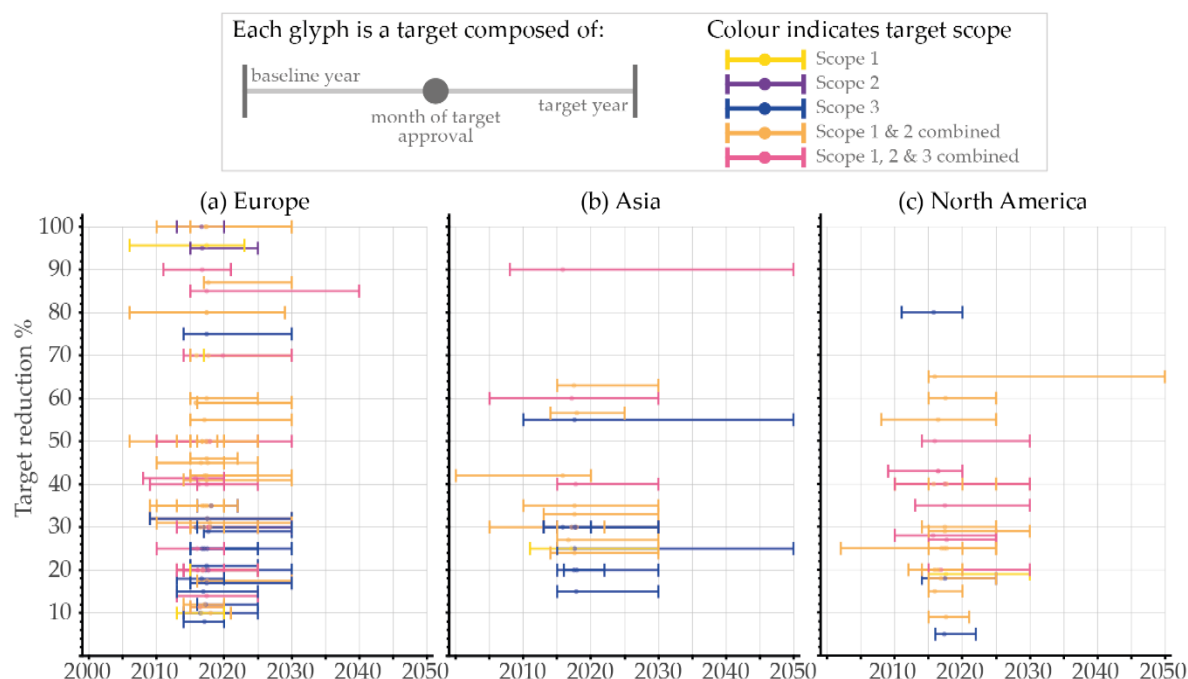


Figure S5. Targets by region.

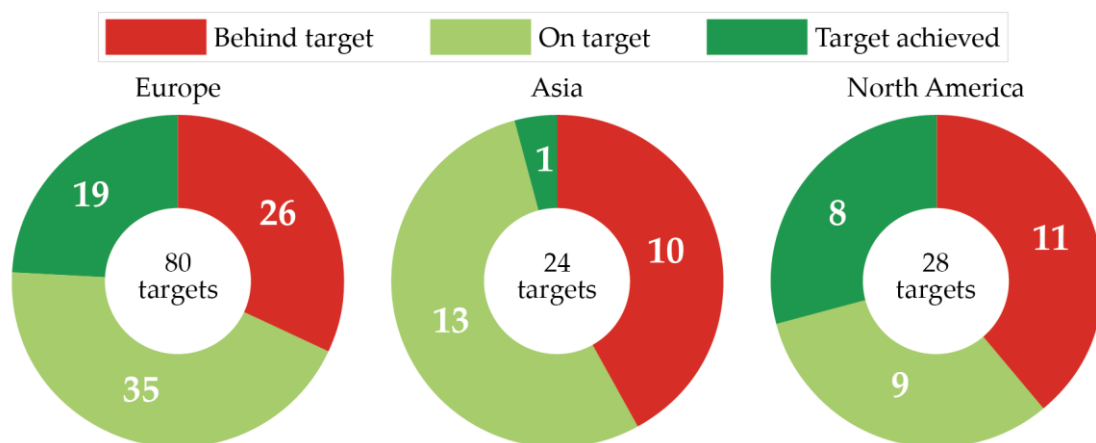


Figure S6. Target progress by region.

Table S5. Target progress by region.

