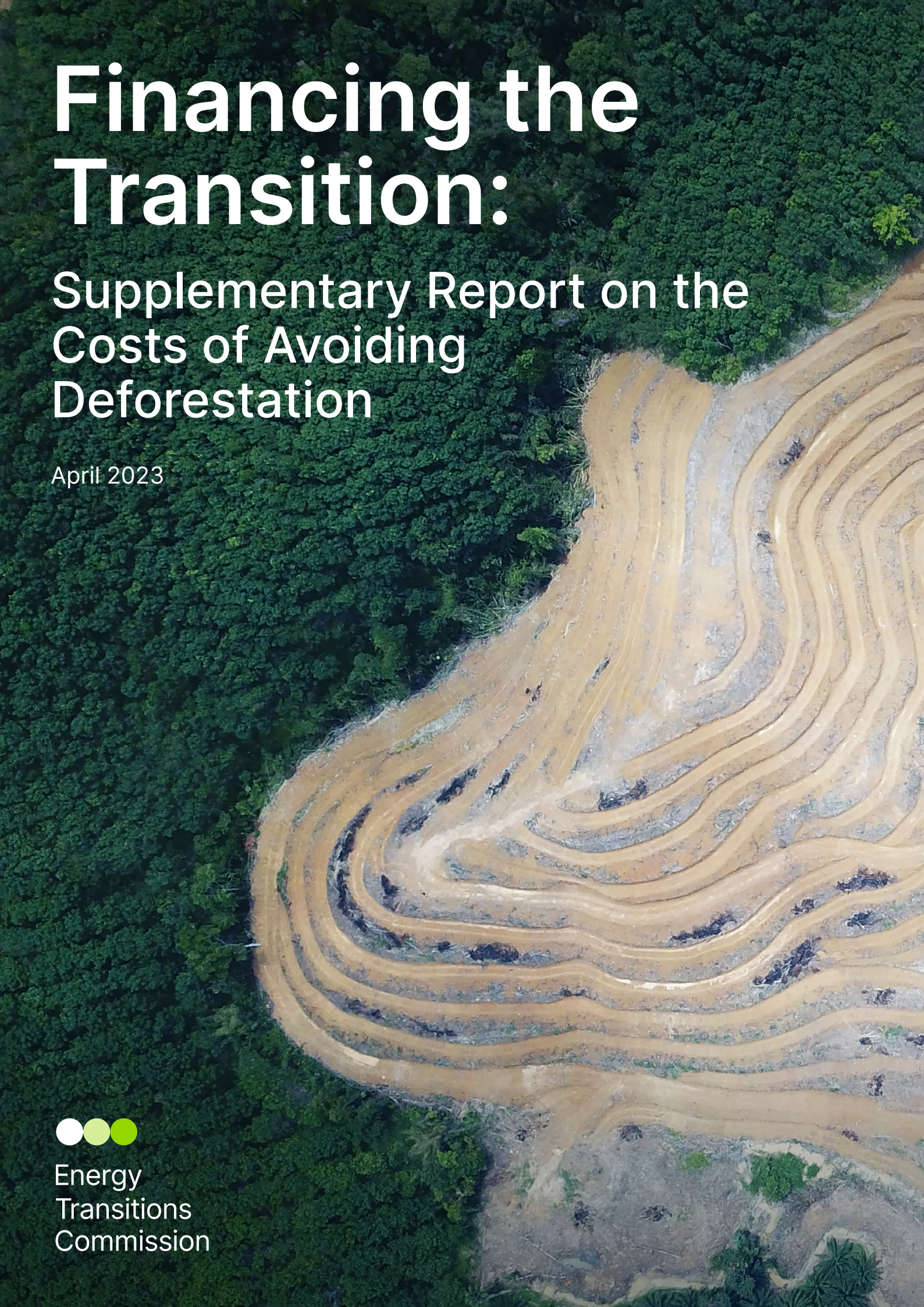
Financing the Transition:

Supplementary Report on the Costs of Avoiding Deforestation

April 2023



Energy Transitions Commission

Financing the Transition:

How to Make the Money Flow for a Net-Zero Economy

The Energy Transitions Commission (ETC) is a global coalition of leaders from across the energy landscape committed to achieving net-zero emissions by mid-century, in line with the Paris climate objective of limiting global warming to well below 2°C and ideally to 1.5°C.

Our Commissioners come from a range of organisations – energy producers, energy-intensive industries, technology providers, finance players and environmental NGOs – which operate across developed and developing countries and play different roles in the energy transition. This diversity of viewpoints informs our work: our analyses are developed with a systems perspective through extensive exchanges with experts and practitioners. The ETC is chaired by Lord Adair Turner who works with the ETC team, led by Faustine Delasalle (Vice-Chair), Ita Kettleborough (Director), and Mike Hemsley (Deputy Director).

The team that developed this report includes:
Lord Adair Turner (Chair), Faustine Delasalle (Vice-Chair), Ita Kettleborough (Director), Mike Hemsley (Deputy Director), Hannah Audino (Lead author) and Carolien van Marwijk Kooy, with support from Alex Andreoli, Laurene Aubert, Leonardo Buizza, Felipe Faria, Philip Lake, Elizabeth Lam, Hugo Liabeuf, Christian Lohmüller, Natasha Mawdsely, Tommaso Mazzanti, Elinor Newman-Beckett, Shane O'Connor, Alessandro Passaro, Viktoriia Petriv, Elizabeth Petykowski, Lloyd Pinnell, Elena Pravettoni, Caroline Randle, Morten Rosse, and Talia Smith (SYSTEMIQ), Kobad Bhavnagri (BloombergNEF), Gert-Jan Naaburs (Wageningen University and Research), and Brent Sohngen (Ohio State University).

This report accompanies the ETC's *Financing the Transition* report which outlines the investment and international financial flows required for the transition to a net-zero economy. The *Financing the Transition* report:

- Sets out the ETC's detailed estimates of investment need by sector and country income group.
- Seeks to define the relative importance of real economy policies and specific financial sector action in mobilising finance, and how this differs between high-income and middle- and low-income economies.
- Analyses the concessional/grant payments required to pay for decarbonisation actions which will not occur fast enough without payments to economic actors to phase out exiting coal plants earlier than is economic, end deforestation, and remove carbon dioxide from the atmosphere.

This report deep dives on the ETC's analysis of the costs of ending deforestation by 2030, which is summarised in *Financing the Transition*.

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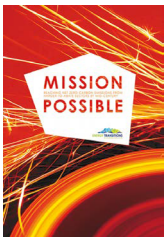
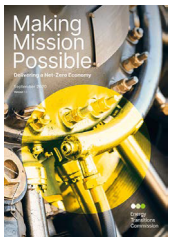
Major ETC reports and working papers

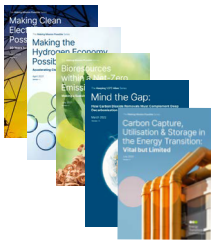
Global Reports



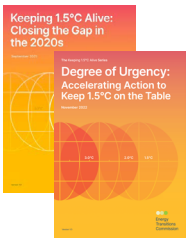
Mission Possible (2018) outlines path-ways to reach net-zero emissions from the harder-to-abate sectors in heavy industry (cement, steel, plastics) and heavy- duty transport (trucking, shipping, aviation).



Making Mission Possible (2020) shows that a net-zero global economy is technically and economically possible by mid-century and will require a profound transformation of the global energy system.



Making Mission Possible Series (2021-2022) outlines how to scale up clean energy provision to achieve a net-zero emissions economy by mid-century.



Keeping 1.5°C Alive Series (2021-2022) COP special reports outlining actions and agreements required in the 2020s to keep 1.5°C within reach.

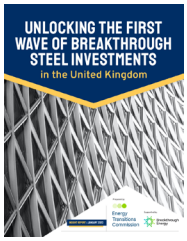
Barriers to Clean Electrification Series (2022-2023) recom-mends actions for stakeholders to overcome key obstacles to clean electrification scale-up, starting with streamlining planning and permitting.

Sectoral and cross-sectoral reports

These reports, which were published as a follow-up to the **Mission Possible** report (2018), provide detailed analysis of six of the harder-to-abate sectors.

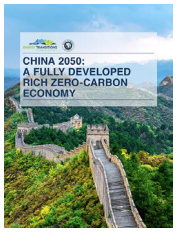
As a core partner of the MPP, the ETC also completes analysis to support a range of sectorial decarbonisation initiatives.

MPP Sector Transition Strategies (2022): a series of reports that aim to guide the decarbonisation of seven of the hardest-to-abate sectors. Of these, four are from the materials industries: aluminium, chemicals, concrete, and steel, and three are from the mobility and transport sectors – aviation, shipping, and trucking.



Unlocking the First Wave of Breakthrough Steel Investments (2023): looks at how to scale up near-zero emissions primary (ore-based) steelmaking this decade within specific regional contexts: the UK, Southern Europe, France and USA.

Regional Reports



China 2050: A Fully Developed Rich Zero-Carbon Economy (2019) describes the possible evolution of China's energy demand sector by sector, analysing energy sources, technologies and policy interventions required to reach net-zero carbon emissions by 2050.

Canada's Electrification Advantage in the Race to Net-Zero (2022) identifies 5 catalysts that can serve as a starting point for a national electrification strategy led by Canada's premieres at the province level. This report is accompanied by 4 sector briefs covering energy, buildings, industry and transport.

A series of reports on the Indian power system and outlining decarbonisation roadmaps for Indian industry (2019-2022) describe how India could rapidly expand electricity supply without building more coal-fired power stations, and how India can industrialise whilst decarbonising heavy industry sectors such as steel.

Setting up Industrial Regions for Net-Zero (2022) and **Pathways to Industrial Decarbonisation** (2023) present industry backed pathways to net-zero emissions for five critical industrial supply chains in the Australian economy and identify the decarbonisation opportunities of key industrial regions.

