

EXPONENTIAL ROADMAP FOR NATURAL CLIMATE SOLUTIONS

PRODUCED BY

CONSERVATION
INTERNATIONAL



PARTNERS



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FOREWORD



Change happens slowly, and then all at once. But it rarely happens by accident.

In August 2022, the United States Congress passed a landmark \$369 billion climate bill, putting the world's largest energy sector on track to slash emissions 40% by 2030. Seemingly overnight, the planet's climate trajectory changed dramatically for the better. But that sudden shift was decades in the making. Around the world, energy policy is finally changing, but only because scientists devoted years to developing a comprehensive roadmap for decarbonization: what we must do, how we should do it, and on what timeline it must be done.

The energy transition will accelerate rapidly in the coming decade, but this is only part of the climate

equation. Here's the shocker: Even if we zero-out energy sector emissions, it will not be enough to stabilize Earth's climate. Worldwide, plants and soils store more than 2,100 metric gigatons (Gt) of carbon, roughly twice the amount contained in all known oil, gas, and coal reserves. Our assault on nature threatens to release this carbon, and last year the land sector — forestry, farming, grazing, even parks and protected areas — was responsible for an astounding 12.5 Gt, or 25 percent, of global greenhouse gas emissions.

Here's the good news: We can halt this trend, and even reverse it, so that the human footprint on nature becomes a net carbon sink, rather than a source. In fact, if we accelerate actions to protect, manage, and restore ecosystems and working lands, nature can furnish around one-third of necessary emissions reductions.

There is growing recognition among heads of state, corporate executives, landowners, land managers, Indigenous peoples, and citizens that natural climate solutions hold great promise. There is growing political *will* for protecting, sustainably managing, and restoring nature. Now, people are looking for a *way*.

The Exponential Roadmap for Natural Climate Solutions offers a clear and achievable path to climate stability. Developed by leading scientists at Conservation International, the Potsdam Institute for Climate Impact Research, and other allied organizations, this first-of-its-kind plan quantifies and details what humans must do to maximize the emissions-mitigating potential of Earth's grasslands, wetlands, and forests — and, crucially, its working lands.

The Exponential Roadmap for Natural Climate Solutions is built around a novel, straightforward yardstick — the Carbon Law for Nature: We can, and we must, reach net-zero land sector emissions by 2030, 5 Gt CO_{2e} of net negative emissions by 2040, and 10 Gt CO_{2e} of negative emissions by 2050.

This is a hugely ambitious target, but we believe there is a realistic path to achieving it. The measures proposed in this report are not only good for climate mitigation, they also build climate resilience, protect wildlife, promote human health, create rural jobs, and grow local economies. That sort of return-on-investment is virtually unprecedented, yet crucial if we are to achieve our broader global goals on biodiversity, climate, and sustainable development.

Everybody has a role to play in the fight against climate change, and this Roadmap offers concrete actions for every role. It empowers every segment of society — NGOs, governments, businesses, and communities — to become better, more accountable, and more collaborative stewards of Earth's natural bounties.

By the time my three-year-old daughter reaches my age, I am confident that energy will be clean, green, and more equitably accessible. The same cannot be said of natural climate solutions, without which everything we have achieved and everything we hold precious on our planet is in jeopardy. This Exponential Roadmap for Natural Climate Solutions gives us a historic opportunity to leave our world better than we found it, by working with coherence, coordination, and focused urgency. We invite you to join us as partners on this journey.

M. SANJAYAN
CHIEF EXECUTIVE OFFICER,
CONSERVATION INTERNATIONAL

“There is growing political *will* for protecting, sustainably managing, and restoring nature. Now, people are looking for a *way*.”

FOREWORD

The world is in a race against time to prevent catastrophic climate change. Nature has the power to help — but we must work to protect, manage, and restore its ability to do so. For the first time, we now have an Exponential Roadmap which shows us how to rapidly scale natural climate solutions.

The climate emergency is already here, it is already deadly, and it is set to get much worse. The average temperature on Earth has now risen 1.2°C above preindustrial levels. There is a 50:50 chance of exceeding 1.5°C within the next five years — the point at which climate impacts will become increasingly harmful for people and the planet.

