ASSESSING THE FINANCIAL IMPACT OF THE LAND USE TRANSITION ON THE FOOD AND AGRICULTURE SECTOR

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UN Climate Change High-Level Champions
in collaboration with:

Marrakech Partnership

Global Climate Action

RACE TO RESILIENCE

RACE TO ZERO

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This report was published by the Race to Zero, the UNFCCC-supported global campaign rallying non-state actors – including companies, cities, regions, financial, educational, and healthcare institutions – to take rigorous and immediate action to halve global emissions by 2030 and deliver a healthier, fairer zero carbon world in time. All members are committed to the same overarching goal: reducing emissions across all scopes swiftly and fairly in line with the Paris Agreement, with transparent action plans and robust near-term targets.

The campaign is led by the High-Level Climate Champions for Climate Action – Nigel Topping and Dr Mahmoud Mohieldin.

With thanks to the UN backed PRI's Inevitable Policy Response's (IPR) Initiative for their analytic support. The IPR Initiative's high-confidence, realistic, policy-based scenario uses in-depth analysis of current policy and technology trends to illustrate a likely future with accelerating policy action and is supported by a strategic advisory group of leading investors including BlackRock, BNP Paribas Asset Management, Fitch Ratings, Nuveen and Goldman Sachs Asset Management.

DISCLAIMER

This research is intended solely to prompt discussion and should in no way be construed as financial advice. The scenarios and forecasts used provide robust reference cases for realistic scenarios, aligned with science, but financial institutions can decide which forecasts and scenarios they use, and actions they take. All results are anonymised and it is not possible to infer any company specific or sensitive data from the results..

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SECTION 1: FOREWORD FROM NIGEL TOPPING AND DR. MAHMOUD MOHIELDIN

Food is at the heart of life, yet today's global food system is beset with unsustainable – and avoidable – practices that render the food sector the single largest contributor to the ecological and climate crises. It is inequitable, carbon-intensive, environmentally damaging, unaffordable, and increasingly vulnerable. We need to move rapidly to a new system that operates within planetary boundaries, can nourish growing populations, and support the livelihoods of those who rely on it. Financial institutions are critical partners in this transformation.

The forest, land and agriculture sectors are the primary drivers of global biodiversity loss and account for over a fifth of global emissions. To have any chance of limiting global warming to 1.5°C and achieving the Sustainable Development Goals by 2030, the food system must be transformed.

The IPCC is clear: there can be no net zero, no 1.5 °C world, without ending deforestation. Time is short: according to expert partners such as the Accountability Framework Initiative, commodity-driven land clearance and deforestation must be halted by 2025.

Indeed: 80% of the climate mitigation opportunity from the land sector in the next decade comes from transforming food systems and avoiding the deforestation connected to them by 2030, while also helping us grow more, better food to provide healthy diets for 2 billion more people[1].

Integral to the successful transformation of the food system is building resilience to buffer against rising shocks from climate change. The climate-induced catastrophe in Pakistan this year highlights the immediacy of the threat and how far the ripple effects from a single event can be felt throughout supply chains: on top of untold human suffering, including displacement of some 33 million people, the flooding destroyed 2 million acres of crops and orchards amounting to an estimated crop loss of around USD$2.3 billion[2], increasing pressure on already fragile global agriculture markets, and further threatening global food security.

1. Conservation International, "Exponential Roadmap for Natural Climate Solutions", 2022, www.conservation.org/roadmap
2. Bloomberg, "Deadly Floods Inundate Farms in Pakistan, Flushing Away Crops", 2022, https://www.bloomberg.com/news/articles/2022-08-31/deadly-floods-inundate-farms-in-pakistan-flushing-away-crops?leadSource=uverify%20wall

Yet despite the dashboard flashing red, when it comes to tackling climate change, public and private sector institutions have been slow to account for the critical significance of necessary food and land use system change within their climate plans.

But that is beginning to change. Businesses and investors are beginning to reckon with the reality that there can be no net zero without reversing nature loss. In Glasgow, 150 countries committed to halt and reverse forest loss and land degradation by 2030, and over 30 financial institutions with nearly USD$9 trillion in assets under management unveiled their Commitment on Eliminating Agricultural Commodity-Driven Deforestation whilst increasing investment in nature-based solutions. In addition, over 100 countries have now joined the High Ambition Coalition for Nature and People, championing a global deal to protect at least 30% of the world's land and ocean by 2030.

Decision-makers are beginning to recognize that a rapid land use transition is coming, which will be just as profound as the energy transition. And that will have significant implications for food and agriculture companies - and the financial institutions that bank and invest in them - that are not currently being accounted for.

Containing first of its kind analysis, this report highlights how the coming land use transition will drive a wedge between financial winners and losers in the sector. The thriving companies and investors of tomorrow will be those who move early to align their business models with, and help accelerate, the land use transition - developing and tapping solutions for a net zero, nature positive, resilient food system that could generate up to USD$4.5 trillion of new business opportunities annually by 2030. Meanwhile, those who fail to act could shortly see billions of dollars of value permanently lost.

Nature and land use have been a major investor blind spot for too long. We hope this research paper is a wake-up call.

Nigel Topping
UN Climate Change
High-level Champion
for COP26

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UN Climate Change
High-level Champion
for COP27

SECTION 2: EXECUTIVE SUMMARY

A rapid land use transition is coming, which will be just as profound as the energy transition.

- Any chance of limiting warming to 1.5 degrees Celsius requires a transformation of the way land is used for food, fibre, and fuel.
- Forest, land, and agriculture industries contribute 22% of global emissions – the second highest emitting sector after energy.
- That's 12 times more than the emissions generated from aviation, and fully half of these emissions comes from deforestation and land conversion for commodities humans rely on.
- Put simply, unless we end net deforestation, achieving net zero and a 1.5 degree world is impossible.
- Policy action to avert climate catastrophe and stem unprecedented loss of the natural world is accelerating rapidly as governments and investors join forces.
- 150 countries have signed the Glasgow Leaders' Declaration on Forests and Land Use to halt and reverse forest loss and land degradation by 2030, and a growing swathe of investors have signed a Commitment on Eliminating Agricultural Commodity-driven Deforestation by 2025 and increasing investment in nature-based solutions. Momentum is accelerating, with profound implications for the food system and the companies at the heart of it.
- Our food system is vulnerable. Climate-linked disasters are increasing in frequency and magnitude, causing USD$108 billion in crop and livestock production losses in developing countries between 2008 and 2018.
- Climate change is fuelling food price inflation and shortages, with food prices 80% higher in April 2022 than in 2020 as supply chain disruption and commodity prices increased. This threatens to undo decades of progress to eradicate hunger and push nearly 10 million additional people into extreme poverty for every 1% increase in food prices.

Transforming today's unsustainable, inequitable, and vulnerable global food system is critical.

- Our food system is vulnerable. Climate-linked disasters are increasing in frequency and magnitude, causing USD$108 billion in crop and livestock production losses in developing countries between 2008 and 2018.

- Climate change is fuelling food price inflation and shortages[3], with food prices 80% higher in April 2022 than in 2020 as supply chain disruption and commodity prices increased. This threatens to undo decades of progress to eradicate hunger and push nearly 10 million additional people into extreme poverty for every 1% increase in food prices.

But nature and land use represent a major blind spot for investors.

- Mainstream climate scenarios used by investors to price risk - such as those developed by the IEA and NGFS - focus on the energy system, overlooking the critical agriculture, forestry, and land use (AFOLU) sectors.

- Deforestation threatens to be the 'new coal' in investors' portfolios, as exposure to companies who drive such continued environmental destruction represent considerable financial, regulatory, and reputational risks. Yet the potential financial impact is accounted for by only a small minority of investors today.

This new first of its kind analysis shines a light on the financial implications of the land use transition.

- To combat this investor blind spot, this analysis presents results of a credible forecast of the accelerating climate and nature transition and the impact it could have on the value of 40 of the world's largest food and agricultural firms worth over USD$2 trillion.

- It builds on the Inevitable Policy Response's (IPR)[4] high-confidence, realistic, policy-based scenario. Commissioned by the UN-backed Principles for Responsible Investment, the 'Forecast Policy Scenario' uses in-depth analysis of current policy and technology trends to illustrate a likely future with accelerating policy action and is supported by a strategic advisory group of leading investors including BlackRock, BNP Paribas Asset Management and Goldman Sachs Asset Management.

3. Earth.org, "Climate Change is Fuelling Global Food Price Inflation and Shortages", 2022, https://earth.org/climate-change-global-food-price-inflation-and-shortages/
4. UN PRI, "The Inevitable Policy Response to climate change", https://www.unpri.org/sustainability-issues/climate-change/inevitable-policy-response

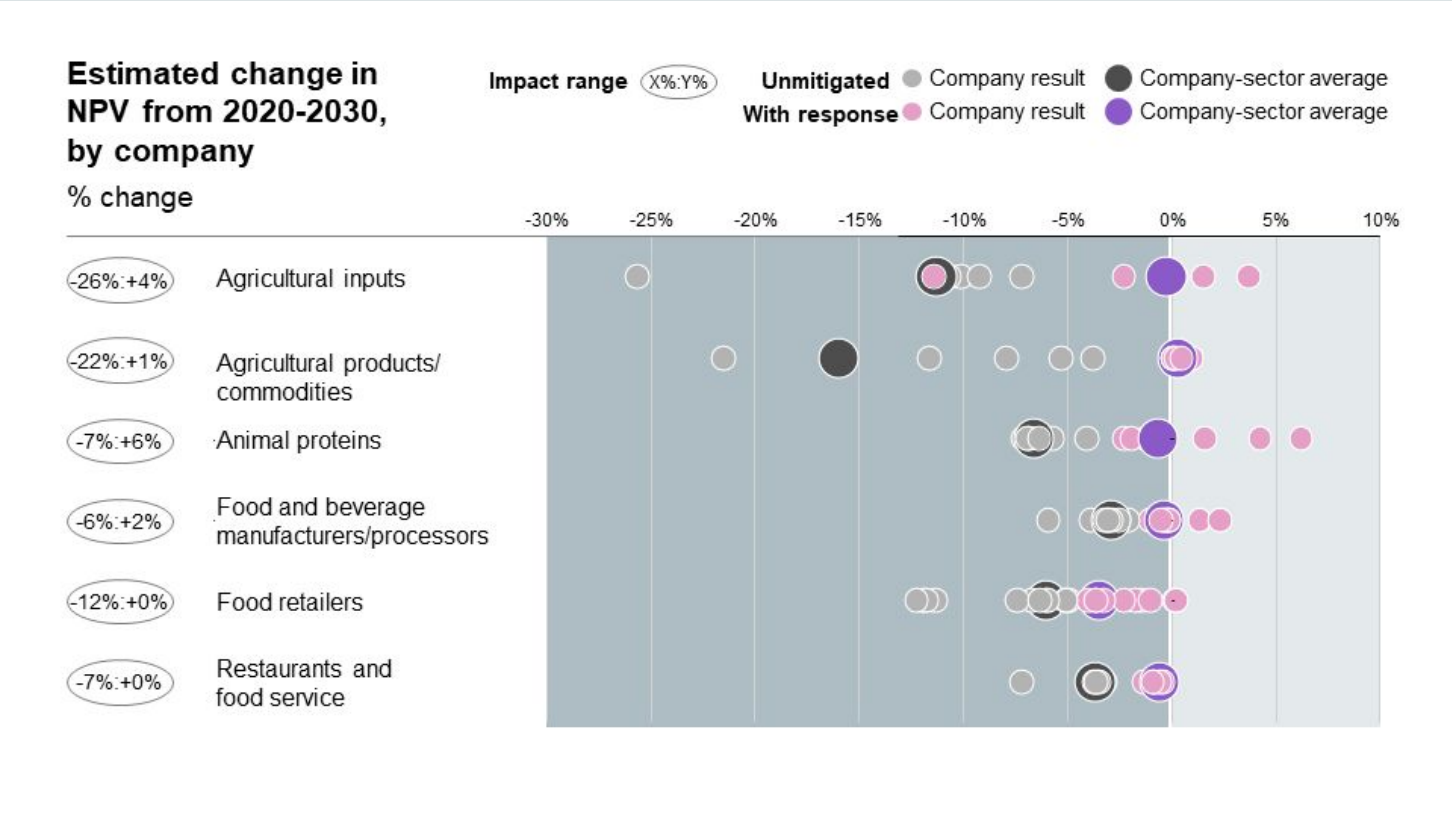
The analysis finds that incoming policy and demand shifts could drive permanent value loss across the critical, but overlooked, food and agriculture sector.