Contents

Introduction

The ETC's *Financing the Transition* report assesses the scale of the investment required to build a net-zero global economy and to limit global warming to 1.5°C. It makes a distinction between two conceptually different categories of financial flow:

- **Capital investment in the technologies and assets** required to create a zero-carbon economy. In some cases, these investments will not occur without changes in policy which reduce risks and the cost of capital, but in principle, these investments deliver a positive return to investors and lenders. Around $3.5trn per year is likely to be required on average to 2050.

- **Concessional/grant payments to pay for decarbonisation actions** which will not occur fast enough without payments to economic actors to compensate them for lost profit opportunity and/or to pay for an action which delivers no profit. The three most important such actions are phasing down coal generation earlier than is economic, ending deforestation, and removing carbon dioxide from the atmosphere. Up to $300bn per year could be required to 2030.

This report accompanies the *Financing the Transition* report and explores the role that concessional/grant payments can play in halting tropical deforestation by 2030.

Many reports have estimated the cost per tonne of CO_2 saved which might be entailed in achieving an end to deforestation.[1] But few have attempted to estimate what it would cost to put a total end to deforestation. This report presents a high-level analysis of the order of magnitude of these costs and illustrates that the reasonable range of those estimates massively exceeds financial commitments made so far to help halt deforestation.

Halting deforestation could, in principle, be achieved without concessional/grant payments via some combination of:

- A reduction in consumer demand for the main products which make deforestation profitable (in particular, animal meat and palm oil).

- The development of alternative businesses which can profit from standing forests (e.g., eco-tourism and various forms of sustainable agroforestry).

- Government actions to make deforestation illegal, if combined with effective enforcement.

However, these levers will either take time to develop (e.g., consumer demand change), provide only a partial solution (e.g., new business opportunities), or are unlikely to be wholly effective in the short term (e.g., making deforestation illegal due to challenges scaling up effective policing). Stopping deforestation by 2030 will therefore require significant concessional/grant payments, even if in the long term the other levers can and must deliver a more permanent solution.

In this supplementary report, we therefore present a range of estimates for how large concessional/grant payments would need to be if they were the only lever deployed to reduce deforestation. We use two different methodologies:

- One focuses on estimates of what might need to be spent each year to prevent deforestation in specific locations and draws upon an IPCC estimated cost curve for the rising cost per tonne of preventing a rising annual amount of deforestation. Interpretation of this cost curve suggests that out of the current 5 $GtCO_2e$ per annum of emissions produced via deforestation,[2] the first 2.3 $GtCO_2e$ a year might be eliminated at a cost of around $30bn per annum, but that eliminating 4 $GtCO_2e$ a year might cost over $130bn per annum while eliminating the final 1 $GtCO_2e$ per annum might cost at least another $100bn per annum. Without action on the three alternative levers mentioned above, these payments might be needed in perpetuity.

- The other focuses on what might be needed to put a complete and (close to) permanent stop to deforestation by 2030, via payments which would secure all of the so-called "forest frontier" against deforestation, and which, as a result, might keep the forest interior safe from deforestation pressures. Here the estimated range stretches from $130bn to $900bn per annum between now and 2030, but with the possibility of a greatly reduced financial requirement thereafter.

1 See ETC (2022), *Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive*; ETC (2021), *Keeping 1.5°C Alive: Closing the Gap in the 2020s*. See also IPCC (2018), *Special Report: Global Warming of 1.5°C*.

2 Including the loss and degradation of peatlands, coastal wetlands and grasslands.

Even the lower ends of these ranges are massively higher than the flows of finance currently available to help end deforestation. Domestic and international mitigation finance for forests currently averages around $2.3bn a year.[3]

Meanwhile, the upper ends of the ranges are so high that it is simply not credible to assume that concessional/grant payments on this scale will ever be forthcoming. Without action on the other three levers mentioned above, there will be no end to deforestation.

But without a significant flow of concessional/grant payments, any reduction in deforestation will come too late to make it possible to limit global warming to well below 2°C, let alone to 1.5°C. Indeed, deforestation shows no signs of slowing; 3.2m hectares a year of primary forest have been lost from non-fire related causes since 2018 (equivalent to a rate of ten football pitches lost a minute), which compares to an annual average of 2.8m hectares this century.[4]

The estimates presented in this report are higher than other estimates of how much finance is needed for forests.[5] This partly reflects different analytical questions (i.e., this report is concerned with how much would it cost to end deforestation by paying land owners not to deforest, compared to analysing the cost of implementing forest-based solutions), but also the cost of inaction over the past decade. As deforestation continues and pressures continue to increase, finance remains limited, and the timeline to end deforestation by 2030 shortens, the cost of protecting forests will increase.

In the main *Financing the Transition* report, we therefore illustrate a combination of finance sources which might deliver $130bn per annum of concessional/grant payments between now and 2030 to help end deforestation. This amount of finance could make an important contribution to avoiding deforestation. Given this would not be sufficient to cover the entire opportunity cost in forest at risk of deforestation, it raises the question of what share of the $130bn should be used as concessional/grant payments, and how much should support the delivery of the suite of other actions required to end deforestation (e.g., monitoring and the development of sustainable business models).

3 Forest Declaration Assessment (2022), *Are we on track for 2030?*
4 WRI (2021), *Forest Pulse: The Latest on the World's Forests.*
5 Other estimates from the literature of the cost of forest-based solutions, including protecting biodiversity and forest management are typically around $300-400bn a year. See a literature by Credit Suisse, WWF and McKinsey in *Conservation Finance: Moving beyond donor funding toward an investor-driven approach* (2014).

Chapter 1

Importance of ending deforestation by 2030

1.1 Importance of forests

The world's forests provide vital services. They are the world's second-largest store of carbon (after oceans), provide clean water, purify the air, protect against erosion and flooding, ensure biodiversity by providing a habitat to more than half of the world's land-based species, provide livelihoods for millions of people, and provide a home to 70 million indigenous people.[6]

Halting deforestation is critical because when forests are cut down, carbon is released from the trees and soil and the sequestration potential is lost. There is no IPCC pathway to limit global warming to 1.5°C without immediate action taken to halt deforestation.[7]

Current levels of net carbon dioxide emissions resulting from the land-use, land-use change, and forestry (LULUCF) are estimated to be around 5 $GtCO_2$ per annum.[8] But the total potential to mitigate climate change is greater than 5 $GtCO_2$ per year since the net figure reflects a combination of:[9]

- Gross emissions of 16 $GtCO_2$ per year, resulting from human activities on land, including deforestation and forest degradation.
- Gross carbon removals into the land sink are equal to around 11 $GtCO_2$ per year, resulting from human activities to reforest and afforest land which sequesters carbon dioxide.

In addition, the natural land sink removes a further (net) ~13 $GtCO_2$ per year through processes not related to human activity. This results from the combined effects of fertilization (the effect of CO_2 on plant photosynthesis) by rising atmospheric CO_2 and nitrogen inputs on plant growth, as well as the effects of climate change such as the lengthening of the growing season in northern temperate and boreal areas.

The combined removal of emissions resulting from human activity (11 $GtCO_2$ per year) and from natural processes (13 $GtCO_2$ per year) by the land sink means that, every year, nature removes around half of the ~50$GtCO_2$ per year of anthropogenic emissions.[10]

Climate change is also increasing the risk of forest fires and tree mortality due to drought. In addition, there are significant concerns about potential tipping points; as forests recycle water through trees to generate rainfall, increasing tree mortality further reduces rainfall and can lead to less vegetation in a shrinking cycle.[11] This not only has implications for further climate change but also threatens global food and water security.[12] This increases the impetus to protect forests from deforestation.

1.2 Drivers of deforestation

Exhibit 1 illustrates the drivers of global forest loss, which differ by region:

- In the tropical forests of Latin America and South-East Asia, the primary driver is the permanent conversion of forest (i.e. deforestation) to produce agricultural commodities for global consumption.
- While in the tropical forests of West Africa, commodity-driven deforestation is currently small, with deforestation instead primarily driven by "shifting agriculture" associated with many different forms of smallholder farming.
- In the temperate zone of the US, Europe and Russia, the primary drivers are wildfires or commercial forestry, which involves managed logging (e.g., for paper and timber). In these regions, forest loss is often temporary, where wildfires and forestry are associated with subsequent regrowth.[13]

