

# Assessing corporate transition plans using a production asset-based approach

Executive Summary

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Full working paper available on [SSRN](#)

October 2024





## Abstract

Corporate transition plans (TPs) are increasingly seen as crucial components of assessing the compatibility and legitimacy of corporate commitments to meet climate targets. However, robust, and transparent methods to assess the credibility of disclosed TPs are lacking. Here we propose a novel open-source methodology for assessing the credibility of corporate TPs based on asset-level data to estimate CO<sub>2</sub> emission trajectories: the production asset-based planning approach (APA). We test this approach on a sample of carbon intensive companies, including ten electric utilities and ten steel companies. We find that only three of the steel companies' stated TPs are compatible with Paris-aligned benchmarks, while none of the electric utilities' TPs is. We also find that 12% and 42% of existing carbon-intensive assets in electric utility and steel companies, respectively, will require reinvestment before 2030, posing significant carbon lock-in risk. Applying this method will ensure that TPs can be assessed in a robust manner and help drive CO<sub>2</sub> emission reductions towards achieving the Paris climate target.

## Acknowledgements

We would like to thank all the attendees of the Transition Planning workshop at the University of Oxford in June 2024 for their valuable and encouraging feedback.

Funding for this work was provided by Santander Group through their support for the Transition Finance Centre of Excellence. We also acknowledge the input provided by Santander and would like to particularly thank Steffen Kram, Christopher Vernon, Christopher Mogridge, Charlie Liechti, and Etienne Butruille for their feedback.

The views expressed in this paper are solely the responsibility of the authors and do not necessarily reflect the opinions of the acknowledged individuals.

## Executive summary

Companies play a significant role in the production of greenhouse gas (GHG) emissions and are thus key actors in determining whether the global emission reduction targets of the Paris Agreement will be met. Corporate transition plans (TPs) have gained significant attention as tools to strategically guide corporate actions to reduce GHG emissions in line with climate targets. TPs are also crucial for stakeholders to hold corporates accountable with regards to their climate commitments.

Corporate TPs are of special interest in carbon intensive sectors because fossil fuel-based production assets need to be phased out to reach the targets of the Paris Agreement.<sup>1</sup> At the same time, a significant share of existing fossil fuel-based production assets will soon reach the end of their economic lifetimes. This means that companies will make decisions whether to reinvest in existing carbon intensive assets or invest in new low-carbon production technologies. Reinvestment in high carbon production infrastructure needs to be prevented to avoid carbon lock-in, while low-carbon technologies need to be developed and scaled up. For TPs to be credible, it is imperative for corporates to outline a rapid redirection of investments that enable the technological change required to reduce absolute GHG emissions resulting from production activities.

Despite the increasing uptake of TP disclosure and the proliferation of methods to assess climate targets (e.g., the Sectoral Decarbonization Approach<sup>2</sup> and methods developed by the Science Based Targets Initiative<sup>3</sup>) or production trajectories (e.g., the PACTA tool<sup>4</sup>), robust methods to assess the credibility of corporate TPs are lacking. From a climate science perspective, such a method needs to assess if stated TPs are compatible with Paris-aligned benchmarks (or not).

However, assessing TPs in carbon intensive sectors such as power and steel is challenging. Consider a steel company that states a company-wide target to reach net-zero emissions by 2050, and announces a phase-out of carbon intensive blast furnace (BF) based production in Europe by 2035 by switching to the less carbon intensive electric arc furnace (EAF) based production. However, the company also announces to significantly expand BF-based production at several plants in India before 2030. So, how can we estimate the potential impact of such proposed changes on direct CO<sub>2</sub> emissions at the company level to assess if the stated TP is Paris-aligned or not?

Our paper proposes a novel open-source methodology for assessing the credibility of corporate TPs based on asset-level data (ALD) to estimate corporate CO<sub>2</sub> emission trajectories: the production

<sup>1</sup> If companies were to operate the already existing fossil fuel-based energy infrastructure until the end of its economic lifetime, this would result in committed CO<sub>2</sub> emissions of 658 GtCO<sub>2</sub> (Tong et al., 2019) to 750 GtCO<sub>2</sub> (IEA, 2020) which alone would exceed the remaining carbon budget of 500 GtCO<sub>2</sub> from 2020 with 50% likelihood of limiting global warming to 1.5°C (IPCC, 2021). *For the full references, please see the working paper.*

<sup>2</sup> Krabbe, O., Linthorst, G., Blok, K. *et al.* Aligning corporate greenhouse-gas emissions targets with climate goals. *Nature Clim Change* **5**, 1057–1060 (2015).