But it could have been worse. Without nature, we would have crossed the 1.5°C threshold many years ago. About half of human emissions are currently taken up by the land and oceans. We need to partner with nature to protect and expand this proportion — to protect our future.

We know what we need to do. To limit global heating to no more than 1.5°C, industrial and fossil fuel emissions must halve every decade from now to 2050. I first proposed such an exponential trajectory with colleagues in 2017, which we called the “Carbon Law” because it follows the same exponential course as Moore’s Law in the technology sector. This halving is a universal benchmark: it applies to businesses and cities as much as it applies to countries.

But as we said in 2017, halving greenhouse gas emissions from energy, industry and transport is not enough, even with nature’s existing subsidy. To stabilize global temperatures, we also need natural climate solutions. In the next decade we need to turn

working lands — from agriculture and grazing lands to forestry — from vast emitters of greenhouse gases to enormous stores of carbon. At the same time we must scale up carbon storage in existing ecosystems: forests, wetlands, peatlands and grasslands.

The Exponential Roadmap for Natural Climate Solutions reveals for the first time the approach we must take to roll out natural climate solutions at extraordinary speed and scale. It focuses on how land can meet the “Carbon Law for Nature”. That is, for nature to achieve net zero greenhouse gas emissions by 2030 and serve as a powerful store of carbon by 2050, locking in an additional 10 gigatons of carbon dioxide each year. **This is essential to ensure that long-term global average temperatures stay close to 1.5°C.**

The Roadmap team, led by Conservation International, designed this document as an action plan for people living and working on the land, but also for policymakers, businesses, the finance sector, and social movements, to enable and accelerate positive change. The natural climate solutions listed within this report provide many other benefits alongside carbon storage, including food security and resilience, and the protection of Earth’s biodiversity.

The targets and timeline outlined in the Roadmap for the implementation of natural climate solutions apply across scales, from entire regions to small businesses. Our call to action is for all countries and companies to design their own roadmaps for natural climate solutions, in line with the Carbon Law for Nature, starting today.

We can do this. We have science-backed solutions that offer the world a clear path to climate stability, with nature playing a vital role. If we start today, we can safeguard the climate, our societies, and the Earth for future generations. This is a golden opportunity. Let’s take it.



JOHAN ROCKSTRÖM
DIRECTOR, POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH; CHIEF SCIENTIST,
CONSERVATION INTERNATIONAL

“The Exponential Roadmap for Natural Climate Solutions reveals for the first time the approach we must take to roll out natural climate solutions at speed and scale.”

DRIVING A NATURE TRANSITION

Humanity is facing an unprecedented crisis and the stakes could not be higher. The central goal of the Paris Agreement – to keep global temperature rise as close to 1.5°C as possible – is in danger, and only swift and decisive action will keep it within reach.

The **Carbon Law**¹ tells us that to limit warming to well below 2°C means halving global fossil emissions by 2030, and then halving again by 2040, and again by 2050. This challenging but achievable trajectory can only be realized through the exponential growth of a wide range of climate solutions, as dramatically demonstrated by the Exponential Roadmap Initiative.²

The global energy sector is transforming before our eyes. More than a decade of massive public and private investments and the resulting technological breakthroughs have created the conditions for even the International Energy Agency to adopt a vision of Net Zero by 2050.³ We've passed the tipping point for clean energy and are accelerating toward the necessary global energy transition. The question is no longer whether it will happen, but how long it will take.

But even with the wildest success of the energy transition, we will fail without nature. There is no viable path to reaching 1.5°C or even 2°C without massive deployment of **natural climate solutions** – actions that increase carbon storage and/or avoid greenhouse gas emissions from forests, wetlands, grasslands, and agricultural lands.

Though the importance and urgency of these solutions is well recognized, progress has been stalled by the lack of a comprehensive and coordinated strategy to scale them up across the globe. This Exponential Roadmap for Natural Climate Solutions describes how we can – and must – slash land emissions and boost natural carbon sinks, accelerating from concepts, to actions, to outcomes.

The journey will be challenging, but it is a massive opportunity to reimagine the relationship between industrialized societies and the natural world and achieve a sustainable and just future for all life on our planet. Let's get started.