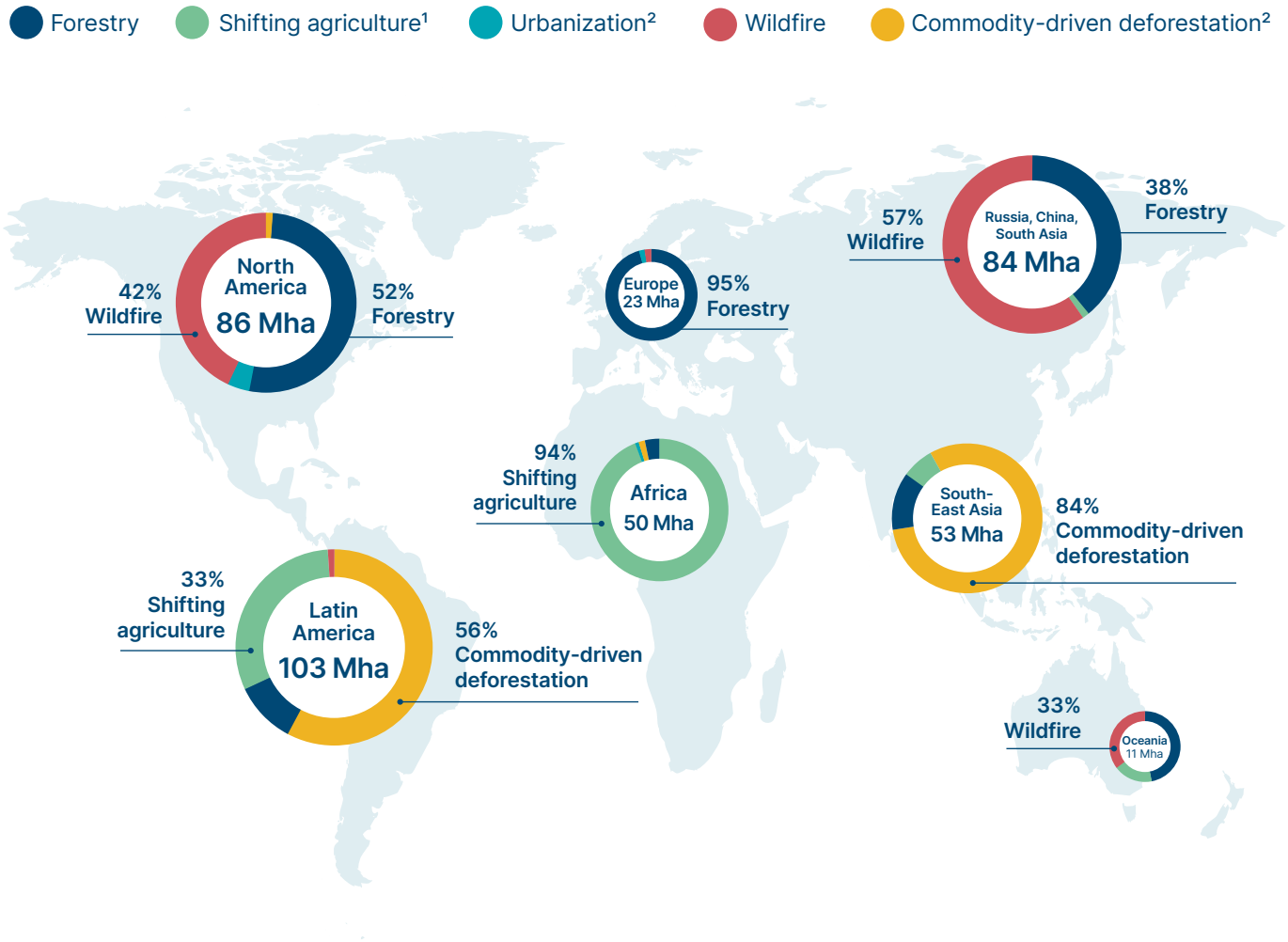
This report focuses on how to end deforestation in tropical forest areas caused either by commodities or by shifts in agricultural production, which together account for over 90% of all deforestation in middle- or low-income countries.

6 WWF (2020), *Why Forests are so Important.*
7 Food and Land Use Coalition (2022), *Assessing the G7's International Deforestation Footprint and Measures to Tackle it.*
8 This estimate does not include non-CO_2 emissions.
9 Food and Land Use Coalition (2021), *Why Nature? Why Now?*
10 For more detail see Food and Land Use Coalition (2021), *Why Nature? Why Now?*
11 Amigo, I. (2020), *The Amazon's Fragile Future. Nature. Vol. 578. 27 February.*
12 WRI (2022), *Not Just Carbon: Capturing all of the Benefits of Forests for Stabilising the Climate from Local to Global Scales.*
13 Curtis et al. (2018), *Classifying drivers of global forest loss.*

Exhibit 1

Deforestation drivers in the tropics relate mostly to agriculture, whereas boreal and temperate regions experience more tree loss from forestry and wildfire

Drivers of tree cover loss by region (2001-2020)



[1] Shifting agriculture is defined as forest degradation and clearing for agriculture before often being temporarily abandoned again. Associated with many different types of smallholder farming practices.
[2] These practices result in permanent tree cover loss. Commodity-driven deforestation refers to the clearance of forest for the purposes of creating commercial agriculture and timber plantations (e.g. farming of soy, palm oil and cattle).

SOURCE: Adapted from WRI (2020) and Curtis et al., (2018); ETC (2022), *Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive.*

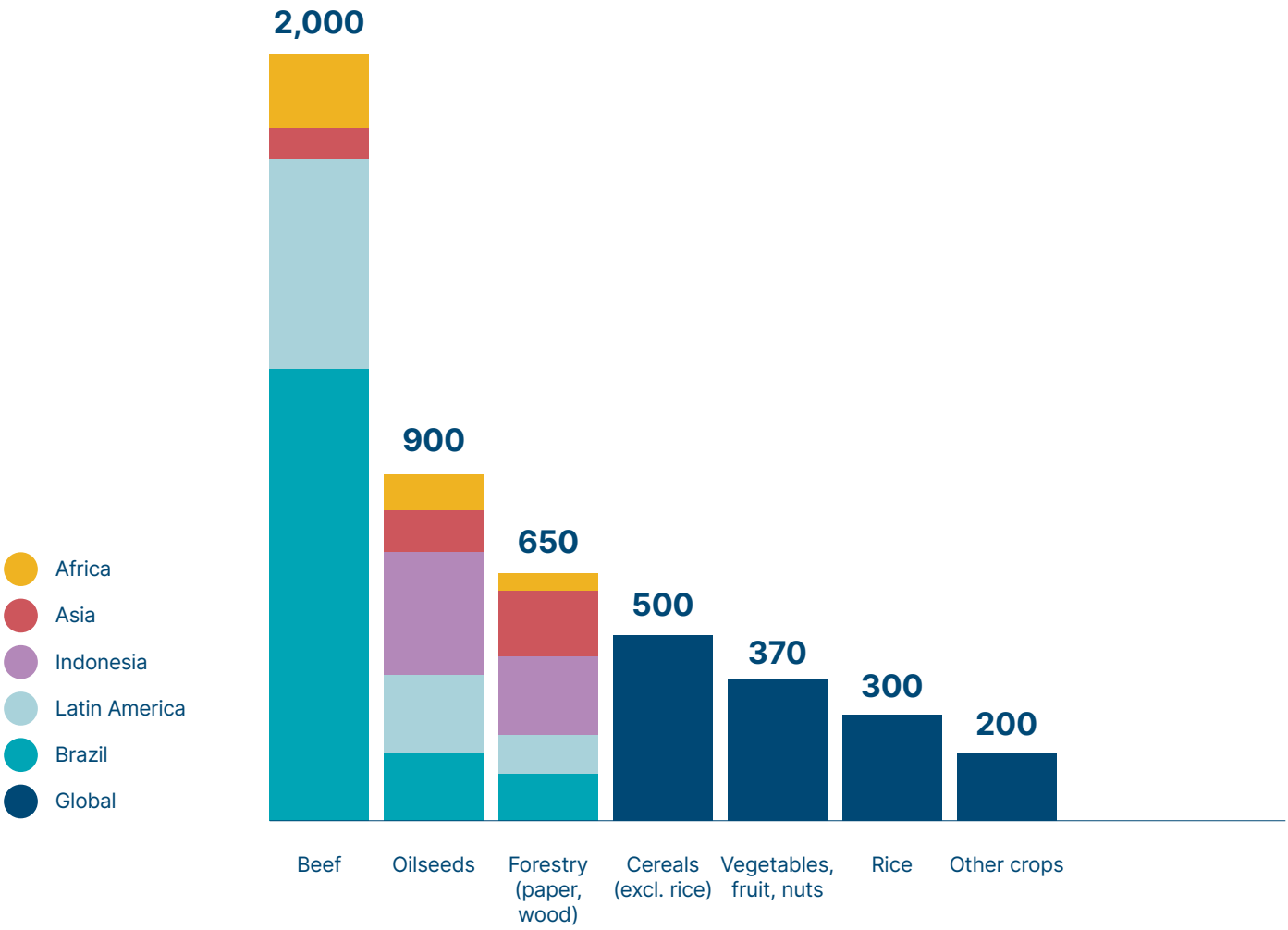
The main driver of commodity-driven agriculture is cattle pasture, which is responsible for over 40% of tropical deforestation, particularly in the Amazon rainforest [Exhibit 2].[14] This is followed by oilseeds (in particular, palm and soy), which account for a further 18%. The vast majority of deforestation for soy is, however, driven by demand for meat; only 20% of global soy production is used for human food, with 75% used as feed for livestock [Exhibit 3].[15]

14 Hannah Ritchie and Max Roser (2021), *Forests and Deforestation.*
15 Ibid.

Exhibit 2

Pasture for beef accounts for 40% of deforestation in tropical forests

Drivers of tropical deforestation
Annual hectares (thousand)



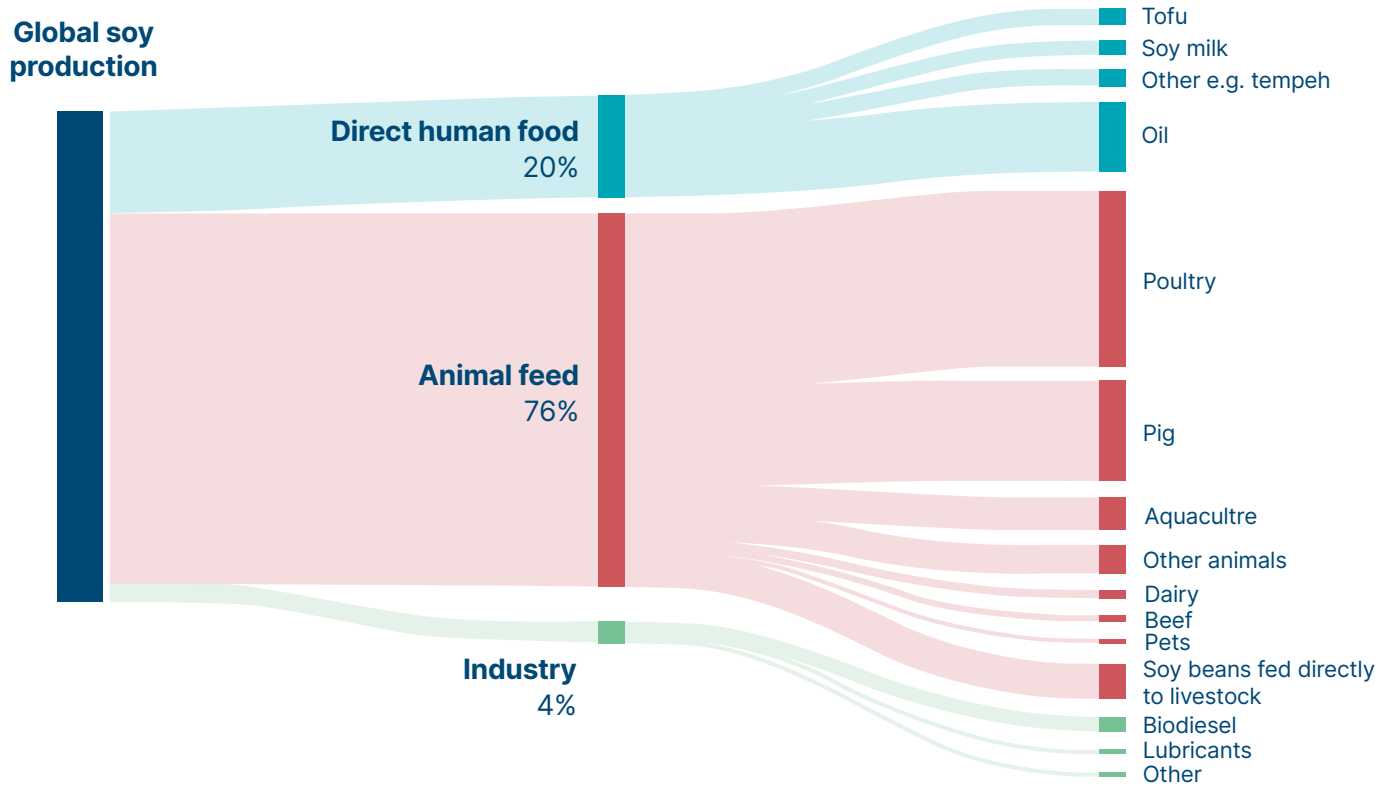
SOURCE: Our World in Data, adapted from Pendrill, F., et al. (2019).