<sup>3</sup> <https://sciencebasedtargets.org/>

<sup>4</sup> <https://pacta.rmi.org/>



asset-based planning approach (APA). We applied APA to 10 electric utilities and 10 steel companies to illustrate how ALD can help to assess the credibility of corporate TPs in carbon intensive sectors by following three methodological steps underpinning APA:

1. **Bottom-up modelling of corporate production profiles** based on independent ALD from Global Energy Monitor for the power and steel sectors to aggregate nominal production capacity of all material production assets at the company level via the equity share approach.
2. **Modelling future reinvestment cycles and proposed technology changes** to estimate future production output and absolute (Scope 1) CO<sub>2</sub> emission trajectories under the following scenarios:
  - a. **Business-as-usual (BAU)**, which assumes continuous operation of fossil-fuel based production assets and disregards technology upgrade pledges, but accounts for low-carbon technology-based assets which are already under construction.
  - b. **Stated Transition Plans (Stated TPs)**, which incorporates technology upgrade and phase-out pledges based on all relevant TP information that is production asset or production technology specific from various disclosure documents.
3. **Benchmarking** against the NGFS “Net Zero 2050” (i.e., 1.5°C warming with 50% probability) and “Below 2°C” (i.e., below 2°C warming with 67% probability) scenarios run on three integrated assessment models (IAM)<sup>5</sup> (i.e., a total of six transition pathways) by allocating the global sectoral carbon budget to companies via absolute contraction (i.e., grandfathering).

By doing so, APA complements existing approaches to assess the alignment of companies with climate targets in two major ways. First, APA **enables assessment of disclosing and non-disclosing companies** based on standardized accounting approach (equity share). Second, APA helps to shift the focus onto **the most important issue** of transition planning: **phasing out fossil fuel-based production assets** and avoiding further carbon lock-in via early retirement of or technology changes to existing carbon intensive assets, retrofitting existing assets with carbon capture and storage (CCS), and cancelling of plans to expand fossil fuel-based production.<sup>6</sup> Our findings are structured as follows. The first section illustrates the in-depth application of APA to one electric utility and one steel company. The second section highlights the assessment outcomes the entire sample of ten electric utilities and ten steel companies.

<sup>5</sup> Those include the MESSAGEix-GLOBIOM 1.1-M-R12, GCAM 6.0 NGFS, and REMIND-MAgPIE 3.2-4.6 models.

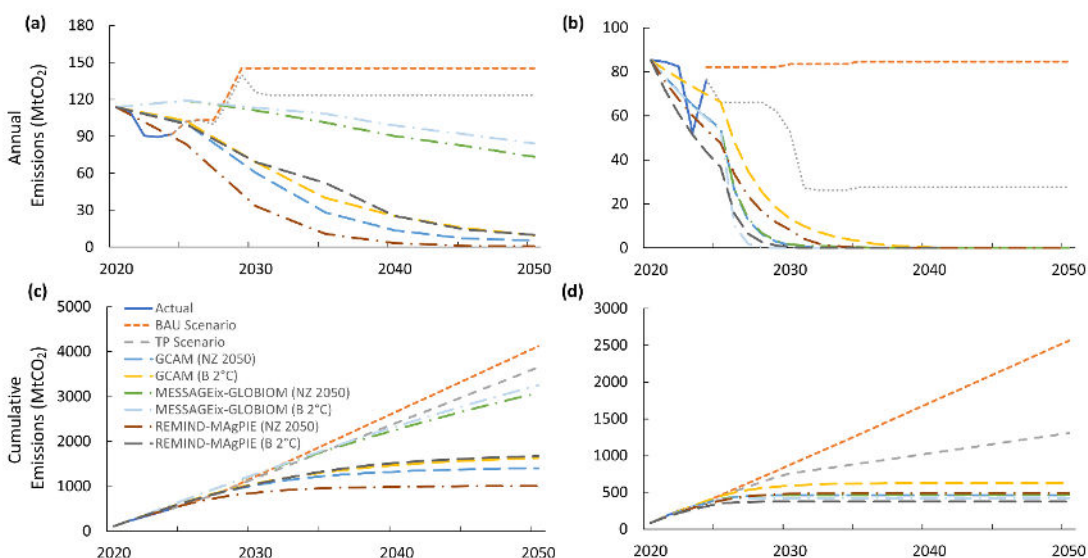
<sup>6</sup> We excluded CCS retrofitting from our modelling (see full working paper).