Individual firms at the centre of the global food supply system could lose up to 26% of their value by 2030[5], with a sector average hit of over 7%.

- This is equivalent to USD$150 billion in losses to investors and, unlike one-off cyclical shocks, this will be a permanent, non-cyclical loss if investors and companies do not act now to protect value.

- The lasting impact would be comparable in magnitude to value loss following the 2008 financial crisis, where enduring losses in potential output across 19 OECD countries averaged 5.5%.

The analysis reveals significant variations between winners and losers within the sector, and between companies relative to their positioning on nature and climate.



Source: Race to Zero, drawing on selected data provided by Vivid Economics – NatuRisk model[6]

5. Assessed based on changes in net present value. The figure of 26% represents the largest value impact among the companies analysed
6. This chart has been created by Race to Zero drawing on selected data provided by Vivid Economics (which does not include investment advice). This chart represents Race to Zero's own selection of applicable scenarios selection. Race to Zero is solely responsible for, and this chart represents, such scenario selection, all assumptions underlying such selection, and all resulting findings, and conclusions and decisions. Vivid Economics is not an investment adviser and has not provided any investment advice.

SECTION 3: CALLS TO ACTION

We are seeing leadership from investors, but not nearly enough.

More than 35 leading financial institutions (with USD$8.947 trillion in assets under management), have signed the Financial Sector Commitment on Eliminating Agricultural Commodity-Driven Deforestation and increasing investment in nature-based solutions.

This commitment has a target date of 2025 for ending deforestation in connection with the commodities tied to the lion's share of impact: beef, soy, palm oil, pulp, and paper. The question is: given the risk and opportunity, why haven't all financial institutions that have net zero commitments – with over USD$130 trillion assets under management collectively – made such a commitment?

This new analysis underscores that all investors can take action to protect and enhance value.

UN Climate Change High-Level Climate Champions' call to action to investors and financial institutions:

1. **Eliminate commodity-driven deforestation from their portfolios by 2025**
2. **Understand wider portfolio risks and opportunities arising from the land use transition**
3. **Conduct company engagement to improve practices and drive the shift to deforestation- and conversion-free sourcing (DCF)**
4. **Invest in high-integrity nature-based solutions**
5. **Advocate for just rural transition policies**

UN Climate Change High-Level Climate Champions' call to action to investors and financial institutions:

1 Eliminate commodity-driven deforestation from their portfolios by 2025

- We urge financial institutions to join the 35 leading signatories of the Commitment on Eliminating Agricultural Commodity-Driven Deforestation by committing "to use best efforts to eliminate forest-risk agricultural commodity-driven deforestation activities at the companies in [their] investment portfolios and in [their] financing activities by 2025." Financial institutions that ignore forest loss in their net zero transition plans risk losing credibility.

2 Understand wider portfolio risks and opportunities arising from the land use transition

- In their risk assessments and valuation exercises, investors should employ scenarios that incorporate land use transition to assess relevance to food and agriculture companies in their portfolios, as leading investors are beginning to do. Scenarios include IPR's FPS and RPS, the IPR's FPS + Nature (forthcoming), or the WBCSD's land use scenario (forthcoming).

- Investors should also engage investee companies to understand how they are positioned to seize a significant share of the USD$4.5 trillion worth opportunity from the transition, for instance by supporting and accelerating new markets such as in natural capital and nature based solutions. These include biofertilizers, credit markets and alternative proteins whilst benefiting farmers, indigenous people, and local communities.

3 Conduct company engagement to improve practices and drive the shift to deforestation- and conversion-free sourcing (DCF)

- Companies are best positioned to preserve and create value when they are resilient to a wide range of challenges, from short-term inflation to climate change and nature degradation.

- Investors should partner with companies to progress nature positive outcomes, particularly by expanding deforestation- and conversion-free (DCF) outcomes. This means avoiding conversion of intact natural landscapes.

UN Climate Change High-Level Climate Champions' call to action to investors and financial institutions:

4 Invest in high-integrity nature-based solutions

- Nature-based solutions (NBS) include conservation, restoration, and land-management actions that present cost-effective opportunities for sequestering well over 10GT CO_2e by 2030 and can also promote biodiversity[7].

- McKinsey analysis shows that emissions must be reduced by 50% by 2030 from 2019 levels in order to limit warming to 1.5°C above preindustrial levels, and NBS could help achieve nearly a third of this target. By avoiding deforestation and encouraging reforestation, NBS can also safeguard livelihoods, habitats and species[8].

- Investments in NBS-type carbon credits should follow high-integrity best-practice principles such as the Integrity Council for the Voluntary Carbon Market's (ICVCM) "The Core Carbon Principles and Assessment Framework", due to be released later this year

5 Advocate for just rural transition policies

- To protect value and ensure an orderly land use transition, investors should advocate for just rural transition policies with a focus on protecting local communities and indigenous peoples.

- Accounting for just rural transition principles can ensure that responses to the climate and nature crises are equitable and put people first. These apply at the company level and also at the policy level, where investors can play a role in advocating for decisive policy action from governments. the policy level, where investors can play a role in advocating for decisive policy action from governments.

7. McKinsey, "Why investing in nature is key to climate mitigation", 2021, https://www.mckinsey.com/business-functions/sustainability/our-insights/why-investing-in-nature-is-key-to-climate-mitigation
8. McKinsey, "Why investing in nature is key to climate mitigation", 2021, https://www.mckinsey.com/business-functions/sustainability/our-insights/why-investing-in-nature-is-key-to-climate-mitigation

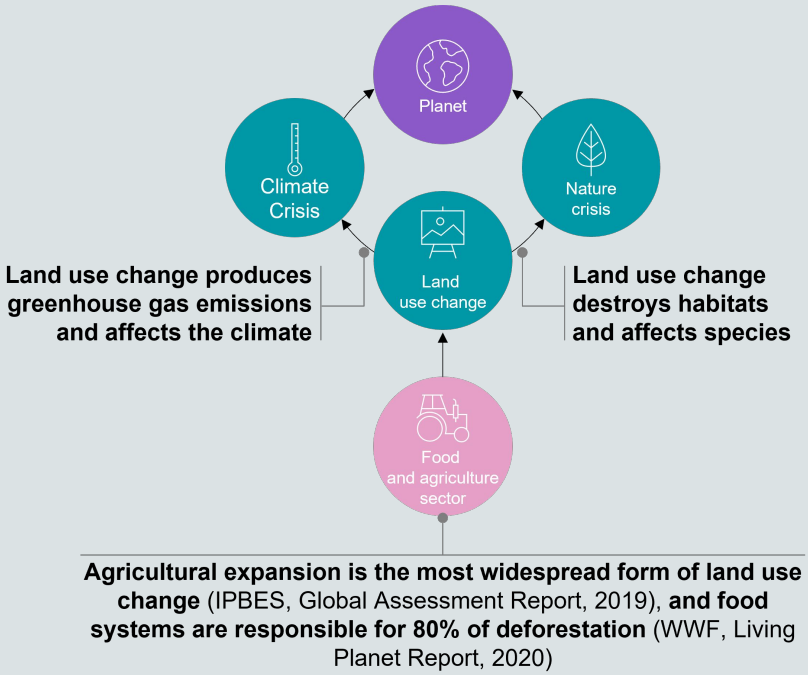
SECTION 4: RESEARCH

I) Introduction: the coming land use transition exposes some blind spots for investors (both equity investors and debt providers) and companies

A land use transition is coming – driven by the need to reduce and reverse carbon emissions and the degradation of nature. Our food and agriculture sector provides the most necessary goods for human survival, feeding us, clothing us, and employing one quarter of the global workforce. Yet the sector is substantially altering the planet's climate and ecosystems. For instance, the sector currently drives 23% of global anthropogenic greenhouse gas emissions[9].

The food system is the primary driver of global biodiversity loss, responsible for three quarters of land use change and threatening 86% of species at risk of extinction[10] and is responsible for the majority of water consumption[11]. Avoiding runaway emissions and more harmful climate change requires the system to be transformed. This could unlock a swathe of climate mitigation potential in the next decade, while bending the curve on further loss of nature and biodiversity.

Figure 1: The food and agriculture sector causes land use change, which is a key driver of the climate and nature crises



Source: Race to Zero[12], drawing on data from IPBES, WWF, Chatham House and IPCC

9. IPCC, "Climate Change, and Land", 2020, https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SPM_Updated-Jan20.pdf
10. Chatham House, "Food system impacts on biodiversity", 2021, https://www.chathamhouse.org/2021/02/food-system-impacts-biodiversity-loss
11. World Bank, "Water in agriculture", https://www.worldbank.org/en/topic/water-in-agriculture
12. Agriculture has other effects on nature other than through land use change that are not captured in this analysis, for example, through pollution and introduction of alien species.

The food and agriculture sector is crucial to delivering against climate goals but is even more fundamental for nature.

- IPCC has shown climate goals like achieving net zero emissions will be undeliverable without a radical transformation in the food and agriculture sector, which contributes more than one fifth of global emissions[13].
- The food and agriculture sector has the potential to play an important role in climate stabilisation, with the global technical mitigation potential of the agricultural sector in 2030 estimated to be 5,500-6,000 Mt CO_2e/yr, relying on supply-side mitigation measures alone[14].
- Limiting and reversing deforestation is a prerequisite for global and sector net zero. Agriculture is responsible for 80% of global deforestation[15], potentially creating policy, legal, reputational, and financial risk for exposed businesses.
- The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has identified five key drivers of biodiversity loss, with land use change having had the largest relative negative impact on nature since 1970[16].
- Since 2020, the World Economic Forum's Global Risks report has ranked biodiversity loss as one of the top five global risks humanity will face in the next 10 years[17].