NOTE: Average annual hectares between 2005 and 2013.

Exhibit 3

Only 20% of global soy is grown for human food, with 75% grown for animal feed

Allocation of global soy production to its end uses by weight



SOURCE: *Our World in Data*, adapted from Food Climate Resource Network.

Without action, rates of deforestation could increase in the future as demands for agricultural output, animal-source foods and other commodities increase with population growth, rising incomes (which typically leads to more meat consumption), and increased food waste.

Projections developed by the Food and Land Use Coalition (FOLU) suggest that if current trends continue, another 400 million hectares (an area twice the size of Mexico) of natural ecosystem could be converted to agricultural land by 2050 [Exhibit 4].[16,17] This could release over 40 $GtCO_2$ into the atmosphere during the 2020s alone; this is equivalent to 8% of the global carbon budget of 500 $GtCO_2$ between now and 2050 which is compatible with a 50% probability of limiting warming to 1.5˚C.[18]

16 Food and Land Use Coalition (2019), *Growing Better: Ten Critical Transitions to Transform Food and Land Use.*

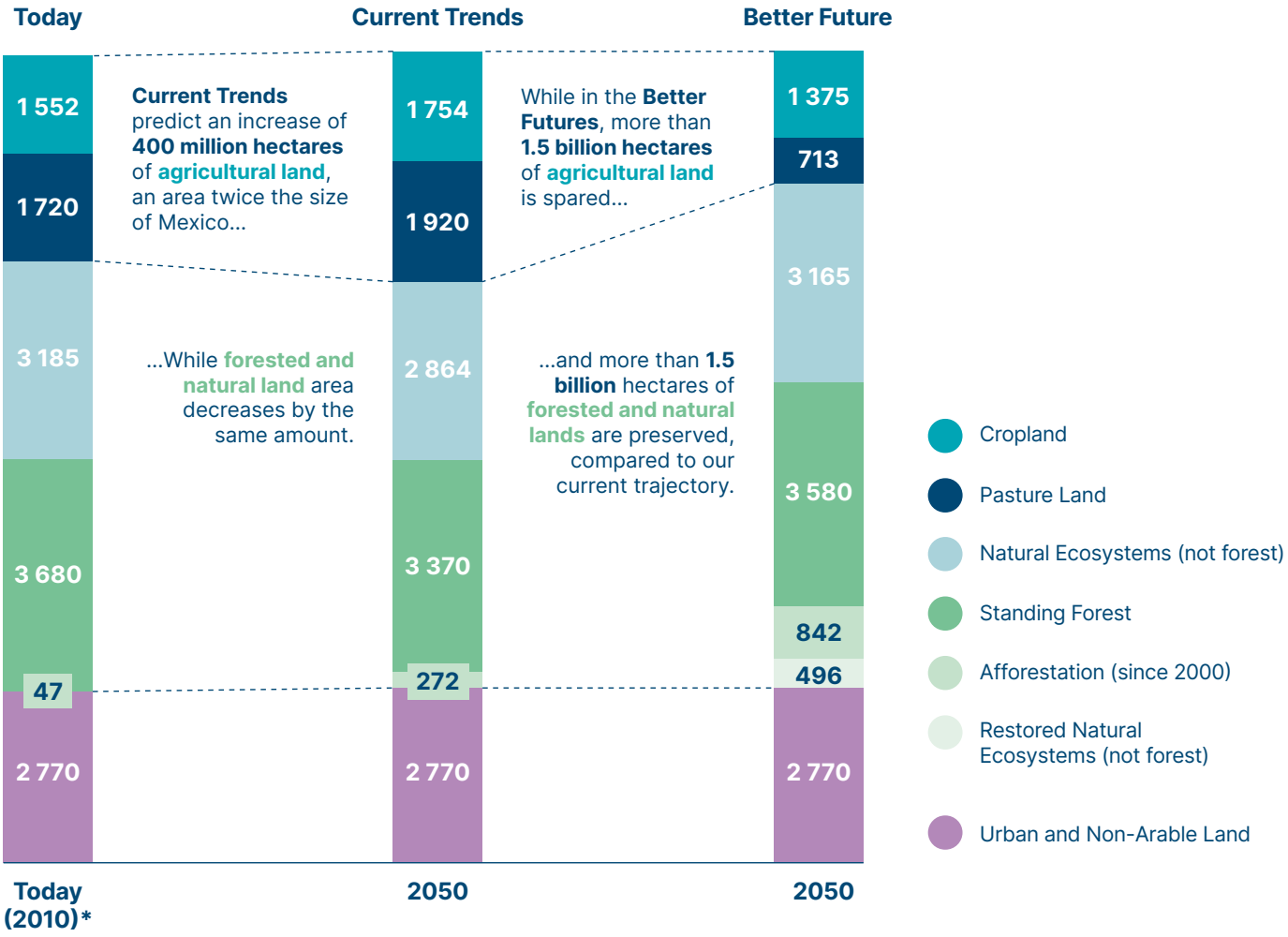
17 FOLU modelling demonstrates that it is both possible – and necessary – to halt tropical deforestation and protect other natural ecosystems while setting aside hundreds of millions of hectares of land for forest and ecosystem restoration, and to produce affordable, nutritious food for the global population. See Food and Land Use Coalition (2019), *Growing Better: Ten Critical Transitions to Transform Food and Land Use.*

18 ETC (2022), *Mind the Gap: How Carbon Dioxide Removals Must Complement Deep Decarbonisation to Keep 1.5°C Alive.*

Exhibit 4

Projections of changing land use under current trends or a "Better Future"

Total Surface Land Use: million hectares



* Baseline data forecast from 2000

NOTE: According to IIASA estimates, parts of the permanent pastures, as defined in the IPCC 2019 Special Report on Climate Change and Land report, are pastures without significant contribution to total livestock production and thus, are included in the land use classification 'Natural Ecosystems Land'. The 'Pasture' land use classification includes only grassland utilised for agricultural production.

SOURCE: IIASA GLOBIOM (2019); Food and Land Use Coalition (2019), *Growing Better.*

1.3 Challenges of ending deforesion

At COP26, more than 140 countries pledged to halt and reverse forest loss and land degradation by 2030.[19] In addition, at COP15, the UN's Convention on Biological Diversity in December 2022, nearly 200 nations committed to designating 30% of the world's land and ocean as protected areas by 2030. However, past progress on ending deforestation has been slow.[20] This reflects a number of factors which increase the private returns to deforestation and reduce the returns to non-deforestation based uses of the forest. These include:[21]

- **Ineffective national and international governance,** which to different degrees in different countries can entail weak bureaucratic and enforcement capacity, corruption and vested interests, lack of integrated land use planning, weak international rules prohibiting the import and sale of products linked to deforestation, and weak or conflicting legal and customary provisions relating to land tenure rights.

- **Lack of transparent supply chains** or accurate product labelling which means that consumers are largely unaware of the deforestation impacts of their purchasing decisions.

- **Barriers to the development of non-deforestation based business models,** with smallholders and local businesses often lacking access to finance and knowledge to develop forest-positive business models, which often have longer pay-back periods and are smaller scale.

1.4 Alternatives to concessional/grant payments

Concessionary/grant payments offset these challenges by paying economic actors not to deforest, but any permanent solution to deforestation will almost certainly need to entail:

- A major reduction in the consumer demands that drive deforestation. Projections by the FOLU coalition, reflected in the "Better Future" column in Exhibit 4, suggest that major changes in the global average diet (including a large-scale reduction in animal meat consumption in high-income countries) together with improvements in agricultural productivity, could release 1.2bn hectares from agricultural land by 2050. This would allow the extensive restoration of natural ecosystems, producing large-scale carbon sequestration and biodiversity improvements.

- The development of new business opportunities to derive employment and profit from standing forests in a sustainable way. Box 1 describes some of the possibilities.

- Government actions to make deforestation illegal, if combined with effective enforcement.

19 UN Climate Change Conference UK 2021 (2021), *Glasgow Leader's Declaration on Forests and Land Use.*

20 See Forest Declaration Platform's Forest Declaration Assessment reports for a comprehensive assessment of progress towards forest goals, including ending deforestation by 2030.

21 FOLU (2021), *Positive Tipping Points for Food and Land Use Systems Transformation.*

Box 1

Alternative revenue streams for standing forest

Leveraging different business models or revenue streams to drive forest protection and recovery can also help reduce the short-term economic incentives to cut down forests and also develop long-term and sustainable alternative sources of income for local communities. There are lots of ways to do this, with three main types of projects.[22]

1. **Models which create value from standing forest:** these depend on harnessing the high variety, value and productivity of naturally growing forest products and environmental services in standing primary forest. Business models include:

    - Wild forest production, including harvesting of wild-grown fruit and nut and plant material for cosmetic and pharmaceutical industries.