## Findings I: Carbon budget overshoot applied to two example companies in power and steel

We illustrate the application of APA to two sample companies, electric utility company Enel and steel producer ArcelorMittal (AM) (*Fig. 1*).

**Enel’s estimated cumulative emissions resulting from the Stated TP trajectory overshoot the allocated carbon budget under the selected NGFS scenarios by 129%-281%.** Under Stated TP, we modelled several announced technology changes including thermal coal and natural gas phase out by 2027 and 2040 respectively, and 100% renewables-based electricity generation from 2040. While these changes lead to a decrease in estimated absolute direct CO<sub>2</sub> emissions from 33 MtCO<sub>2</sub> in 2023 to ~0 MtCO<sub>2</sub> in 2041, the total cumulative CO<sub>2</sub> emissions of 492 MtCO<sub>2</sub> of between 2020-2050 (52% reduction compared to BAU) still overshoot the company’s remaining carbon budget significantly.

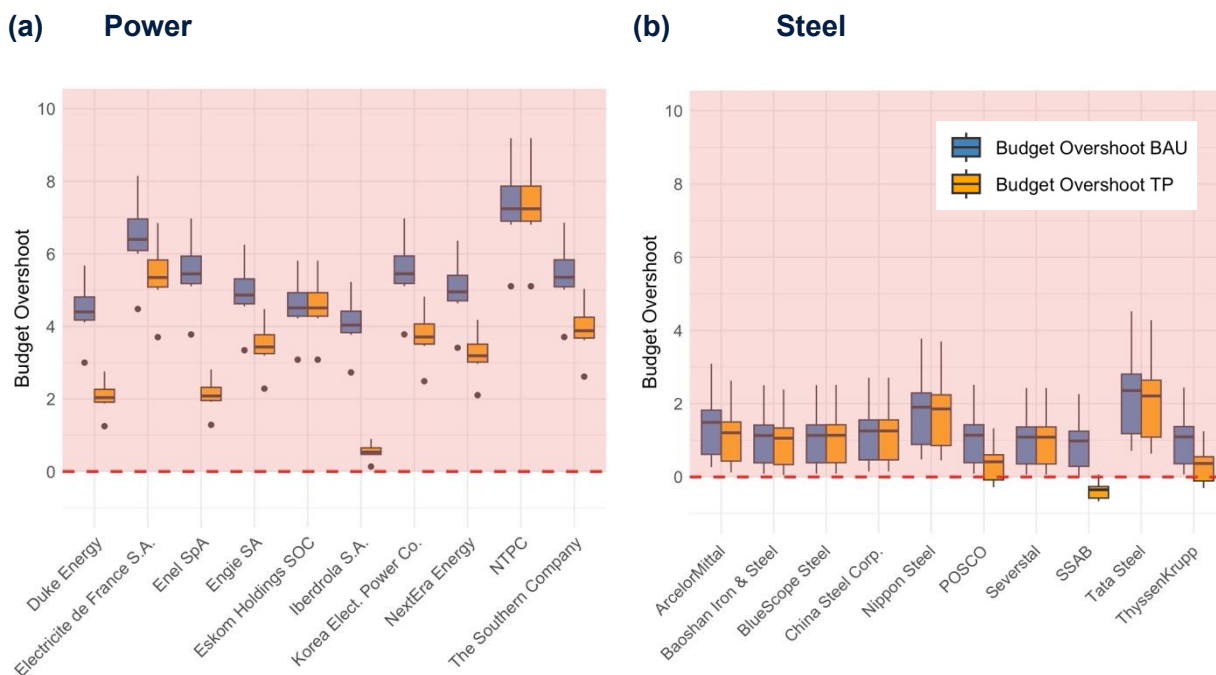
**AM’s estimated cumulative emissions resulting from the Stated TP trajectory overshoot the allocated carbon budget under the selected NGFS scenarios by 12%-263%.** This is because the announced carbon intensive BF-BOF crude steel production capacity expansion (9.6 MTPA in 2024 to over 37 MTPA by 2030) of joint venture ArcelorMittal/Nippon Steel India (AM/NS), more than overcompensates the emission reductions from AM’s plans to switch from BF-BOF to H<sub>2</sub>-DRI-EAF bases crude steel production at seven steel plants in Europe and one in South Africa (for which we assumed availability of green hydrogen at scale from 2030).