Policy and investor action is accelerating and is likely to alter profoundly how agriculture and food systems operate, as actors seek to improve resource efficiency whilst averting climate catastrophe and stemming unprecedented loss of the natural world. As highlighted by the Inevitable Policy Response initiative, current and expected policy change combined with changes to investor and consumer behavior are likely to have far reaching effects on agriculture and food systems[18]. 150 countries have signed the Glasgow Leaders' Declaration on Forests and Land Use to halt and reverse forest loss and land degradation by 2030, covering four billion hectares of forest, amounting to 90% of the world's

13. IPCC, "Climate Change 2022: Mitigation of Climate Change", 2022, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Full_Report.pdf
14. OECD, "Potential for mitigation policies in agriculture: Summary insights", https://www.oecd-ilibrary.org/sites/16af156c-en/index.html?itemId=/content/component/16af156c-en
15. WWF, "Living Planet Report", 2020, https://wwfin.awsassets.panda.org/downloads/lpr_2020_full_report.pdf
16. IPBES, "Global Assessment Report on Biodiversity and Ecosystem Services", 2019, https://ipbes.net/global-assessment. Other drivers are direct exploitation of organisms, climate change, pollution, and introduction of invasive non-native species
17. World Economic Forum, "The Global Risks Report 2020", 2020, https://www.weforum.org/reports/the-global-risks-report-2020/
18. Principles for Responsible Investment, "The Inevitable Policy Response to climate change", https://www.unpri.org/sustainability-issues/climate-change/inevitable-policy-response

forest area[19]. More than 35 financial institutions (representing USD$8.947 trillion in assets under management), have signed the Commitment on Eliminating Agricultural Commodity-Driven Deforestation, targeting 2025[20]. The ratcheting-up of carbon pricing across the land use sector is expected and could affect producers that are not able to implement cost-effective mitigation strategies[21]. Countries will also meet in Montreal in December 2022 for the UN Biodiversity Conference to discuss the establishment of a new framework to stop biodiversity loss. The necessary steps to reduce emissions and safeguard nature will transform the way we produce food, as we transition to a model that is more secure, sustainable and resource efficient, delivering economic value and enhancing natural capital.

The transition will affect a fragile sector that lacks resilience and is prone to shocks in many parts of the world. The sector has noticeably been affected by climate-linked disasters in 2022 such as drought in China[22] and the Horn of Africa[23]. These events are occurring with increasing frequency[24], causing USD$108 billion in crop and livestock production losses in developing countries alone between 2008 to 2018[25]. The susceptibility of the sector to shocks is also evident in food prices, with prices in April 2022 80% higher than in 2020, driven largely by supply chain disruption and elevated commodity prices as a result of the war in Ukraine[26]. The accumulation of supply chain disruption and extreme events driven by climate change has shone a spotlight on resilience and food prices globally[27]. This has created business challenges for the world's largest food and agriculture companies that are likely to be exacerbated by the nature and climate transition.

The food and agriculture sector will likely face mounting scrutiny from consumers, governments and investors to demonstrate resilience and an effective response to the coming transition. Policies to halt deforestation and align production with changing consumer preferences will likely shine more light on supply chains, forcing investors to assess risk exposure. For instance, major importing countries, including the EU

19. UK Cop 26, "Glasgow Leaders' Declaration on Forests and Land Use", 2021, https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/
20. Climate Champions, "Tackling Deforestation + Scaling NBS", https://climatechampions.unfccc.int/system/nature-and-tackling-deforestation/
21. World Bank, "State and Trends of Carbon Pricing 2021", 2021, https://openknowledge.worldbank.org/handle/10986/35620
22. The Financial Times, "China drought highlights economic damage wrought by global warming", 2022, https://www.ft.com/content/9420686b-e571-4eeb-99ac-1fef10ce93ca
23. Climate and Migration Coalition, "Unpacking climate change and the Horn of Africa crisis", https://climatemigration.org.uk/climate-change-horn-africa-crisis/
24. Yale Environment 360, "Extreme weather events have increased significantly in the last 20 years", 2020, https://e360.yale.edu/digest/extreme-weather-events-have-increased-significantly-in-the-last-20-years#:~:text=Climate%2Drelated%20disasters%20jumped%2083,droughts%2C%20wildfires%2C%20and%20heatwaves.
25. FAO, "The impact of disasters and crises on agriculture and food security: 2021", 2021, https://catalogue.unccd.int/1688_FAO_cb3673en.pdf
26. World Bank Blogs, "Food prices continued their two-year-long upward trajectory", https://blogs.worldbank.org/opendata/food-prices-continued-their-two-year-long-upward-trajectory
27. McKinsey & Company, "A reflection on global food security challenges amid the war in Ukraine and the early impact of climate change", 2022, https://www.mckinsey.com/industries/agriculture/our-insights/a-reflection-on-global-food-security-challenges-amid-the-war-in-ukraine-and-the-early-impact-of-climate-change

and the UK, have proposed legislation to ban the purchase of deforestation-linked commodities. Yet action on emissions has been slow to materialize, with recent analysis from the High Level Champions and partners showing over 90% of major forest, land and agriculture companies that have committed to net-zero are at risk of missing their climate commitments due to a lack of action on deforestation[28].

Investors face significant challenges in gauging the financial impact of an inevitable and accelerating transition in land use, despite the fact that the transition will be every bit as profound as the energy transition for affected firms. Most of the climate scenarios used by investors to price risk - such as those produced by the International Energy Agency and Network for Greening the Financial System - focus heavily on the energy system, which means market assessments by investors and businesses do not usually account for the agriculture, forestry, and land use (AFOLU) sector. As emphasised in the PRI Inevitable Policy Response scenarios[29] – which have explored the AFOLU sector in greater depth, a climate and nature transition forces investors to confront new types of risk in the near-term. For instance, a compounding set of regulatory, reputational, and financial risks specific to agriculture and food could profoundly alter the dashboard of factors that investors use to price risk. Changing demand for carbon- and nature-intensive products could also erode markets for companies not prepared. Investors are starting to recognise the pivotal role of the land use sector as a source of risk, captured by Blackrock's CEO Larry Fink recently stating that "The one thing I worry about that we don't talk enough about is food... We talk a lot about gasoline prices because that's what affects Americans, but the bigger issue is food." [30]

This first of its kind analysis quantifies the financial impact of the nature and climate transition on the global food and agriculture sector. Until now the compounding effect and far-reaching response to the interdependent and accelerating climate and nature crises has not been adequately estimated financially, nor widely factored into investor risk assessments[31]. The analysis seeks to address this major blind spot for businesses and their investors by incorporating policies and projected trends in consumer demand related to both the climate crisis and the rapidly emerging nature crisis. This study aims to give investors a sense of the losses they might be exposed to as a result of profound changes in global land use (relative to business as usual) driven by policy and consumer trends to

28. Climate Champions, "Why Net Zero Needs Zero Deforestation Now", 2022, https://climatechampions.unfccc.int/wp-content/uploads/2022/06/Why-net-zero-needs-zero-deforestation-now-June-2022.pdf
29. Principles for Responsible Investment, "The Inevitably Policy Response 2021: Forecast Policy Scenario and 1.5C Required Policy Scenario", 2021, https://www.unpri.org/inevitable-policy-response/the-inevitable-policy-response-2021-forecast-policy-scenario-and-15c-required-policy-scenario/8726.article
30. Financial Times, "We should worry about price of food more than petrol, warns BlackRock's Fink", 2022, "https://www.ft.com/content/7dd4c4cc-bb2d-4725-a1de-f95c394bad93"
31. Finance for Biodiversity Initiative, "Towards an Integrated Transition Framework: Managing Risks and Opportunities at the Nature-Climate Nexus", 2022, https://www.f4b-initiative.net/_files/ugd/643e85_4d5933c17dca4a0f92865c96e07ce215.pdf

reduce carbon emissions and reverse nature decline in the food and agriculture sector.

Analysis quantifies the financial impact of the nature and climate transition on the value of 40 of the largest food and agriculture companies, worth USD$2.2 trillion. It estimates, for each company, the financial impact of a set of transition risks compared to a business-as-usual scenario by 2030, a short term, investor-relevant timeframe. These range from the impact of specific policies such as carbon pricing, subsidies for nature-based solutions, due diligence obligations, and bans on deforestation, to the impact of changes in consumer attitudes and technologies. This quantification approach has previously been tested with leading investors and seeks to identify the risks and opportunities from the transition and the role that well prepared companies can play in mitigating potential losses in value to themselves, investors, and the planet.

Financial impacts from the transition could, within a short timeframe, represent a permanent loss of shareholder value. Investors are exposed to sources of risk that act on short-term and long-term time scales. Certain sources of risk, such as financial crises or supply chain shocks driven by pandemics or armed conflict, can be extremely damaging in the short and long-term.

For example, enduring losses in potential output resulting from lower productivity across 19 OECD countries affected by the 2008 financial crisis averaged 5.5%. Losses reached more than 10% in certain countries and persisted even after cyclical recovery from the crisis was achieved[32].

The analysis also quantifies the positive financial impact of proactive company responses to climate- and nature-related transition risks. This includes operational responses, such as finding cost-effective ways to reduce emissions, commercial responses, for example offering more sustainable products, and market responses, like ensuring suppliers source inputs from deforestation-free markets to mitigate regulatory risk.

The analysis further explores a set of opportunities that companies could use to win a share of the annual USD$4.5 trillion market associated with the transition[33]. Significant pools of value are available for companies willing to think innovatively to contribute to society's climate and nature goals, including opportunities in biofertilizers, alternative proteins, carbon credits and sustainable food products.

Beyond its financial impact, sparking change and increasing the resilience of food and agriculture companies can have outsized positive effects on nature and the climate. Key food and

32. OECD, "The effect of the global financial crisis on OECD potential output", 2014, https://www.oecd.org/economy/growth/The-effect-of-the-global-financial-crisis-on-OECD-potential-output-OECD-Journal-Economic-Studies-2014.pdf
33. Food and Land Use Coalition, "Growing Better: Ten Critical Transitions to Transform Food and Land Use", 2019, https://www.foodandlandusecoalition.org/global-report/

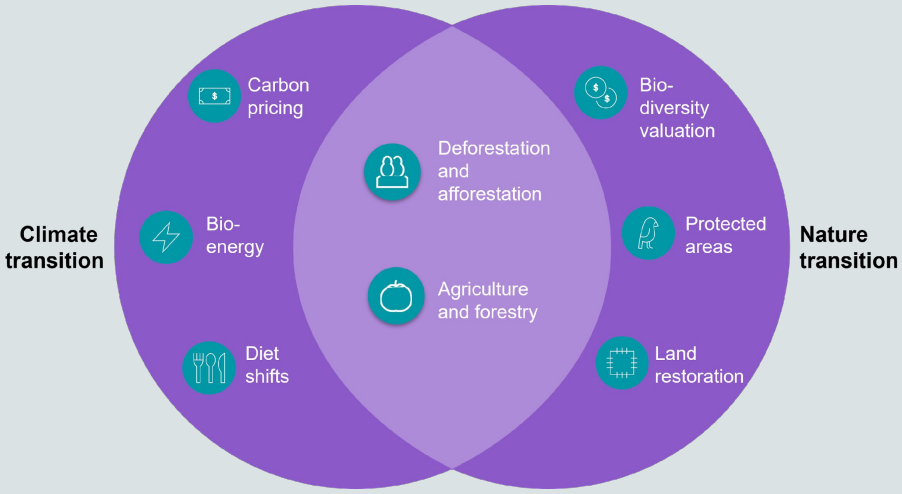
food production to the impact of fossil fuels on climate[34], with the food system threatening 86% of species at risk of extinction[35]. However, only 26 of the world's 350 largest and most influential food and agriculture companies have set Paris-aligned emissions reductions targets[36], and major global food brands have failed to meet public targets to eliminate deforestation in their beef supply chains by 2020[37]. There is a significant opportunity for environmentally-minded investors to have a transformative impact on nature and climate outcomes by driving change in this industry.