Region	Behind Target		On Target		Target Achieved	
	Number	% of Sample	Number	% of Sample	Number	% of Sample
Targets						
Europe	26	20	35	27	19	14
Asia	10	8	13	10	1	1
North America	11	8	9	7	8	6

S4.4 Progress by Latest CDP Score

Table S6 and Figure S7 summarize SBT progress by company compared with their most recent CDP Climate Change score. CDP scores are calculated using a common scoring methodology resulting in grades between A and D- (or F in the case of a company no longer responding). No reporting company in the sample scored lower than a C. However, this is unsurprising, given that only 2% of companies disclosing in 2018 received a D or lower and such companies are unlikely to be setting SBTs. The resultant grades are often quoted in company reports as an indicator of climate action, particularly when firms achieve 'A list' status. Setting a SBT, or committing to do so in the next 2 years, also accrues points towards the CDP score [39]. As indicated in Figure S7, sample companies with higher CDP scores are not significantly more likely to be on target. The reasons for this are not clear. The only obvious difference between grades amongst the sample being that companies with higher grades typically used earlier baseline years, most likely reflecting a longer history of assessment and disclosure. This longer record and greater familiarity with disclosure may also aid companies in securing higher grades. The role of differing baselines is discussed in Section 4.4 of the main article.

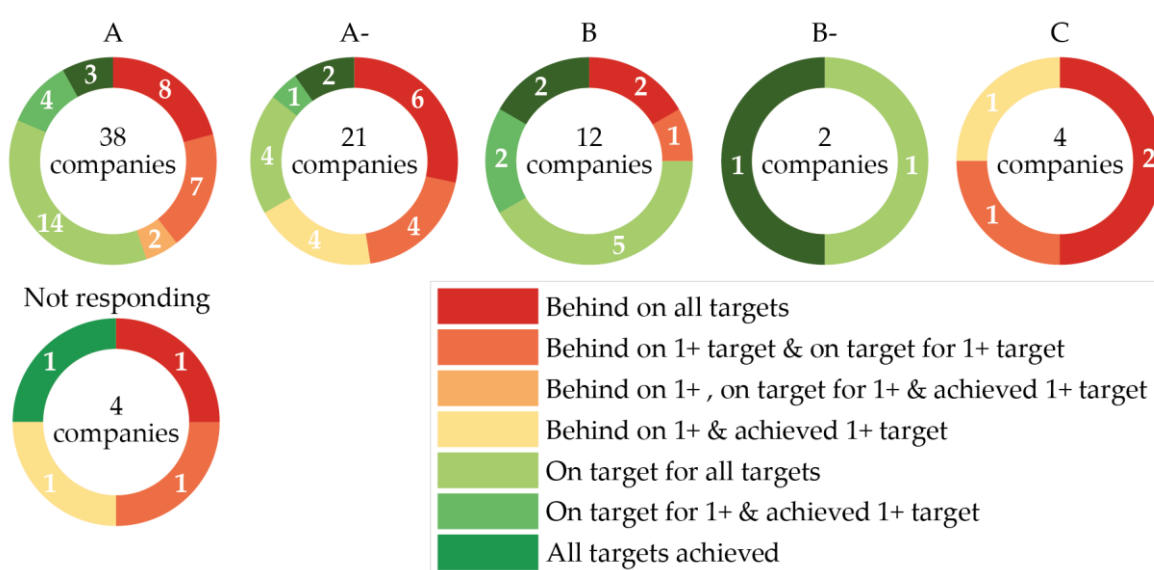


Figure S7. Company progress against targets by CDP score.

Table S6. Company progress against targets by CDP score.

CDP Score	Behind Target				On Target for All Targets	On Target for 1+ Target and Target Achieved for 1+ Target	
	Behind Target for All Targets	Behind Target for 1+ Target and on Target for 1+ Target	for 1+ Target, on Target for 1+ Target and Target Achieved for 1+ Target	Behind Target for 1+ Target and Target Achieved for 1+ Target		Target Achieved for All Targets	Target Achieved for All Targets
A	8	7	2	0	14	4	3
A-	6	4	0	4	4	1	2
B	2	1	0	0	5	2	2
B-	0	0	0	0	1	0	1
C	2	1	0	1	0	0	0
F/Not responding	1	1	0	1	0	0	1

S4.5 Progress by Annual Operating Revenue

Past studies have suggested that there are statistically significant relationships between firm size and pro-environmental behaviours [40–43]. However, this could be influenced by the metric used as proxy for company size, where some adopt employee numbers [43] and others financial data [40]. Firm size has been shown to be more likely to drive target setting than previous emissions [43]. In our analysis, with a limited set of companies for which data was available, no clear relationship emerged between size of company and target achievement.

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