**Fig. 1 | Decarbonization Pathways and transition performance metrics for electric utility Enel and steel maker ArcelorMittal.** Panel **a** shows absolute CO<sub>2</sub> emission of ArcelorMittal’s BAU and Stated TP trajectories against NGFS scenarios. Panel **b** shows absolute CO<sub>2</sub> emissions of Enel’s BAU and Stated TP trajectories against NGFS scenarios. Panel **c** shows cumulative CO<sub>2</sub> emissions of ArcelorMittal’s BAU and Stated TP trajectories against NGFS scenarios. Panel **d** shows cumulative CO<sub>2</sub> emissions of Enel’s BAU and Stated TP trajectories against NGFS scenarios.

## Findings II: Carbon budget overshoot applied to entire samples of power and steel

**Most of the power and steel companies' transition plans are misaligned on emissions.** When stated TPs are considered, seven steel companies' cumulative emissions are misaligned compared to all pathways (with overshoots of 11%-428%), while three companies' emission trajectories (SSAB, POSCO, and ThyssenKrupp) are aligned with at least the MESSAGEx Net Zero and Below 2°C pathways. Only SSAB's cumulative emissions are also aligned with GCAM Net Zero 2050 and Below 2°C (overshoots of -24% and -34%) as well as REMIND Below 2°C (overshoot of -36%). As for the stated TPs in the power company sample, none of the power companies' cumulative CO<sub>2</sub> emissions are aligned with any of the selected pathways, with overshoots ranging from 14% (Iberdrola under GCAM Below 2°C) to 919% (NTPC under REMIND Net Zero 2050).



**Fig. 2 | Expected carbon budget overshoot for power and steel companies under six NGFS scenarios.** Panel a and b shows the carbon budget overshoot of power and steel companies, respectively, for both Business As Usual (BAU) and stated Transition Plan (TP) trajectories against six NGFS scenarios. The carbon budget overshoot measures by how much a companies' cumulative emissions between 2020-2050 are expected to exceed the carbon budget under the same time frame and is an indicator of the companies' expected alignment with an underlying decarbonization scenario. The shading for values greater than 0 indicates the company is expected to overshoot their 2020-2050 carbon budget.

## Findings III: Required reinvestments before 2030 in fossil fuel production assets

**Power companies are facing the challenge of early retirement of fossil fuel power generation assets.** Among the ten power companies, the share of required reinvestment before 2030 in fossil fuel-based power generating capacity ranges from 2% (Enel) to 32% (Eskom Holdings). For the total power company sample, we estimate that around 12% of fossil fuel generating capacity will require reinvestment before 2030. This means that these power companies face the challenge of retiring early fossil fuel-based plants to switch to renewables as most of the currently operating generation assets will not reach the end of their economic lifetimes anytime soon.

**Steel companies' BF assets are likely to require significant reinvestments before 2030, which results in high carbon lock-in risk.** Among the ten steel companies, the share of required reinvestment before 2030 in BF capacity relative to total BF capacity ranges from 0% (SSAB) to 67.3% (Nippon Steel). For six out of 10 steel producers, over 1/3 of their BF capacity requires relining before 2030. Across all steel companies, we estimate that around 42% of BF capacity requires relining before 2030. This means that there is significant reinvestment required in the next five years if steel companies want to keep current production levels constant. This poses a significant carbon lock-in risk if steel companies chose to reline existing unabated BF capacity instead of switching to less carbon intensive EAF-based production routes.