II) Modelling approach: estimating the impact of the land use transition on company value

The land use transition will be driven by policy and demand shifts in response to the twin climate and nature crises.

Figure 2 shows the key drivers of change that are distinct and overlapping in addressing the twin crises. For instance, carbon pricing policies, the use of second-generation bioenergy produced with people and nature positive considerations, and diet shifts contribute to meeting climate goals. They are complemented by deforestation and afforestation action along with agriculture and forestry policy, such as a reduction in food waste, which contribute to meeting both climate and nature goals. Additional drivers, such as implementation of biodiversity valuation, increases in protected areas and increases in land restoration represent additional action for nature by safeguarding habitats and species. Drivers will interact to build a more climate- and nature-positive world, creating both risks and opportunities.

Figure 2: The forecast shows a growing suite of interrelated policy responses emerging globally to combat the climate and nature crisis



Source: Race to Zero, based on the forthcoming IPR FPS + Nature scenario

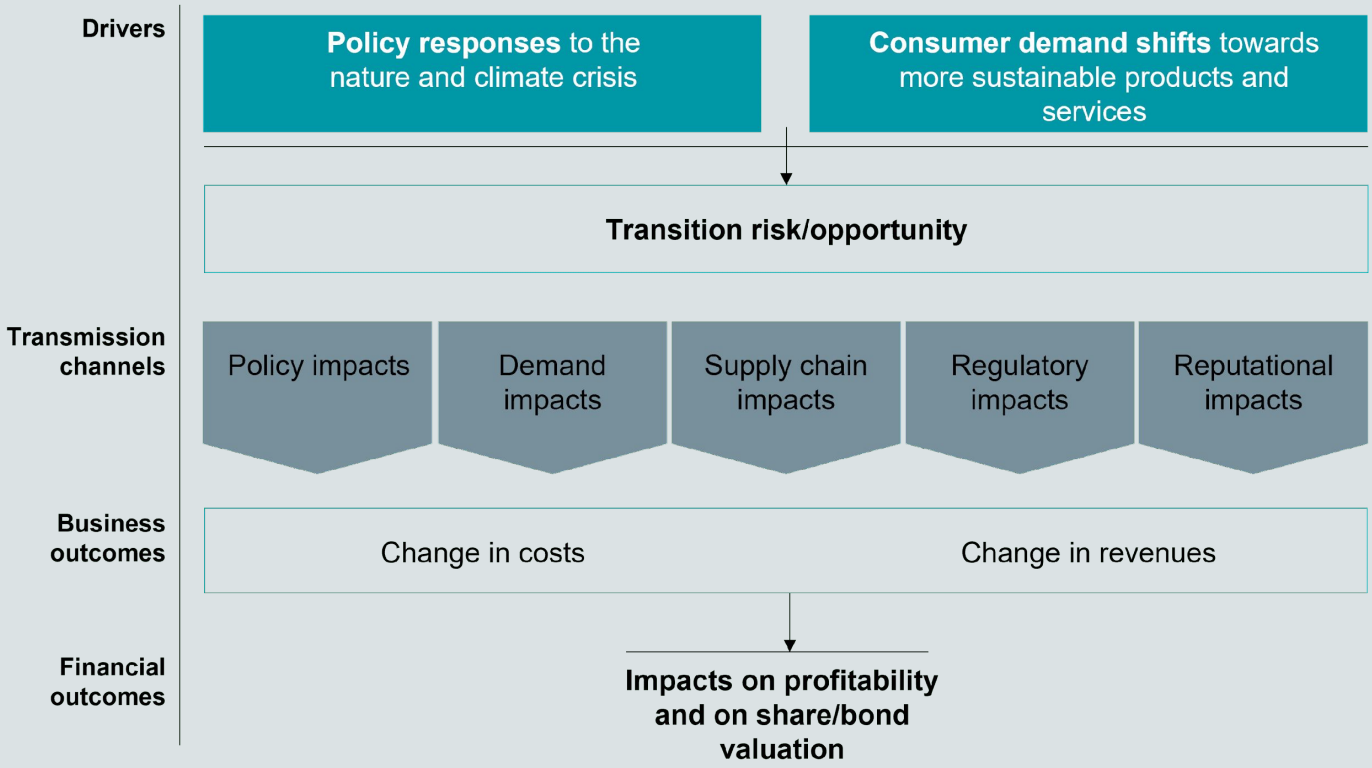
34. WWF, "Bringing It Down To Earth: Nature Risk & Agriculture", 2021, https://wwf.panda.org/wwf_news/?2660466/nature-finance-risk-and-agriculture
35. Chatham House, "Food system impacts on biodiversity", 2021, https://www.chathamhouse.org/2021/02/food-system-impacts-biodiversity-loss
36. World Benchmarking Alliance, "2021 Food and Agriculture Benchmark", 2021, https://www.worldbenchmarkingalliance.org/publication/food-agriculture/
37. World Benchmarking Alliance, "2021 Food and Agriculture Benchmark", 2021, https://www.worldbenchmarkingalliance.org/publication/food-agriculture/

The transition is likely to profoundly impact companies whose products rely on the use of land, creating new risks and opportunities. Companies face impacts that can be split into five categories:

- **Policy impacts:** New or strengthened policies to mitigate climate change and nature loss increase costs for businesses. For example, a carbon pricing policy will directly increase costs for companies that produce emissions and will need to pay for them.
- **Demand impacts:** Consumer responses to climate change and nature loss lead to shifts in demand away from non-sustainable products. For example, consumers will decrease ruminant meat consumption, directly decreasing revenues for companies that produce this product.
- **Supply chain impacts:** Increases in the price of commodities will increase costs for other companies in the value chain. For example, a higher price for wheat will increase costs for food and beverage manufacturing and processing companies that use wheat as an input for their products.
- **Regulatory impacts:** New or strengthened policies to prevent deforestation increase costs for businesses across the supply chain. For example, upstream companies will need to implement deforestation monitoring procedures in light of deforestation regulation. These costs may be passed down the value chain in the form of regulatory risks.
- **Reputational impacts:** Consumer responses lead to shifts away from companies engaging in environmentally unfriendly behaviour. For example, consumers will shift away from companies with deforestation in their supply chains, decreasing company revenue.

Transition risks affect company value through cost- and revenue-related channels, decreasing profits for companies that are not prepared. Figure 3 illustrates this process. Policy and demand shifts create transition risks that can impose additional costs or reduce revenues for companies that are underprepared for the transition. For example, the EU has proposed a ban on the import of products linked to deforestation. A company selling deforestation-linked

Figure 3: Public policy and demand responses create transition risks and opportunities that affect company value



Source: Vivid Economics, based on the NatuRisk modelling framework

products in the EU market faces additional costs via fines for non-compliance, along with negative reputational impacts that can manifest in lower revenues. In contrast, companies that have prepared for the transition and eliminated deforestation from their supply chains are unlikely to experience reduced profits from this particular policy.

Despite the risks created by the transition, companies have considerable scope to act to reduce costs and protect revenues by delivering on society's climate and nature goals. Companies face opportunities that can be split into three categories:

- **Market opportunities**: Companies can actively work with suppliers in key input source countries to ensure that they are deforestation and conversion free (DCF). This will reduce costs associated with regulatory risks and ensure that the entire food and agriculture sector is contributing to climate- and nature-positive outcomes.
- **Operational opportunities:** Companies can optimise their production processes to reduce emissions. This will reduce the cost impact of carbon pricing policies while boosting efficiency and encouraging uptake of carbon mitigation technologies.

- **Commercial opportunities:** Companies can shift lines of business away from environmentally harmful activities to growth areas afforded by the transition. Companies that seize this opportunity capitalize on consumer demand shifts toward sustainable products while also safeguarding their reputation. For example, companies can offer green-branded products, such as certified deforestation-free products, or companies can enter new markets, such as the biofertilizer market or the NBS market.

To understand how material these risks and opportunities are to companies, we conduct a world-first analysis using the following steps:

1. **Developing scenarios and risk drivers –** scenarios forecast a set of likely policy and demand shifts and define their impact on key nature and climate variables, such as protected area expansion, and diet and consumption shifts. The analysis uses an updated version of the Inevitable Policy Response 2021 Forecast Policy Scenario, accounting for the nature transition.
2. **Defining transmission channels –** the framework converts these risk drivers into a set of five transmission channels that impact the revenue and cost of companies – 1) policy impacts, 2) demand impacts, 3) supply-chain impacts, 4) regulatory impacts, 5) reputational impacts.
3. **Estimating company-level impacts –** the model aggregates revenue and cost impacts to the company level, taking into account upstream and downstream exposure. Additionally, the model estimates the financial impact of company risk mitigation strategies, e.g., operational responses to reduce emissions.

The forecast is based on the Inevitable Policy Response Forecast Policy Scenario (FPS), a scenario underpinned by realistic assessments of likely policy developments based on discussions with over 200 global policy experts across countries. The Forecast Policy Scenario provides investors with a unique tool for navigating a complex, evolving policy and regulatory landscape – to enhance portfolio resilience and inform strategic asset allocation.