    - Payments to communities or owners of the forest for the benefits that those forests provide (e.g., a hydropower company could pay an upstream land manager for the protection of forest around a mountain watershed, in order to maintain effective water flows).

    - Ecotourism, where visitors are attracted to the natural biodiversity and beauty of a forest.

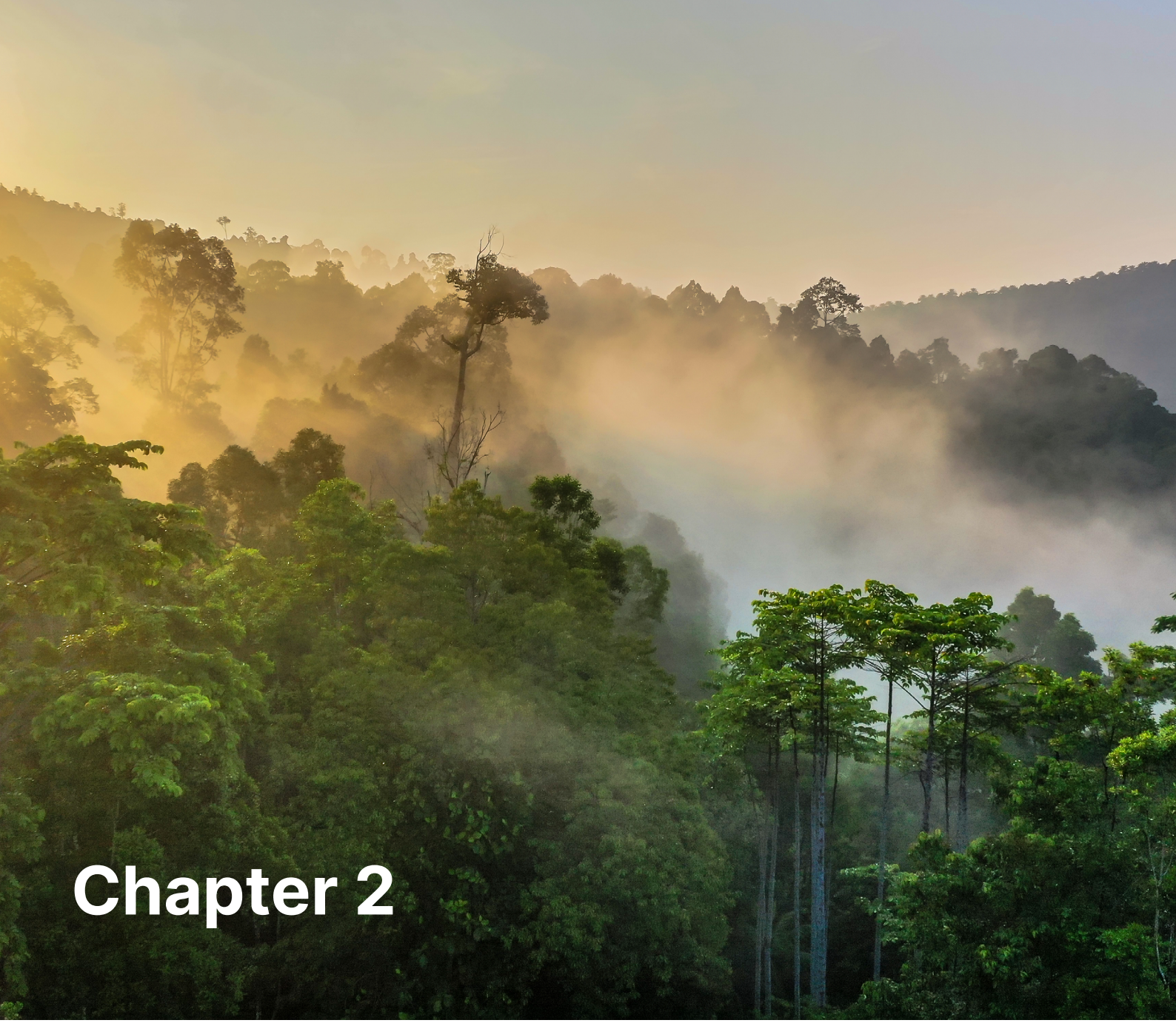
    - Reduced impact logging, involving the selective timber harvesting of specific high-value species, minimising disturbance and maintaining maximum ecological functionality of the forest, following internationally accepted standards of best practice.

2. **Models that incorporate forest protection into agricultural production:** these models involve improving production efficiency, and therefore reducing the environmental impact, of agricultural activities. Improved agricultural practices are combined with effective land use planning, robust local governance, and incentive and reward mechanisms for forest protection.

3. **Models which create value from re-growing degraded forest:** these models centre on restoring previously degraded land and returning that land to a state that is as close as possible to natural forest. Business models exist through payments for ecosystem services (e.g., payments from organisations on a compliance or voluntary basis), or regrowing areas of degraded land to create a productive forest.

It is unclear how large the opportunity is, but alternative revenue streams are unlikely to have a material impact on avoiding deforestation in most tropical forest frontier in isolation; they would need to be combined with well-designed real economy policy and likely other financial incentives.

22 Food and Land Use Coalition (2019), *Prosperous Forests.*



Chapter 2

Estimating concessional/ grant payments to avoid deforestation

The fundamental barrier to preventing deforestation is that there is a short-term economic incentive to cut down forest and devote land to agricultural production. Some governments can, and have, overcome this by making deforestation illegal, implementing effective monitoring systems, and designating protected areas.[23]

In the absence of such action, concessional/grant payments can offset the short-term economic incentive by paying landowners a sufficient amount to cover the cost of the economic opportunity foregone.

Avoided deforestation projects will entail some operating and monitoring costs, but these will typically be small in comparison with opportunity cost payments.[24] In addition, other investments may be needed to support alternative economic development for local communities.

Our analysis excludes these other categories of cost. It aims to estimate the global cost of avoiding deforestation through concessional/grant payments which cover the opportunity cost of not cutting down tropical forest.

There are two possible ways to estimate this total cost:

- The first seeks to identify how much would have to be paid to prevent the deforestation that would otherwise occur each year and implicitly assumes that these payments would need to continue in perpetuity.
- The second assumes that with sufficient finance, one could protect the whole of the "forest frontier" (whether or not currently threatened by deforestation) in a way which would put a stop to any deforestation in the forest interior.

We consider each of these approaches in turn and then compare the estimated need for concessionary/grant payments with the amounts currently occurring or promised.

2.1 Annual payments to prevent deforestation each year

In its latest assessment report, the IPCC estimates the reductions in net greenhouse gas emission reductions that could be achieved by measures to reduce deforestation, the loss and degradation of peatlands, coastal wetlands and grasslands, relative to specified emission baselines. It estimates the technical mitigation potential to be around 6 $GtCO_2e$ a year, broadly in line with historical emissions from deforestation.[25]

The IPCC also provides an estimate of the cost curve for achieving 6 $GtCO_2e$ of emission reductions a year [Exhibit 5]. While this curve does not define a precise total cost to end deforestation, interpretation of the ranges of cost per tonne saved imply that:

- 2.3 $GtCO_2e$ of emissions per annum could be prevented by payments of less than $20 per tonne; at an average assumed cost of $12.5 per tonne, this would suggest a need for payments of around $30bn per annum.
- Another 1.7 $GtCO_2e$ could be prevented at a cost between $20-100 per tonne, implying a need for $100bn per annum payments if the average cost were $60 per tonne.
- Preventing more than 4 $GtCO_2e$ per annum would cost more than $100 per tonne, implying at least $100bn per annum to prevent another 1 $GtCO_2e$.

In total, the IPCC analysis suggests that preventing 5 $GtCO_2e$ of emissions in forests at immediate risk of deforestation every year via payments to compensate for opportunity foregone would cost in excess of $230bn per annum, and significantly more to avoid the final 1 $GtCO_2e$ that the IPCC estimate is technically possible to mitigate.

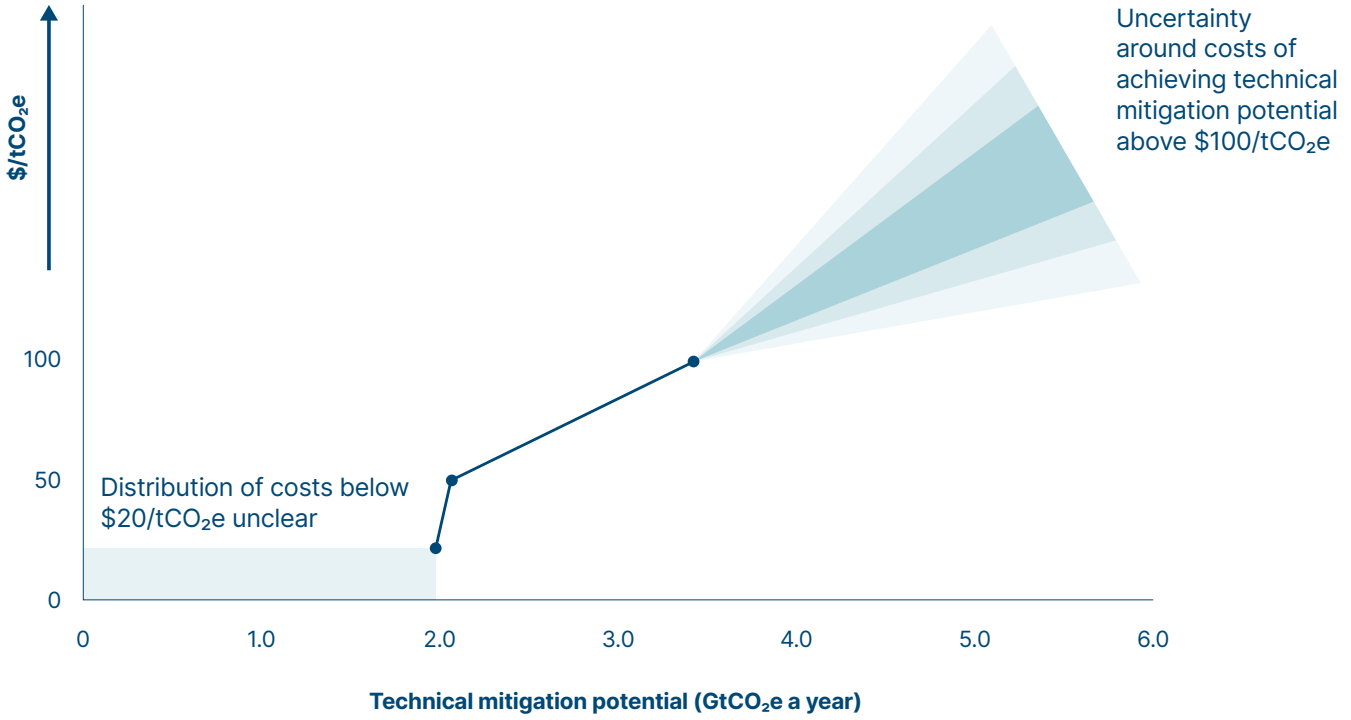
23 Policies to make deforestation illegal, including a permanent ban on issuing new permits to clear primary forests and peatlands, have formed part of a suite of policies in Indonesia to reduce deforestation. Others include actions to reduce forest fires and investment in land rehabilitation. However, falling rates of deforestation in recent years can also be attributed to external factors, including falling palm oil prices, an economic slowdown due to the COVID-19 pandemic, and more rains.