**There are significant economic incentives for steel companies to prolong lifetimes of existing carbon intensive asset base.** Among six steel companies with larger than 30% share of BF capacity requiring relining before 2030, only two companies (ArcelorMittal and POSCO) disclosed TPs that would lead to a (modest) reduction in estimated cumulative emissions between 2020-2050 (11.4% and 33.8% respectively) if implemented, even though both TPs are not aligned with any of the selected NGFS scenarios. There are strong economic incentives for steel producers to prolong the operation of profitable BF assets for as long as possible because of the high CAPEX required to switch to DRI-EAF steel plants compared to the typical costs of BF relining campaigns.<sup>7</sup> The absence of Paris-aligned TPs will make it even more likely that these companies will reinvest in existing BF assets.

<sup>7</sup> As CAPEX requirements for switching from BF-BOF to DRI-EAF based production tend to be substantially higher than relining existing BF capacity (at 48 EUR/t crude steel capacity for BF relining versus 574 EUR/t crude steel capacity for a greenfield H2-DRI-EAF steel plant; see Vogl. et al., 2018), there are strong economic incentives for these steel producers to prolong the operation of profitable BF assets for as long as possible. The absence of Paris-aligned TPs might make it even more likely that these companies will reinvest in existing carbon intensive assets.

## Implications for stakeholders

- 1. Stakeholders should focus their engagement with companies on preventing (a) reinvestments into existing carbon intensive production technologies and (b) plans to build new fossil fuel-based production assets.** APA focus on the most important issue when it comes to transition planning that is often lost in debates about the best metric or method in the plethora of different frameworks to assess companies' alignment with Paris: phasing out of fossil fuel-based production assets.
  - It is crucial for stakeholders to engage with companies on each operating or planned fossil fuel-based production asset. Required reinvestments are an important window of opportunity to phase out or upgrade carbon intensive production technologies. To assess the order in which production assets in different countries would have to be phased out or upgraded requires a more detailed jurisdiction specific TP assessment which integrates “common but differentiated responsibilities” of countries as per the Paris Agreement.<sup>8</sup>
  - In the absence of such a differentiated jurisdiction-specific assessment, APA assessments should be based on the precautionary principle, which asserts that no reinvestments in any existing fossil fuel production asset be made, either in power or in steel. Corporates should also not plan to build new fossil fuel-based production assets. Each such reinvestment or expansion project would result in carbon lock-in that needs to be prevented. Instead, companies need to plan and implement managed asset phase-outs and low-carbon technology upgrades.
- 2. Stakeholders should use APA to continuously monitor TP implementation and update assessments.** Irrespective of the initial positive TP alignment assessment – e.g., the three steel companies in our sample – stakeholders should continuously monitor the implementation of stated TPs and update the assessment once new, independently verified information about production technology changes (and their likely impact on asset- and company-level CO<sub>2</sub> emissions) is made available. It is crucial that APA-based monitoring is enhanced with more detailed technical assessments of emissions reduction potentials of future technology changes proposed by corporates, particularly with regards to so-called bridge technologies, such as natural gas-based direct reduced iron (DRI) furnaces labelled as hydrogen ready.
- 3. Regulators should make transition planning-related asset-level disclosure mandatory.** Transition plans that do not include detailed information on how companies plan to operate their production assets (i.e., the point sources of CO<sub>2</sub> emissions) in the future to reach climate targets should not be deemed as credible. Regulators should mandate standardized corporate disclosure of forward-looking asset-level information that is vital for credible transition planning, including information on current production technology and proposed technology changes as well as resulting changes in nominal production capacity, expected annual production output, and

<sup>8</sup> It is important to keep in mind that even such a framework could be based on various equity principles which stakeholders from different countries may choose or apply differently, resulting in different orders in which assets would have to be phased out.



absolute GHG emissions at the asset and company levels. Such forward-looking asset-level disclosure should cover the entire scenario time horizon that underpins TPs and corporate climate targets.