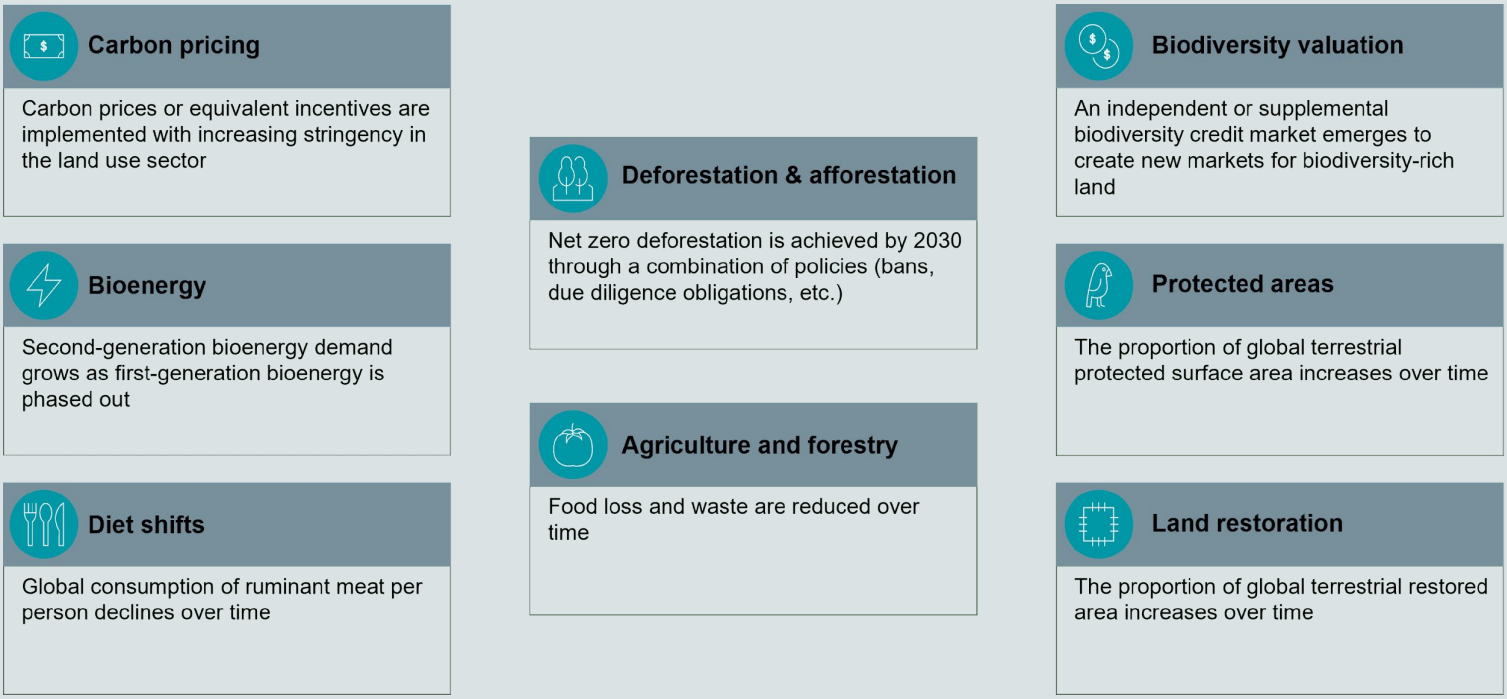
The Forecast Policy Scenario:

- Provides a realistic outline of the coming policy response through the 2020's and quantifies the financial risks that it presents.
- Is based on working forward from the policy and technology developments most likely to emerge, rather than working backwards from pre-defined target temperatures.
- Focused on a timeframe that is relevant to investors.
- Models the interaction between impacts of the macro economy, the energy system and the land use system.
- Provides a granular analysis that breaks down the impact at the regional, sector and – for the first time – asset level.

The forecast has been expanded to additionally account for the nature transition, with policy forecasts covering protected areas, nature restoration and biodiversity valuation. This expanded version of the FPS will be published in November 2022. The forecast is constructed through the following steps:

1. Assessing legislation and consumer trends, including proposed policies and commitments.
2. Conducting regional and country-level research, to identify geographic variation in policy action and consumer trends.
3. Forecasting trajectories, by developing policy forecasts to parametrise key variables for 2030 and 2050. Parameters are calibrated for credibility according to geographic-specific governance quality.

Figure 4: The projection focuses on the impact of policies on value drivers that are most important to food and agriculture companies



Source: Race to Zero, based on the forthcoming IPR FPS + Nature scenario

Modelling is limited to a set of transition risks which likely underestimate the total impact of the climate and nature transition on food and agriculture companies. The analysis focuses on transition risks because their financial magnitude has been less understood. The analysis does not focus on physical and nature dependency risks or drivers of biodiversity loss other than land-use change.

- **Physical and nature dependency risks**: The analysis focuses on relatively near-term transition risks, which are less well understood by investors in the food and agriculture sector compared to near-term physical risks. The increasingly visible and direct nature of physical climate- and nature-related risks, such as droughts and floods, has been a financial focus for food and agriculture companies for more than a decade. Nevertheless, temperatures are expected to increase between 1.5°C and 5°C in most locations by 2050 compared with 2020, with significant effects on crop yields and productivity[38]. Extreme weather events resulting from climate change also have negative effects, disrupting transportation within supply chains and destroying physical assets. Although not the focus of this work, such physical risk impacts on company value may also be insufficiently understood, especially in the medium to longer run.
- **Drivers of biodiversity loss other than land-use change**: In addition to the policies covered by IPR FPS 2021, the analysis focuses on incorporating nature-related policies linked to land use due to available modelling techniques

38. McKinsey & Company, "Climate risk and response: Physical hazards and socioeconomics impacts", 2020, https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts

and data. Additional policies to address the climate and nature crises are likely to be instated in the areas of sea use change, direct exploitation organisms, pollution, and invasive species. Policies related to the aquatic and marine environment, policies protecting specific species, and policies regulating sources of pollution have not been included due to modelling complexity and because company-level data to translate policies into cost and revenue impacts is not available. Although they are not modelled, these policies will likely impose additional costs on companies, influencing company value.

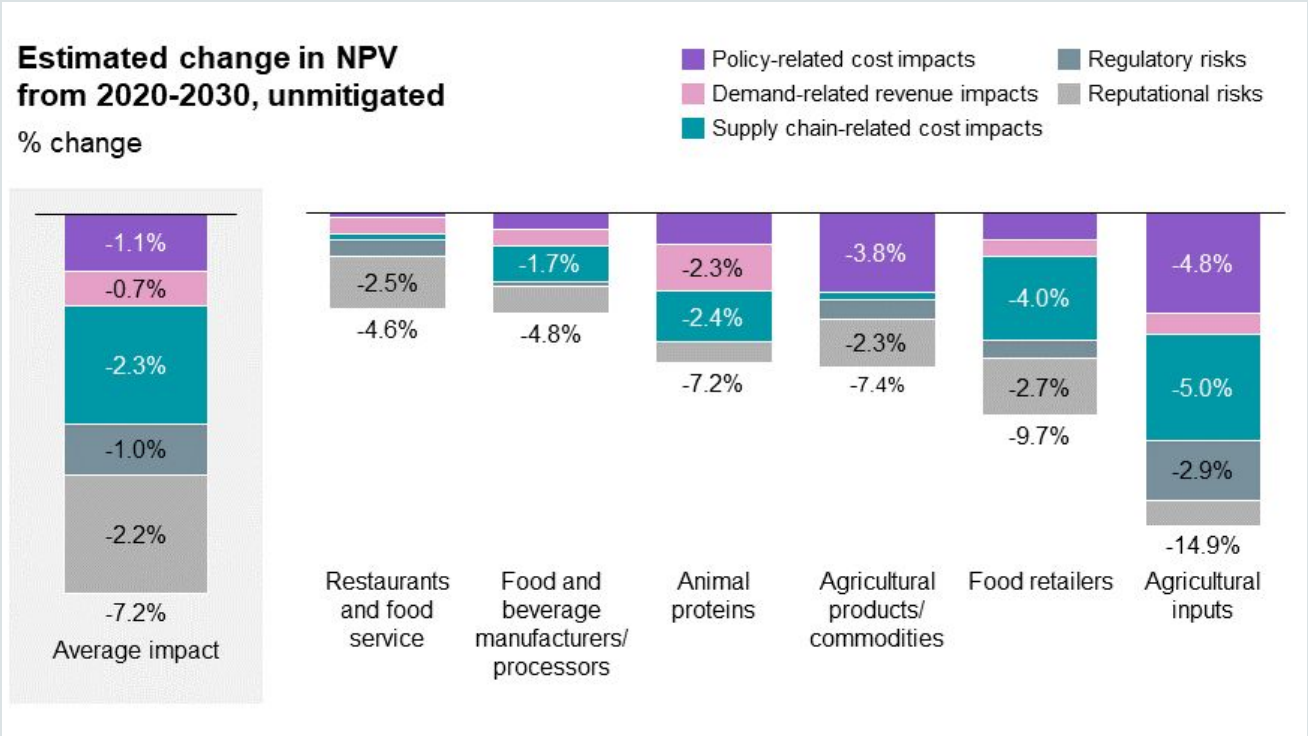
III) Findings: Value at stake

The estimation of potential value at stake covers 40 of the largest and most influential food and agriculture companies, chosen by geography, sector, and data availability. These companies are collectively worth USD$2.2 trillion and employ nearly 8 million people. The companies were selected from the 2021 Food and Agriculture Benchmark's list of 350 influential food and agriculture companies. The Benchmark defines influential companies as those that (1) "dominate global production revenues and volumes within a particular sector," (2) "control globally relevant segments of production," (3) "connect ecosystems globally through subsidiaries," and (4) "influence global governance processes and institutions[39]." The companies selected cover six sectors across the food and agriculture value chain, and only companies with a revenue above USD$3 billion were selected.

If transition risks are unmitigated, individual firms at the centre of the global food supply system could lose up to 26% of their value , with a sector average hit of over 7% compared to a BAU scenario[40] . Transition risks negatively impact companies across the value chain. The average figure masks significant variation across different sectors, ranging from nearly 15% value loss for the agricultural inputs sector to around 4.5% value loss for the Restaurants and food service sector, as seen in Figure 5. They also mask significant variation between companies within sectors, with some seeing losses of up to 26% in their value by 2030, as shown in Figure 7 below.

39. World Benchmarking Alliance, "2021 Food and Agriculture Benchmark", 2021, https://www.worldbenchmarkingalliance.org/publication/food-agriculture/
40. The methodology for estimating financial impacts is detailed in the appendix

Figure 5: Transition risk impacts vary across sectors with over 7% potential value loss by 2030 on average



Source: Race to Zero, drawing on selected data provided by Vivid Economics – NatuRisk model[6]

Upstream sectors such as agricultural inputs are expected to be more affected on average, driven by high exposure to policy-related risks and demand impacts. Agricultural inputs companies see around a 15% value adjustment by 2030, 30% of which is caused by policy risks largely driven by carbon pricing - companies in this sector are relatively emissions intensive. Deforestation regulation and compliance also increases costs, especially in the agricultural products/commodities sector that uses land as a key input. Demand destruction is a significant factor, particularly in the animal proteins sector, where more than 2% of the sector's value is eroded by 2030, contributing more than 30% to the sector's overall value loss. This is driven by consumer preferences shifting away from the consumption of ruminant meat