24 Analysis by BloombergNEF of projects from the Verra project registry suggests the average operational cost is around $1/$tCO_2$. See BloombergNEF (2022), *Long-term Carbon Offsets Outlook 2022.*

25 IPCC (2022), *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.*

Exhibit 5

Estimated annual mitigation potential ($GtCO_2$-eq/yr) to 2050 and cost of reduced deforestation, loss and degradation of peatlands, coastal wetlands and grasslands



SOURCES: IPCC Sixth Assessment Report Mitigation of Climate Change (2022) *Chapter 7: Agriculture, Forestry and Other Land Uses (AFOLU).*

However, there are limitations to this approach, which suggest that the true costs to ending deforestation could be much higher:

- The IPCC's technical mitigation potential is based on net emissions from human activity (~5$GtCO_2$). However, as set out in Chapter 1, gross emissions from deforestation are much higher at 16$GtCO_2$.
- The costs per tonne shown in the IPCC analysis assume that once a payment of this size is made to prevent deforestation in a particular location, deforestation in the area covered by the payment will not occur for a long period of time (e.g., over 15 years). Prices for voluntary avoided deforestation credits are also quoted on this assumption. This estimation approach does not assume that the pressures for deforestation, or the need for compensation payments, are removed since each year a new area of land will be threatened with deforestation and new payments will be required. It therefore implicitly assumes that the need for payments of this magnitude could continue in perpetuity unless the demands which drive deforestation were reduced and/or deforestation were effectively prohibited.

2.2 One-off payments to protect the forest frontier and halt deforestation

The second estimation approach reflects the fact that in most but not all cases, deforestation occurs from the outside in – that is, it begins on the edges of forests that are easily accessible from roads and more desirable for economic purposes. This means the forest at the highest risk is usually the "forest frontier". There is therefore a theory that if you can prevent deforestation in the entirety of the forest frontier, you can also protect the intact forest that sits behind the frontier since it will be significantly harder to access.

To estimate the cost of preventing future deforestation via a programme of one-off payments, we therefore have to consider:

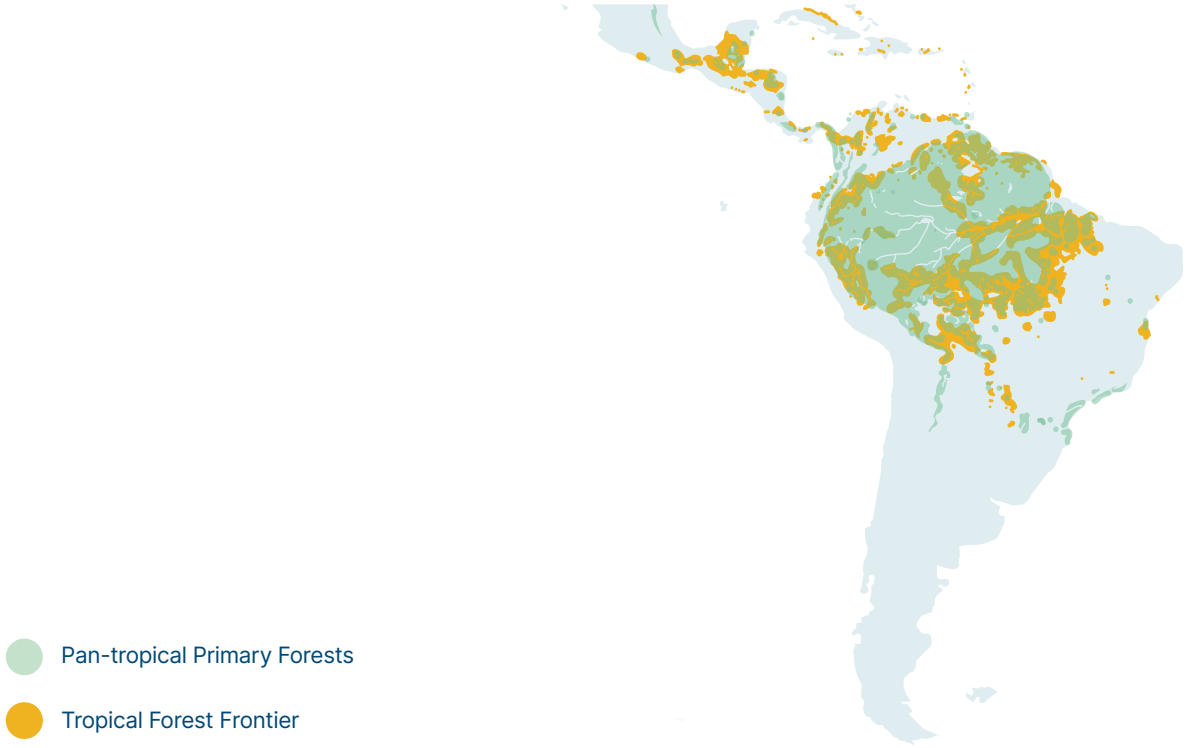
- How large is the "forest frontier" and how large a carbon stock does it store?
- What will be the average cost per tonne of preventing deforestation throughout this forest frontier?

Size of the tropical forest frontier

Analysis by the Food and Land Use Coalition, using satellite imagery to isolate forest loss "hotspots", suggests that a reasonable definition of the forest frontier might include around 20% of remaining tropical forest.[26]

Exhibit 6

The forest frontier in South America shows where human development is driving the loss of primary forests



SOURCES: Food and Land Use Coalition (2019), *Prosperous Forests*.

26 See Food and Land Use Coalition (2019), *Prosperous Forests* for more information. Forest loss "hotspots" were defined as areas that exhibit statistically significant clustering in patterns of forest loss over time. A buffer area of 5 km was added to hotspots in all directions and the nature of the land within this defined area was examined.

Tropical forests account for around 45% of total standing forests by area, but around 60% of total stored carbon.[27] Estimates from Harris et al. put the total tropical carbon dioxide stock at 1360 $GtCO_2$, with 975 $GtCO_2$ in the trees, deadwood and litter, and a further 400 $GtCO_2$ in the soil.[28] Assuming that 25% of soil carbon stock can be lost in deforestation, this implies a total stock of CO_2 at risk in the whole remaining tropical forest of 1075 $GtCO_2$ (975+100), of which 215 $GtCO_2$ (20% of this total) might therefore be at risk within the forest frontier.[29]

Cost per tonne of emission avoided

The opportunity cost of not deforesting will vary significantly, depending on factors including:

- Type of crops produced and the scale of the land owner's operation.
- Soil and climate conditions which impact yields.
- Input costs (e.g., labour and technology).
- Supply chain costs (e.g., transport and distribution).

This makes it extremely difficult to estimate average costs and thus calculate a global cost to stop deforestation. We therefore draw on several different inputs to establish a range of possible costs including:

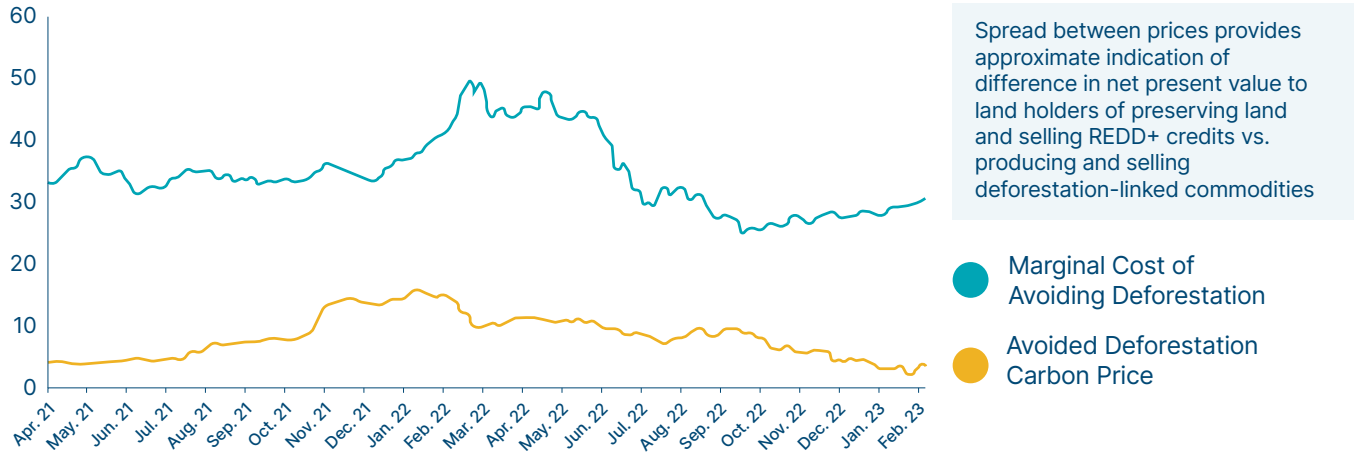
- The IPCC's cost curve shown in Exhibit 5 and has already been discussed.[30]
- The price of nature-based carbon credits (such as REDD+)[31] which today typically cost around \$5-10/tCO_2.[32,33] These prices are determined by the market dynamics of supply and demand, but their low current level may reflect both some low-quality credits (e.g., due to challenges of ensuring additionality and preventing leakage [Box 2]) and relatively low demand while voluntary carbon markets mature. As standards and regulations are improved, and lower-quality credits are removed from the market, average prices are likely to increase. Analysis by BloombergNEF suggests that average carbon credit prices (including other non-REDD+ types) could increase to around \$50/tCO_2 by 2030.[34]
- Analysis of what the opportunity cost of not deforesting should be given the value of commodities which could be grown on deforested land. Analysis by Vertree, for example, suggests that the opportunity cost has varied within a range of \$25-45/tCO_2 (averaging around \$35/tCO_2) versus market prices varying in a \$5-15 range [Exhibit 7].[35,36]