**4. Financial Institutions (FIs) should use their leverage over corporates for disclosure and implementation of credible TPs.** FIs provide the capital that most carbon intensive corporates require for transitioning away from fossil fuel-based production activities, which would enable them to make financing conditional on credible TP disclosure and implementation. In case APA highlights corporate misalignment on emissions, FIs should obtain more accurate asset-level information that underpins corporate TPs. FIs should further engage with companies on how to retire early and/or repurpose existing fossil fuel-based production assets. To that end, FIs engagement efforts with portfolio companies must be strategic and consequential<sup>9</sup> to be effective. Further, FIs must not provide financing for reinvestments into fossil fuel-based production assets (e.g., BF assets). Any new project financing must be strictly conditional on Paris-alignment at the asset/project (and not company or portfolio) level.

- It is crucial that FIs do not focus only on emission intensity metrics at the portfolio level to measure the (mis-)alignment of portfolios and prioritize project and asset-related alignment assessments, which may require building up inhouse climate-related expertise. This is not only because emission intensity alignment is a flawed proxy for absolute emission alignment, but also because portfolio-level optimization of financed emissions obscures the threat and realization of carbon lock-in in the real economy, which always takes place at the level of the physical production asset as the point source of actual GHG emissions.
- In this context, it is crucial for all stakeholders to consider the growing threat of companies selling off carbon intensive assets. As long as they can be operated profitably, carbon intensive assets will be sold and acquired by other investors willing to continue operating them. Moving physical production assets from one balance sheet to another does not reduce a single gram of CO<sub>2</sub> emissions, but risks obscuring who owns and controls production assets, and who is to be held accountable for transition planning and execution. The expectation that FIs engaging in less regulated financial activities would acquire fossil fuel-based production assets if traditional financing dries up due to climate considerations should not serve as a convenient excuse for FIs to adopt a hands-off approach when engaging with portfolio companies. Thus, it is imperative for the success of the real economy transition for regulators to restrict ways in which fossil fuel-based production assets are acquired by FIs in private markets.

<sup>9</sup> With “consequential” engagement strategies we mean those that include (1) a clear timeline with specific requirements for how corporate operations should change, (2) deadlines by when certain actions to drive change should be taken, and (crucially) also (3) a credible threat of divestment or withholding of debt financing if requirements are not met.



## What to consider when using APA for engagement with companies

To achieve effective engagement, stakeholders should be aware of the following considerations when applying APA to engage with companies.

**APA shifts the burden of proof onto companies.** Due to the lack of detailed and independently verified company disclosure at the asset level, we may have incorrectly classified companies based on the best (yet incomplete) publicly available information we could find. If companies disagree with assessment outcomes, they are welcome to disclose more detailed, independently verified information on transition planning at the asset and company levels. Regulators should make the disclosure of such information mandatory. Until this happens, APA can help induce change in corporate behaviour by incentivizing companies that deem independent assessments inaccurate to disclose audited, more granular information about their current and planned future production activities, so that stakeholders have a more robust basis of information to conduct TP assessments.

**APA does not assess the likelihood of TP implementation.** For those three out of 20 sample companies for which we classified the direct CO<sub>2</sub> emission trajectories based on stated TPs as aligned, it is important to stress that APA cannot account for the likelihood of TPs being implemented. We made a highly optimistic assumption by taking disclosed TPs at face value to estimate the potential impact that TPs would have on future CO<sub>2</sub> emissions *if* companies were to fully implement them.

**APA relies on standardized yet adjustable assumptions.** It is also important to keep in mind that APA relies on highly stylized assumptions to model reinvestment cycles and estimate CO<sub>2</sub> emissions, including (optimistic) assumptions about the future availability of low-carbon technologies such as green hydrogen. Importantly, the assumptions underpinning APA are easily adjustable, so that the assessment can reflect users' views on the future availability *and* carbon intensity of low-carbon technologies. Other assumptions about past and expected future reinvestments as well as technology-specific EF and plant-specific UR can be used to increase the accuracy of APA.

**APA is scenario-agnostic.** We tested APA on a selected number of NGFS scenario models and our findings demonstrate that the choice of transition scenario *and* IAM can significantly affect the assessment outcomes. This means that it is imperative for IAM modelling groups to clearly communicate to users which key assumptions underpinning scenario model runs drive GHG emission pathways and sectoral carbon budgets. Our methodological approach can incorporate any transition scenario with sector-specific absolute pathways. While this includes absolute CO<sub>2</sub> emission pathways, APA can be adjusted to conduct benchmarking based on production output pathways.



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