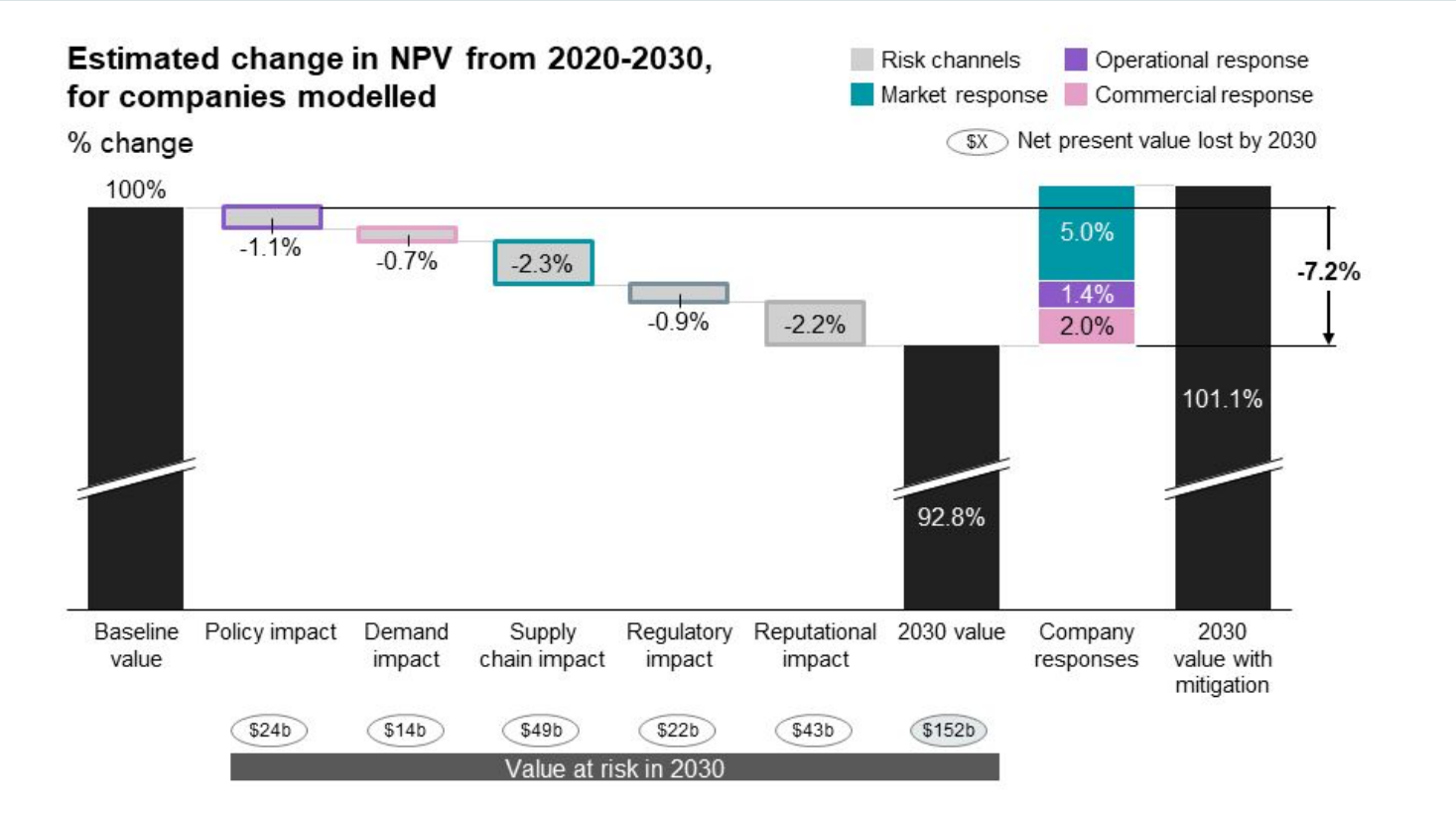
Downstream sectors like food retail tend to see impacts accrue through increased reputational risks because they are consumer facing. The food retail sector loses nearly 10% of its value by 2030, over 25% of which is due to reputational risks, driven by the sector's exposure to markets in high-income countries, where demand for deforestation-free products is emerging[41]. The restaurants and food services sector loses less value, with 4.6% total value loss by 2030, but reputational risks are responsible for an even greater proportion of this, at more than 50%. Reputational risks manifest as consumers signal preferences for sustainable products, such as certified deforestation-free products, through their purchasing decisions. As such, they affect downstream, consumer-facing sectors the most.

41. Greenpeace, "Over 1 million people tell EU to stop funding forest destruction", 2020, https://www.greenpeace.org/eu-unit/issues/nature-food/45406/over-1-million-people-tell-eu-to-stop-funding-forest-destruction/

Supply chain impacts tied to primary commodity prices affect sectors across the value chain and are responsible for one third of overall average value loss. Supply chain impacts are particularly significant in the food and beverage manufacturing/processing sector, where they account for approximately 35% of overall value loss. In the agricultural inputs sector and the animal proteins sector they account for one-third of overall value loss. The magnitude of supply-chain impacts for downstream firms varies according to industry margins and cost structure – they are significant in the food retail sector, where they account for 40% of overall value loss, but the impact is small among restaurants and food service companies, where margins are bigger, and costs are more diversified. Supply chain effects increase costs and are caused by the price of primary commodities being passed up and down the food and agriculture value chain.

Across the food and agriculture sector, proactive action can preserve value. To understand this, modelling incorporates three ways in which companies could preserve value. The first way is through market responses, which relate to sourcing inputs and selling outputs. Companies can work with suppliers in key source countries to ensure that their inputs are deforestation/conversion free (DCF), or they can pass costs further down the value chain when they sell their outputs. The second way to preserve value is through operational responses, which involve increasing efficiency in production processes to reduce carbon emissions and the impacts of carbon pricing policies. The third way to preserve value is through commercial responses, which include offering green-branded products, such as products certified to be deforestation free.

Figure 6: Rapid and effective company responses can mitigate transition risk impacts and preserve value for the sample of food and agriculture companies

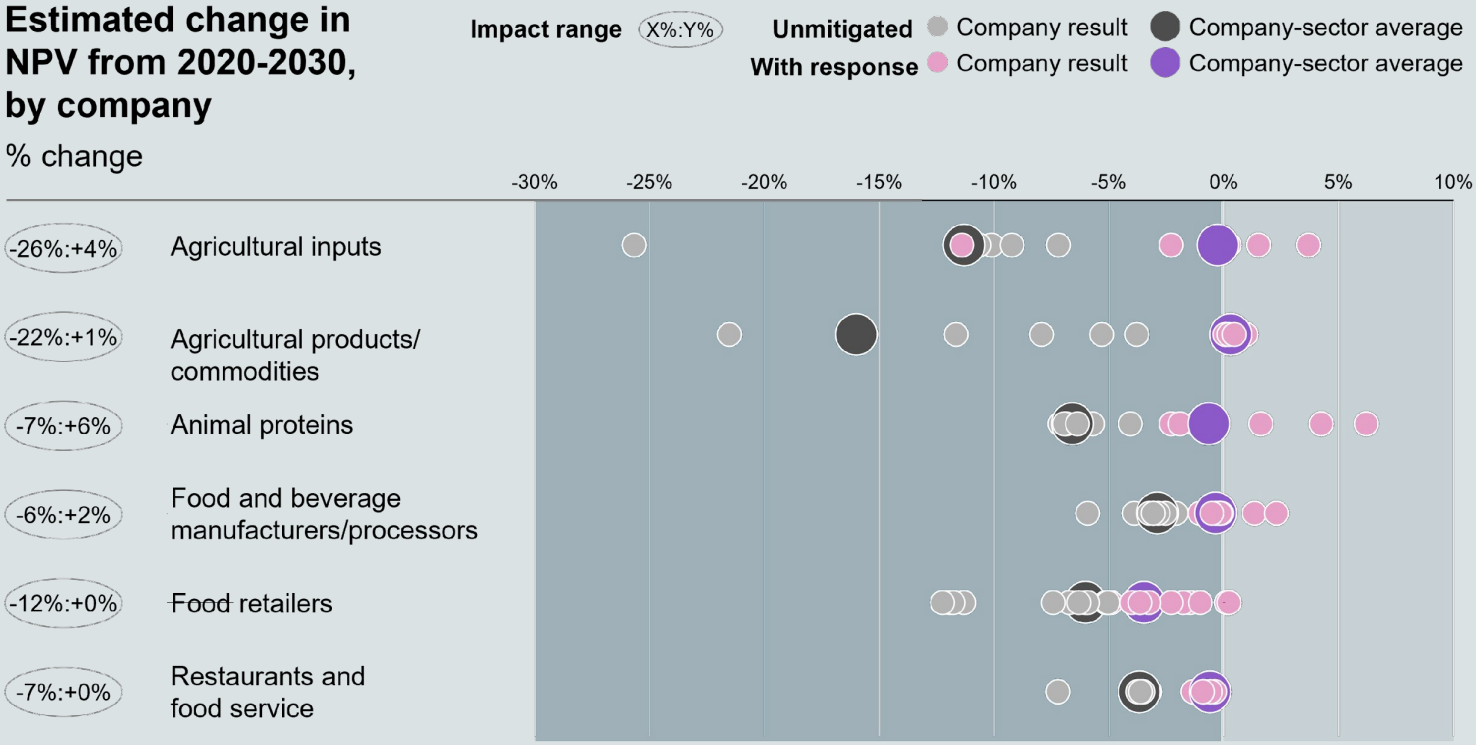


Source: Race to Zero, drawing on selected data provided by Vivid Economics – NatuRisk model[6]

Results reveal that company responses can completely mitigate potential losses by 2030 if early and decisive action is taken. Effective market responses are the most direct and impactful strategy to protect value, contributing 60% of the value gain from company responses. For example, by sourcing deforestation-free inputs, companies mitigate costs caused by regulatory risks, such as deforestation policies that affect input providers in a company's supply chain. In contrast, operational responses preserve a smaller amount of value as carbon costs only make up a minority share of costs on average.

Progressive commercial responses are also less impactful than market responses but can counterbalance reputation-related revenue losses caused by consumers shifting away from companies they do not perceive to be sustainable. These responses are available to companies across the value chain that take early and decisive action.

Figure 7: Company-specific value loss may reach 26% while value gain may reach 6%



Source: Race to Zero, drawing on selected data provided by Vivid Economics – NatuRisk model[6]

Both upstream and downstream companies have strong opportunities to protect value through company responses, potentially resulting in individual company value gain of up to 6% by 2030. Company responses will be the deciding factor in creating winners and losers in the food and agriculture sector as it confronts risks created by the land use transition. The effectiveness of the three modelled company response channels is influenced by a company's position in the value chain.

Upstream companies have strong opportunities to protect value through altering operations and increasing efficiency to avoid increased policy-related carbon costs. These operational responses counteract 5% of total value loss, on average, for individual companies in the agricultural inputs sector and the agricultural products and commodities sector. Upstream companies have a number of low-cost abatement options available to them and tend to be more emissions intensive, therefore facing larger carbon costs, which leads to larger value preservation through emissions abatement.

Downstream companies can preserve value through commercial responses to protect their reputations by offering sustainable and certified products. Companies can offer green-branded products, winning customer support through environmentally friendly products such as products certified to be deforestation free. Over 50% of consumers from Germany, the US, the

UK, and Australia are willing to pay more for environmentally-friendly products[42], so companies may be able to boost revenue (not modelled) in addition to mitigating the revenue-related reputational risk of being labeled as unsustainable.

Downstream companies also face the difficult choice of absorbing increases in costs or passing them on to consumers. Downstream companies face cost increases that are passed down to them from further up the value chain. Their tight margins may make it difficult to absorb these costs, and they will have to choose whether to pass costs on to consumers instead, by increasing the price of their outputs as part of their market response. Such a choice would contribute to food price increases in a time of already high inflation.