27 Harris et al. (2019); Food and Agriculture Organisation of the United Nations (2020), *Global Forest Resources Assessment.*
28 Harris et al. (2021), *Global Maps of twenty-first century forest carbon fluxes.*
29 The IPCC GHG inventory suggest carbon dioxide loss from soils due to deforestation could be anywhere between 0-33%. This report takes a reasonable assumption of 25%.
30 IPCC (2022), *Mitigation of Climate Change – Chapter 7: Agriculture, Forestry and Other Land Uses.*
31 REDD+ projects work by offering credits for actual emissions reduced, compared to a baseline (both of which are verified by independent third parties) based on historical emissions.
32 BloombergNEF (2022), *Long-term Carbon Offsets Outlook 2022.*
33 A floor of \$10/tCO_2 for REDD+ credits has recently been implemented by the Lowering Emissions by Accelerating Forest finance (LEAF) Coalition for all of their future funding commitments.
34 BloombergNEF (2022), *Long-term Carbon Offsets Outlook 2022.*
35 Data provided for Systemiq by Vertree.earth.
36 This opportunity cost is the equivalent carbon price that needs to be paid today to make a landholder indifferent between deforesting to produce commodities and keeping the forest standing. It is an average of analysis in 50+ tropical forest countries, including Brazil, Indonesia, Malaysia, and the Democratic Republic of Congo.

Exhibit 7

The current cost of carbon credits for avoided deforestation is insufficient to cover the marginal cost of avoiding commodity-driven deforestation

Marginal cost of avoiding deforestation vs. carbon price for avoided deforestation
$/tCO$_2$



SOURCE: Vertree Analysis based on World Bank, Bloomberg.

NOTE: Marginal cost of avoiding deforestation refers to average price of basket of commodities most commonly linked to deforestation; Avoided deforestation carbon cost refers to price for nature-based projects traded on CBL Global Emissions Offset Futures, verified by Verra and Climate Community and Biodiversity (CCB) accredited – majority of credits included are REDD+ avoided deforestation projects (minimum vintage year of 2016).

Box 2

Reduced Emissions from Deforestation and forest Degradation (REDD+)

One approach to mitigate emissions from deforestation has been to develop REDD+ projects in order to encourage payments for "avoided deforestation". REDD+ was devised as a programme that would facilitate results-based finance for "Reduced Emissions from Deforestation and forest Degradation (REDD)" as well as the role of conservation, sustainable forest management and enhancement of forest carbon stocks in developing countries (+).

Originally, implementation was intended to be at the national scale or sub-national jurisdictional scale on an interim basis, in order to improve forest governance and effect systemic change to address the drivers of deforestation. In practice, jurisdictional approaches have struggled to get off the ground but there have been several recent developments. These include Norway's International Climate and Forest Initiative (NICFI), the Forest Carbon Partnership Facility (FCPF), and the world's first large-scale jurisdictional REDD+ deal announced to prevent deforestation in Guyana.

Some 600+ REDD+ projects have been initiated to date, and some 400 are still active, mostly implemented by NGOs or for-profit developers.[37] Since 2018, the market size for REDD+ voluntary carbon credits has grown from around $50m to over $500m in 2022.[38]

Four fundamental challenges have dogged REDD+ projects and apply also to carbon credits for natural climate solution (NCS) removals (though not all challenges are unique to the food and land use sector). They include:

37 Yeung, P. (2021), *As COP26 looms and tropical deforestation soars, REDD+ debate roars* on.
38 Trove Research (2022), *Voluntary carbon Market 2022 in Review.*

- **Leakage:** the risk of displacing deforestation activity to a nearby local area.
- **Additionality:** Predicting what would have happened in the absence of a REDD project.
- **Permanence:** Difficulty of long-term storage assurance.
- **Measurement:** Difficulty accurately counting carbon stored.

In addition, it is important to recognise that the costs entailed in seeking to protect the entire tropical forest frontier could be higher or lower than those relevant to particular locations where deforestation is already likely, since:

- There will be areas of the forest frontier which have a high likelihood of being cut down, but which are not at immediate threat in a given year. This means the opportunity cost to protect them may be lower.
- The cost of protecting additional areas of the forest frontier is likely to increase as more deforestation is avoided and the supply of forest available to cut down becomes more restricted.

The range of possible costs to protect the entire forest frontier is therefore extremely wide:

- If preventing 215 $GtCO_2$ emissions cost a minimal $5 per tonne (reflecting the fact that the majority of the frontier is not immediately threatened), the total cost could still be over $1 trillion, implying about $130bn over the next 7 years to halt deforestation by 2030.
- But if costs per tonne reflected an average $35/$tCO_2$ opportunity cost foregone, total costs could reach over $7trn, implying impossibly large payments of $900bn per annum between now and 2030.

2.3 Required payments versus current payments and commitments

Both estimation approaches suggest that if the sole strategy to end deforestation were to make payments to compensate landowners/existing businesses for the opportunity foregone, the required level of payments would be very large.

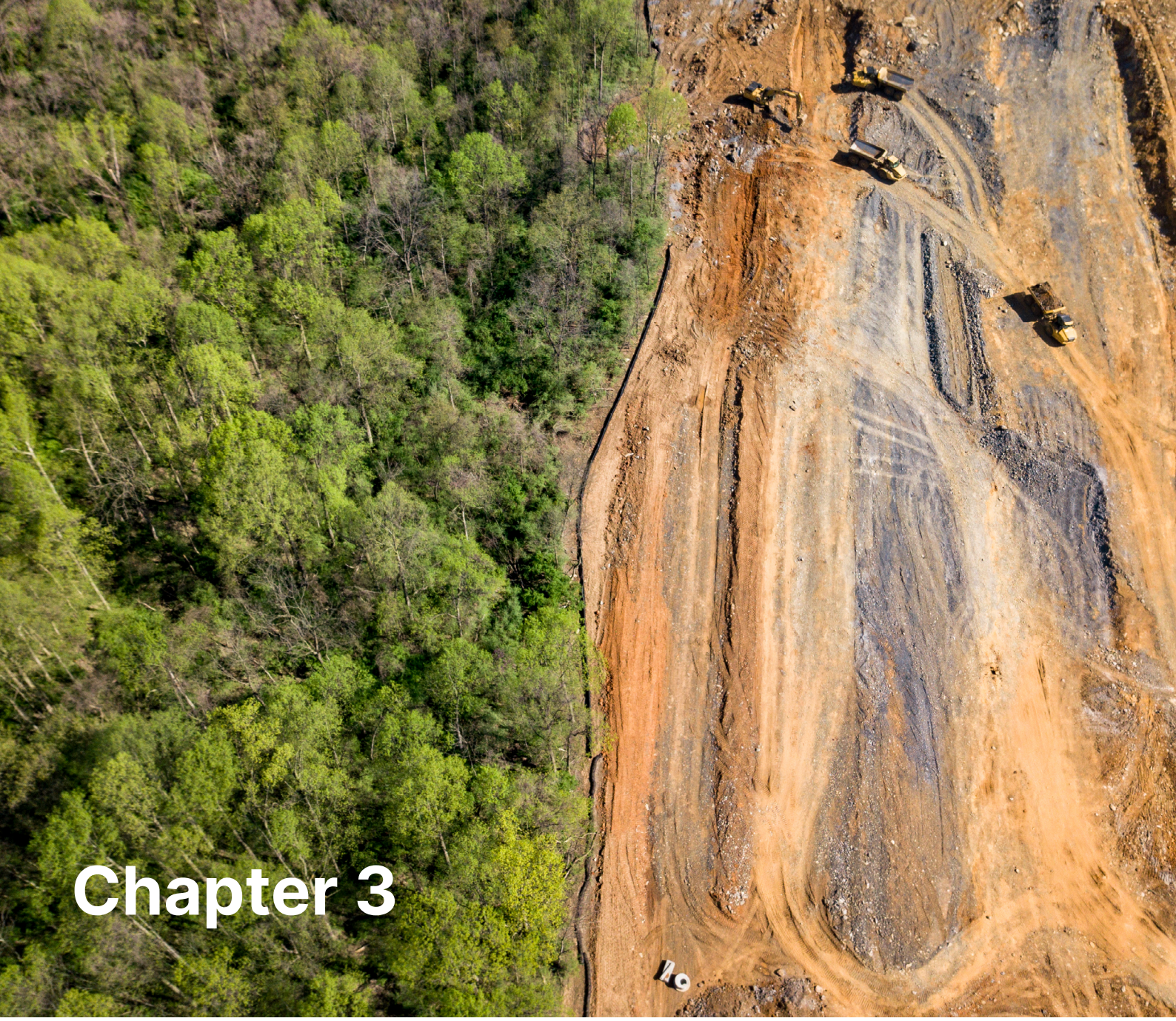
- The IPCC cost curve suggests that payments of about $130bn could be required perpetually to reduce deforestation-related emissions by around 4 $GtCO_2$ a year, but would be much higher to stop deforestation entirely.
- And the estimated cost to fully protect the forest frontier by 2030 is at the very least $130bn per annum from now to 2030, and potentially much higher.