Company-level variation in impacts is driven in part by geography, with individual companies experiencing value losses of up to 26% by 2030, in the absence of company responses. Outliers in upstream sectors may see value losses of more than 20%, while company-level value losses in downstream sectors tend to be more tightly clustered. Differences between companies in the same sector reflect geographical variation. For example, regulatory risk associated with emerging deforestation policy will act through supply chains to impact companies that derive revenue from US and EU markets. The proposed US Forest Act will prohibit import of products that have been linked to illegal deforestation, and the EU has also proposed a similar ban with maximum fines of 4% of company turnover. As another example, consumer shifts away from ruminant meat consumption will have less of an effect on animal protein companies that sell their products in regions where ruminant meat consumption grows slightly, in line with strong income and population growth. These company-level differences highlight the need for investors to understand the geographic context of individual companies in their portfolios.

Company-level outcomes pictured in Figure 7 do not adhere to sector-specific averages presented in Figure 4 because companies often derive revenue from more than one sector. For example, a food retailer may also derive revenue from activities in the food and beverage manufacturing/processing sector. This company may experience relatively less value loss than its food retail peers due to this revenue diversification, as the food and beverage manufacturing/processing sector experiences smaller transition risk impacts than the food retail sector, on average. This finding further highlights the need for investors to investigate risks and opportunities at the company level as opposed to uniformly applying sector averages across their portfolios.

42. YouGov, "Global: Consumer willingness to pay for environmentally friendly products", https://yougov.co.uk/topics/consumer/articles-reports/2021/04/29/global-willingness-pay-for-sustainability

Figure 8: The value of new business opportunities in the food & agriculture sector is expected to reach USD$4.5 trillion by 2030

IV) Findings: opportunities for innovation

Opportunity category	Business opportunities in 2030 (USD$ trillion)	Examples of opportunities (not exhaustive)
Healthy diets	2.0	Organic food & beverage, fortified food, product reformulation
Productive and regenerative agriculture	0.53	Technology in large scale and smallholder farms
Diversifying protein supply	0.24	Plant-based meat
Protecting & restoring nature	0.2	Forest restoration
Other	1.5	Reducing food waste in the value chain, internet of things for agriculture
Total	**4.5**	

Source: Food and Land Use Coalition "Growing Better: Ten Critical Transitions to Transform Food and Land Use", 2019

A USD$4.5 trillion pool of opportunities is expected to accompany the coming land use transition, benefitting companies who align with the transition early. Existing research by the Food and Land Use Coalition shows that by 2030, the size of opportunities in the food and agriculture sector are expected to total USD$4.5 trillion annually[43]. As shown in figure 7, this reflects growth in four key revenue areas. In particular, significant market opportunities of USD$2.5 trillion and USD$0.5 trillion will be created as diets change and as regenerative agricultural practices scale. Companies well positioned to benefit from the transition can capitalize on these opportunities by acting early.

Our research has identified four revenue opportunities that companies could take advantage of based on expected growth areas. To estimate financial impacts, we carried out a market potential assessment based on four steps:

1. Determine a commercial opportunity across different parts of the food and agricultural value chain
2. Conduct supplemental research to determine a credible market size and revenue potential for each opportunity
3. Apply this research to a specific company whose characteristics are similar to the companies studied
4. Estimate potential increase in revenue for a company from moving into the identified market. This exercise is designed to be indicative of additional revenue associated with entering new, growing markets.

43. Food and Land Use Coalition, "Growing Better: Ten Critical Transitions to Transform Food and Land Use", 2019, https://www.foodandlandusecoalition.org/global-report//

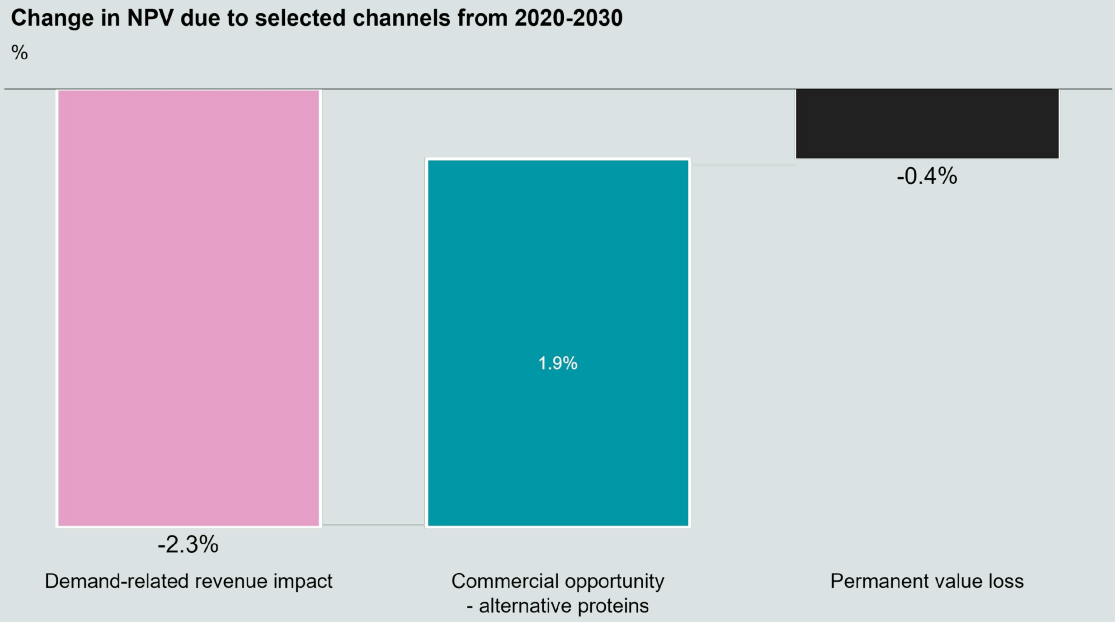
The research identified four leading opportunities with the following potential impacts for companies adopting these business models:

***Biofertiliser*. An established agricultural input company could generate USD$4.5 billion in additional revenue in 2030 by entering new markets.** The biofertiliser and organic fertiliser market represents a new market opportunity expected to be worth a total USD$45 billion in 2030. If an agricultural input company could establish a 10% market share in biofertilizer and organic fertiliser market, this would lead to an additional USD$4.5 billion in revenue. Companies producing conventional fertilisers could leverage their competitive advantage in production to capture a proportion of this new market if they move quickly.

***Alternative proteins*. Animal proteins companies can offset over 80% of demand-related impacts, on average, through revenue diversification.** Modelled change in company value due to entering the alternative proteins market is on average 1.9%[44], compared with a loss in value of -2.3% due to demand destruction from reductions in meat demand. This occurs as a result of consumers shifting away from animal proteins and towards more environmentally friendly food sources. Companies that shift a large proportion of their production towards alternative proteins will likely experience larger benefits.

44. We use a conservative assumption that investment in the alternative proteins market would be equivalent to savings in production cost from reduced demand for animal proteins. A time lag is used so companies do not earn revenue from the alternative proteins immediately after investment.

Figure 9: Entering the alternative proteins market leads to an average value increase of 1.9%



Source: Race to Zero, drawing on selected data provided by Vivid Economics – NatuRisk model[6]

***Nature-based solutions (NBS).* A midstream company could gain an additional USD$2.6 billion in revenue by entering the NBS credit market as a producer and seller.**. The size of the voluntary carbon market is expected to grow to USD$50 billion in 2030, up from USD$1 billion in 2020. After having reduced emissions by 90% in line with Science Based Targets initiative net zero guidance[45], a company could produce NBS equivalent to base year emissions, offsetting its remaining 10% of emissions with NBS and then selling carbon credits equivalent to 90% of base year emissions to generate revenue. This would lead to additional revenue of USD$2.6 billion for a company with emissions of 40m tonnes CO_2e, selling carbon credits equivalent to 90% of base year emissions at a forecasted carbon price in developed economies of USD$74 /t$CO_2e$ in 2030, as per IPR FPS.

***Sustainable food products.* As an example, a downstream company could increase revenue by USD$3.5 billion by capturing 2% of the sustainable food products market in 2030.** The sustainable food products market is expected to grow at over 5% p.a, reaching USD$171 billion by 2030[46]. A food retailer could start a new subsidiary, opening stores selling solely sustainable food stores to appeal to 'green' consumers. For a representative company with USD$50 billion in revenue, capturing 2% of this market would lead to a 7% increase in revenue by 2030. Companies operating in this market are likely to see higher profits, since profit margins are typically larger for health and sustainable food products.

45. SBTI, "SBTI Corporate Net-Zero Standard Version 1.0", 2021, https://sciencebasedtargets.org/resources/files/Net-Zero-Standard.pdf
46. Data Bridge Market Research, "Global Environment Friendly and Sustainable Food Market – Industry Trends and Forecast to 2028", https://www.databridgemarketresearch.com/reports/global-environment-friendly-and-sustainable-food-market

UN Climate Change High-Level Climate Champions' call to action to investors and financial institutions:

1 Eliminate commodity-driven deforestation from portfolios by 2025

Deforestation is a key driver of both the climate and nature crises. Forests absorb one third of the CO_2 released from burning fossil fuels every year[47] and are home to 80% of the world's biodiversity[48].

At the same time, deforestation related to key agricultural commodities, including palm oil, soy, and beef, accounts for 11% of CO_2 emissions. Eliminating commodity-driven deforestation is an imperative for reaching net zero.

Financial institutions should join the 35 leading signatories of the Commitment on Eliminating Agricultural Commodity-Driven Deforestation. Signatories "commit to use best efforts to eliminate forest-risk agricultural commodity-driven deforestation activities at the companies in [their] investment portfolios and in [their] financing activities by 2025." Signatories further commit to assessing exposure to deforestation risk by the end of 2022 and later reporting risk and mitigation activities[49]. The Commitment remains open for sign-on by additional financial institutions[50].

2 Understand wider portfolio risks and opportunities arising from the land use transition

Land use transition-related risks have been a blind spot for investors. This report aims to help close that knowledge gap by highlighting the potential for these risks to erode up to 26% of a food and agriculture company's value.

In their risk assessments and valuation exercises, investors should employ scenarios that incorporate land use transition to assess relevance to food and agriculture companies in their portfolios. Scenarios include IPR's FPS and RPS, the IPR's FPS + Nature (forthcoming), or the WBCSD's land use scenario (forthcoming).

Leading investors are already piloting these approaches to protect and enhance value.

Leading companies can seize significant opportunities from the transition by supporting and accelerating new markets, for instance by supporting and accelerating new markets such as in natural capital and nature based solutions. These include biofertilizers, credit markets and alternative proteins whilst benefiting farmers, indigenous people, and local communities.

47. Science Daily, "Forests absorb one third of fossil fuel emissions, study finds", 2011, https://www.sciencedaily.com/releases/2011/08/110810093835.htm#:~:text=Summary%3A%2D%2D%20according%20to%20new%20research.
48. FAO, "Global Forest Resources Assessment", 2020, https://www.fao.org/3/ca9825en/ca9825en.pdf
49. Race to Zero, "Financial Sector Commitment Letter on Eliminating Agricultural Commodity-driven Deforestation", 2021, https://racetozero.unfccc.int/wp-content/uploads/2021/11/DFF-Commitment-Letter-.pdf
50. Race to Zero, "Deforestation Commitment Letter", https://www.tfaforms.com/4934254

3 Conduct company engagements to improve practices and drive the shift to deforestation- and conversion-free sourcing (DCF)

Companies are best positioned to preserve and create value when they are resilient to a wide range of challenges, from short-term inflation to climate change and nature degradation.

Investors can partner with companies to progress nature positive outcomes, particularly by expanding deforestation- and conversion-free (DCF) outcomes. This means avoiding conversion of intact natural landscapes.

Stewardship and engagement are key to eliminate practices incompatible with the transition to a net zero, nature positive system. Divesting from underperforming companies will not contribute to creating a sustainable future and preserving economic value. Engaging with companies and ensuring they are pursuing necessary approaches to generate and protect long-term value is crucial.

Engagement can follow the Principle for Responsible Investment's (PRI) Active Ownership 2.0, a proposed standard for improved stewardship, which the PRI's 5,000+ signatories can choose to adhere to.

4 Invest in high-integrity nature-based solutions

The transition to a nature-positive economy presents significant opportunities for investors to help deliver on society's climate and nature goals and generate returns on investment.

The Food and Land Use Coalition's Growing Better report finds that transformations in the food and land use sector could result in USD$4.5 trillion per year in new business opportunities by 2030.

- For example, nature-based solutions (NBS) include conservation, restoration, and land-management actions that present cost-effective opportunities for sequestering well over 10GT CO_2e by 2030 and can also improve nature outcomes[51].
- McKinsey analysis shows that emissions must be reduced by 50% by 2030 from 2019 levels in order to limit warming to 1.5°C above preindustrial levels, and NBS could help achieve nearly a third of this target. By avoiding deforestation and encouraging reforestation, NBS can also safeguard livelihoods, habitats and species[52].
- Investments in NBS-type carbon credits should follow high-integrity best-practice principles such as the Integrity Council for the Voluntary Carbon Market's (ICVCM) "The Core Carbon Principles and Assessment Framework", due to be released later this year

51. McKinsey, "Why investing in nature is key to climate mitigation", 2021, https://www.mckinsey.com/business-functions/sustainability/our-insights/why-investing-in-nature-is-key-to-climate-mitigation
52. McKinsey, "Why investing in nature is key to climate mitigation", 2021, https://www.mckinsey.com/business-functions/sustainability/our-insights/why-investing-in-nature-is-key-to-climate-mitigation

5 Advocate for just land use transition policies

To protect value and ensure an orderly land use transition, investors should advocate for just rural transition policies with a focus on protecting local communities and indigenous peoples.

Accounting for just rural transition principles can ensure that responses to the climate and nature crises are equitable and put people first. These apply at the company level and also at the policy level, where investors can play a role in advocating for decisive policy action from governments.

Policies that involve knowledge building, re-training programs, fair prices for farmers in the food chain, new market development, targeted supplementary transition aid, and fairness among consumers can help support a just rural transition[53], [54].

Across the world, 65% of the poorest adults work in agriculture, a sector that accounts for up to 25% of GDP in some of the least-developed countries[55].

The transition can also account for indigenous people. Indigenous and tribal territories contain 14% of the carbon stored in the world's tropical forests, and the FAO has found that deforestation rates are reduced by up to 60% in areas where indigenous and tribal land rights are formally recognised[56].

53. Institute for European Environmental Policy, "Just transition in the EU agriculture and land use sector", 2021, https://ieep.eu/uploads/articles/attachments/8d472ed3-cc73-428c-b9cd-da67e1e229c2/Just%20transition%20in%20the%20EU%20agriculture%20land%20use%20sector%20-%20IEEP%20(2022).pdf?v=63809716825
54. Grantham Research Institute on Climate Change and the Environment and the Centre for "Just Nature: How finance can support a just transition at the interface of action on climate and biodiversity, 2022, https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/08/Just_Nature_How_finance_can_support_a_just_transition_at_the_interface_of_action_on_climate_and_biodiversity.pdf
55. The World Bank, "Agriculture and Food", 2022, https://www.worldbank.org/en/topic/agriculture/overview
56. Food and Agriculture Organization of the United Nations, "Inclusive and Sustainable Territories and Landscapes Platform", 2021, https://www.fao.org/in-action/territorios-inteligentes/noticias/detalle/en/c/1392821/

ANNEX: METHODOLOGY

Disclaimer

This report has been created by the Race to Zero drawing on selected data provided by Vivid Economics (which does not include investment advice). This report represents Race to Zero's own selection of applicable data. Race to Zero is solely responsible for, and this report represents, such scenario selection, all assumptions underlying such selection, and all resulting findings, and conclusions and decisions. Vivid Economics is not an investment adviser and has not provided any investment advice.

Overview of the modelling approach

Changes in net present value (NPV) for 40 sample companies are modelled by quantifying how profits change under a climate and nature scenario (i.e. FPS + Nature), compared to a business-as-usual scenario. The modelling is composed of three components: 1) developing scenarios and risk drivers, 2) defining transmission channels, and 3) estimating company-level impacts.

Developing scenarios

We use the 2021 IPR Forecast Policy Scenario (IPR FPS), expanded to account for nature-related policies, to define plausible outcomes for key nature and land use variables. The baseline scenario against which financial impacts are compared is a business-as-usual scenario. The scenarios define risk drivers including protected area expansion, deforestation, carbon prices, diet & consumption shifts, land use change, crop productivity, and biodiversity intactness index.

The FPS + Nature forecast focuses on the impact of policies on value drivers that are most important to food & agriculture companies. The most important of these are:

- **Carbon pricing –** carbon prices reach around 75 USD/tCO_2 in leading countries in the land use sector by 2030. This reflects global ambition to reduce emissions in order to meet climate goals, which will require emissions pricing in the land use sector.

- **Bioenergy –** second-generation bioenergy demand grows through to 2030 as first-generation bioenergy is phased out. Second-generation bioenergy demand is expected to emerge as an important fuel source in the energy sector due to a shift away from fossil fuels.

- **Diet shifts –** global consumption of ruminant meat per person falls by around 10% as consumers decide to eat less meat because of concerns about sustainability and as climate and nature policy increase the price of emissions- and land-intensive meat.

- **Deforestation and afforestation** – net deforestation ends by 2030. Developed countries will introduce legislation preventing the sale of products related to deforestation e.g., the Proposed US Forest Act. This will be accompanied by more stringent controls on deforestation in developing countries with high levels of deforestation e.g., Brazil, Indonesia.

- **Agriculture and forestry –** global food waste and loss falls from around 26% today to 20% in 2030. This reflects a scaling of policy ambition, particularly in developed countries, to meet international targets, such as UN SDG 12.3, which targets a halving of per capita global food waste at the regional and consumer levels by 2030[57]. Policies are likely to be focused on changing consumer habits e.g., the UK will roll out separate household food waste collection across the country by 2023, taking advantage of consumer interest in sustainability.

- **New markets for biodiversity rich land –** an independent or supplemental biodiversity credit market emerges by 2030, at USD$5,500/ha. This will be driven by increasing corporate interest in financing biodiversity enhancement in response to consumer concerns about sustainability.

- **Protected areas –** over 25% of global terrestrial area is protected by 2030. Governments in developed countries and some developing countries are expected to commit to protecting 30% of the world's land and sea by 2030 at COP15, introducing legislation to meet targets.

- **Land restoration –** the proportion of global terrestrial restored area, including forest land, agricultural land and peatland, is expected to increase from close to <1% today to around 5% in 2030. This reflects substantial global ambition and emerging restoration policy e.g., The EU Commission has proposed a nature restoration law with binding restoration targets.

57. UN, "Food loss and waste", https://sdg12hub.org/sdg-12-hub/see-progress-on-sdg-12-by-target/123-food-loss-waste

Defining transmission channels

Transmission channels allow us to identify how risk drivers impact the cost and revenue of individual companies. We include five transmission channels:

1. **Policy-related cost impacts** – the impact on a company's costs associated with taxes on scope 1 and scope 2 emissions and deforestation policy.
   - Direct carbon costs – estimated using data on:
     a. Greenhouse gas emissions for the six Kyoto gases, available at the company level, using data derived from FactSet
     b. Carbon prices, based on the IPR FPS 2021 carbon prices
   - Deforestation policy costs – deforestation costs are modelled at the country level using three steps:
     a. Crop-specific deforestation from land use change and intensification is determined based on estimates of forest land cover change from MAgPIE and the amount of land covered by specific commodities from CLUMondo
     b. Deforestation levels are assigned to countries based on their sectoral and geographic profiles
     c. A country and crop specific policy cost is applied
2. **Demand-related revenue impacts** – the impact on a company's revenue associated with changes in demand, based on demand trajectories defined at the sub-sector and country level. Demand trajectories are estimated through land-use modelling and available data. There are two types of demand impacts:
     d. Demand destruction – a subsector experiences a decline in demand relative to the business-as-usual baseline. In FPS + Nature, this occurs in sectors associated with environmentally harmful products e.g., animal proteins production
     e. Demand creation – a subsector experiences an increase in demand relative to the baseline. In our climate and nature scenario, this occurs in sectors offering sustainable alternatives to emissions intensive or environmentally harmful production practices e.g., alternative proteins
3. **Supply-chain related cost impacts** – the impact on a company's costs of changes in raw material costs, based on modelled changes in demand for and costs of raw materials

4. **Regulatory risk impacts** – the impact on a company's costs of fines incurred due to having deforestation in its supply chain. This modelling applies to companies that derive revenue from the EU, UK, and US, where regulation banning the sale of deforestation-linked commodities and products is emerging.
5. **Reputational risk impacts** – the impact on a company's revenue of consumers in high-income countries switching to alternative products due to a company having deforestation in its supply chain. This is based on estimates of the share of consumers in developing companies that would avoid a company's product if it was known to be linked to deforestation.

Estimating company-level impacts

Impacts across a company's sub-sectors and production regions are aggregated to the company-level to calculate changes in profit using Vivid Economics' NatuRisk model. Changes in NPV are calculated using discounted cash flow modelling. Results are weighted by revenue when aggregated to the level of the full sample. Total changes in value account for both the transmission channels listed above as well as strategic responses available to food & agriculture companies. These strategic responses are:

1. **Market responses** – companies can respond to cost and demand changes by altering the way they source and sell. Companies can actively work with suppliers in key input source countries to ensure that they are deforestation/conversion free (DCF), pass costs down the value chain, alter their production volumes or exit (or re-enter) the market. A company's ability to pass-through costs depends on the competitive landscape in the sub-sectors in which they operate.
2. **Operational responses -** companies can optimise their production processes to reduce emissions. This can reduce the cost impact of carbon pricing policies while boosting efficiency and encouraging uptake of carbon mitigation technologies. Emissions abatement is based on sector-specific marginal abatement cost curves (MACCs). A company will implement any abatement option that is below the carbon cost in a given region for a given year.
3. **Commercial responses –** companies can shift lines of business away from environmentally-harmful activities to growth areas afforded by the transition. This analysis models the impact of companies certifying production or procurement of 'green certified' e.g., deforestation-free commodities, in order to avoid reputational risk.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