These estimates of required payments are hugely higher than the amounts currently flowing or promised:

- To date, governments and corporates of high-income countries have pledged $19.2bn to end deforestation but these commitments are spread over several years.
- Financing via REDD+ credits in voluntary carbon markets was around $500m in 2022, up from $50m in 2018, but with further growth facing important challenges [Box 2].[39]
- Total domestic and international mitigation finance for forests in recent years from all sources has been estimated at $2.3bn a year.[40]

A strategy to end deforestation primarily through payments to compensate for profit opportunity foregone would therefore require a minimum 50-fold increase in current levels of mitigation finance for forests, and possibly much higher still.

39 Trove Research (2022), *Voluntary carbon Market 2022 in Review.*
40 Forest Declaration Assessment (2022), *Are we on track for 2030?*



Chapter 3

Implications for finance and other policies

The scale of payments required to offset the economic incentive to deforest is so large that they cannot be the sole, or even the primary means, to end deforestation. Deforestation will continue unless, in addition:

- Tropical forest countries are willing to ban or severely restrict deforestation without receiving payments equal to the economic opportunity foregone and are able to enforce these bans.
- Alternative business models are developed to derive significant employment and revenue from standing forests.
- Consumer demand for products directly sourced from deforested land is dramatically reduced. This requires changes in consumer and company behaviour informed by greater transparency, improved traceability and better labelling.
- Consumer demand for the products which drive deforestation, in particular animal meat, and especially beef, is significantly reduced. This might be achieved via consumer shifts to plant-based diets, plant-based meat alternatives or the development of synthetic meats.

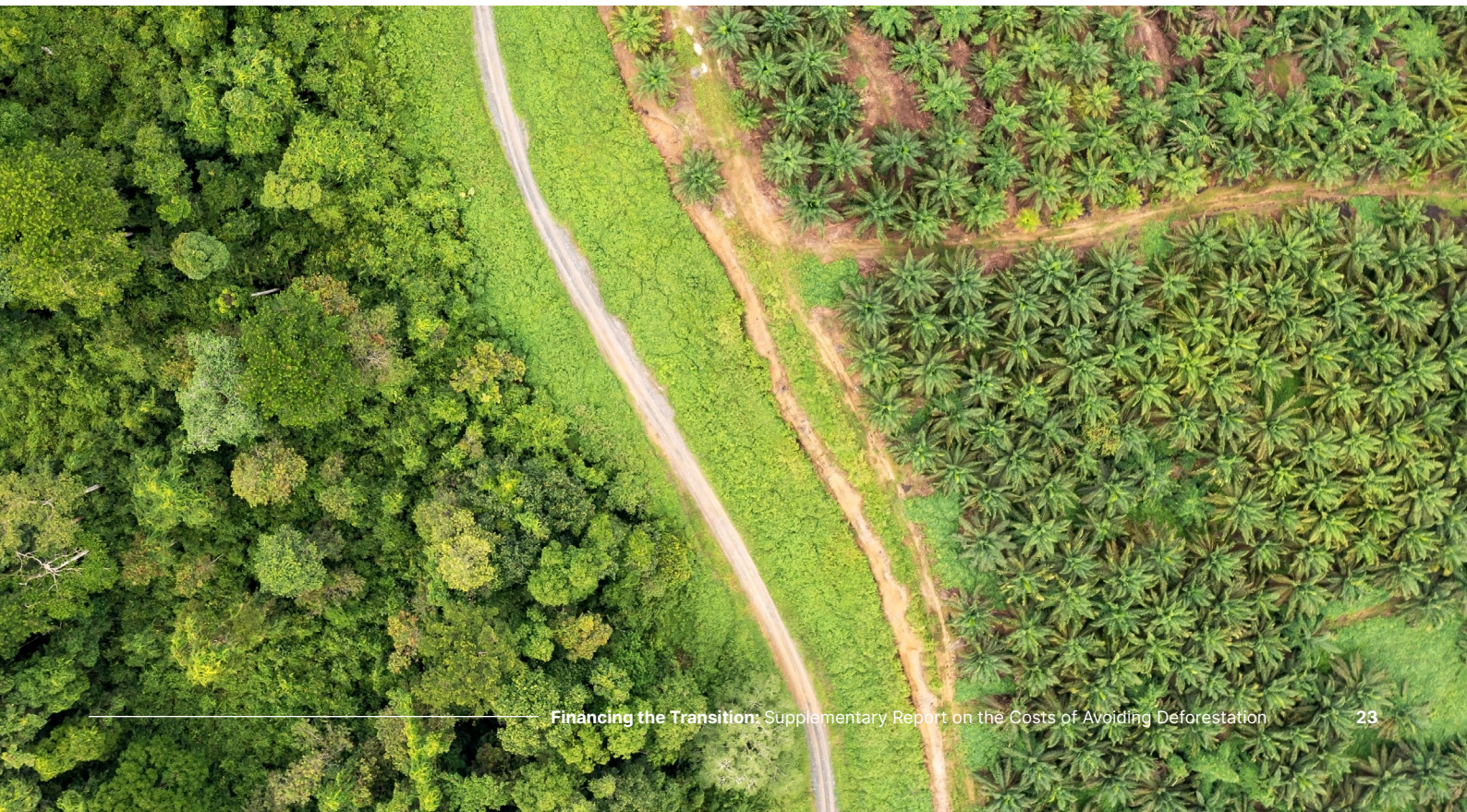
Box 3 sets out some of the policy actions required.

But implementing these actions will take time and their impact will likely be inadequate for many years. Some level of concessionary/grant payments to offset the incentive to deforest will therefore be essential over the next decade to limit deforestation, buying time before more fundamental policy changes can be put in place.

We recommend that at least $130bn a year of finance could make an important contribution to avoiding deforestation. Given this would not be sufficient to cover the entire opportunity cost in forests at risk of deforestation, it raises the question of what share of the $130bn should be used as concessional/grant payments, and how much should support the delivery of the suite of other actions required, discussed above.

How much such finance can credibly be mobilised is a matter of judgement. The potential to provide concessionary/grant finance to limit deforestation must be assessed alongside the two other major needs for such finance considered in our Financing the Transition report – finance to support the early phase-out of coal where it remains competitive with renewables and to finance carbon dioxide removals.

In *Financing the Transition*, we present a scenario in which $130bn per annum of payments are made to help avoid deforestation over the rest of the 2020s, combine this with assumptions relating to payments for early coal closure and carbon removals, and assess what combination of contributions from corporates (via voluntary carbon markets), philanthropists and governments might make this level of payments possible.



Box 3

Actions to address the drivers of deforestation

The right mix of policy, behaviour change and corporate action will vary significantly in different countries, particularly depending on a country's per capita income (e.g., richer countries tend to have greater meat consumption and so should focus efforts on reducing this and driving behaviour and diet change). A summary of some of the key solutions and actions that are important to implement this decade include:

Policy

- Demand-side government regulation to support deforestation-free supply chains (i.e. EU Deforestation Due Diligence regulation, UK Environment Act, proposed FOREST Act in the US), coupled with producer transitional support.
- Both government and private sector support to strengthen R&D and de-risk investments in new business models and solutions:
  - Develop alternative proteins through financial incentives which trigger a tipping point, where alternative proteins reach cost parity with animal protein, with equivalent attractiveness (taste, texture, nutrition).[41]
  - To support and scale up productivity improvements within agricultural commodity systems.
- Financial instruments and subsidies to support smallholder economic and social development, access to finance, sustainable agricultural and agroecological practices, natural ecosystem protection and participation in sustainable markets.
- Government support for open access, collection, sharing, monitoring (including real-time monitoring and centralised data systems) and evaluation of deforestation data - including maps, satellite data and other data (both at a national and international cross-border level).
- Introduction of legislation to limit the import of commodities linked to deforestation, for example, recent EU legislation requiring importing companies to verify the origin of products and provide evidence they are free of any association with deforestation.
- Governments of forest nations can use a combination of regulation and fiscal policy to stop deforestation, including establishing protected areas, providing land rights and financial incentives for ecosystem protection and restoration, forest codes which require landowners to protect an increasing share of their land, and improved monitoring of illegal deforestation.
- Government support (e.g., financial, educational) to develop agricultural systems that are both productive and regenerative (e.g., farming which is focused on improving soil health) and which combine traditional techniques (e.g., crop rotation, controlled livestock grazing systems and agroforestry), with advanced precision farming technologies. These systems will support more judicious use of inputs including land, water and synthetic and bio-based fertilisers and pesticides; while the overall impact on avoided deforestation may be limited, this strategy delivers significant wider ecosystem benefits.
- Promote stakeholder collaborations to ensure full and effective participation of farmers, civil society and indigenous peoples in the decision-making process, including through multi-stakeholder platforms, coalitions and cooperatives.

Behavioural Change

- Governments, combined with corporate action to support healthy diets through targeted consumer campaigns that support adjacent objectives in creating demand for nature-positive products, a decline in red meat consumption, and health benefits.
- Reduction of food loss and waste through regulation and consumer campaigns.

41 Systemiq (2023), *The Breakthrough Effect: How to trigger a cascade of tipping points to accelerate the net-zero transition.*

Corporate Action

- Private sector investment in systems that can fully trace supply chains to point of origin.
- Engagement with local land owners and farmers to better understand the impact of deforestation on their supply chains and identify the barriers to developing deforestation-free supply chains.
- Businesses and farmers to organise pre-competitively to support government reform agendas and set internal standards for specific sectors.
- Financial institutions should work with farmers in the supply chain to identify mechanisms to incentivise avoided deforestation, such as through premiums or guarantees.
- Follow the latest guidance and regulation from organisations such as the Accountability Framework Initiative (AFi), Science-based Targets Initiative (SBTi), the Taskforce for Climate-related Financial Disclosures (TCFD), and the Taskforce on Nature-related Financial Disclosures (TNFD).

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