A CARBON LAW FOR NATURE

The clarity and simplicity of the Carbon Law has helped to set humanity on a path to make the necessary rapid strides towards deep decarbonization of global energy and industry sectors. To similarly revolutionize how we collectively care for nature and land – growing carbon sinks and cutting emissions across the world’s farms, ranches, forests, and natural lands – we introduce the **Carbon Law for Nature** – a simple, science-based benchmark for accelerating emissions mitigation through natural climate solutions.

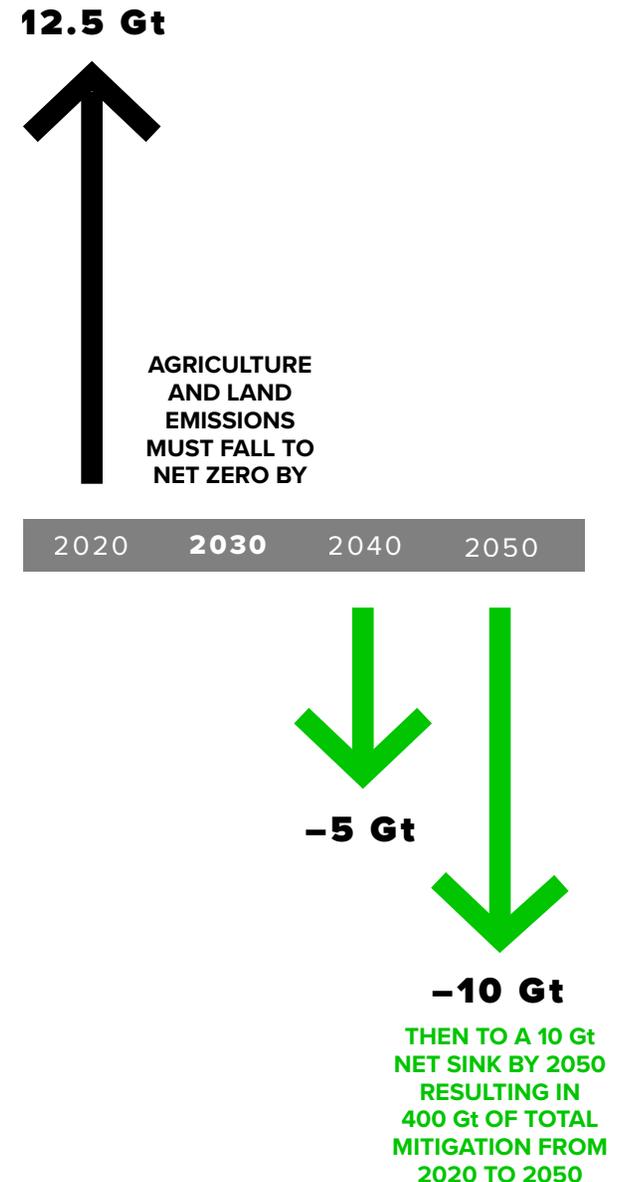
The Carbon Law for Nature – the first key innovation in the Roadmap – shows that we must rapidly transition global land use, moving from 12.5 Gt of greenhouse gas emissions from land each year, to net zero by 2030, a 5 Gt sink by 2040 and a 10 Gt sink by 2050. This transition becomes less daunting when we consider the ways we can reduce sources of emissions while simultaneously investing in growing carbon sinks.

This clear trajectory provides us with the necessary aspiration, and a common destination. It is derived

from what the latest science tells us *needs* to be achieved by land and nature, and what land emissions accountants tell us *can* be achieved⁴ – what is possible *and* cost effective – to keep global temperature rise to no more than 1.5°C and safeguard our natural environment.

The Carbon Law for Nature is ambitious, but it doesn’t rely on hypothetical technologies or risky geoengineering. In most cases, it’s about rapidly scaling practices that have been known for centuries to Indigenous peoples and other long-term stewards of the land – with commensurate support from businesses, policymakers, and the finance sector. It’s also about embracing emerging technologies and social movements that can help drive a radical reduction in our footprint on the land while achieving our sustainable development goals.

If we achieve climate action on land at the scale called for by the Carbon Law for Nature, our chances of maintaining a safe climate – and a healthy and resilient biosphere overall – are greatly increased.



ABOUT THIS ROADMAP

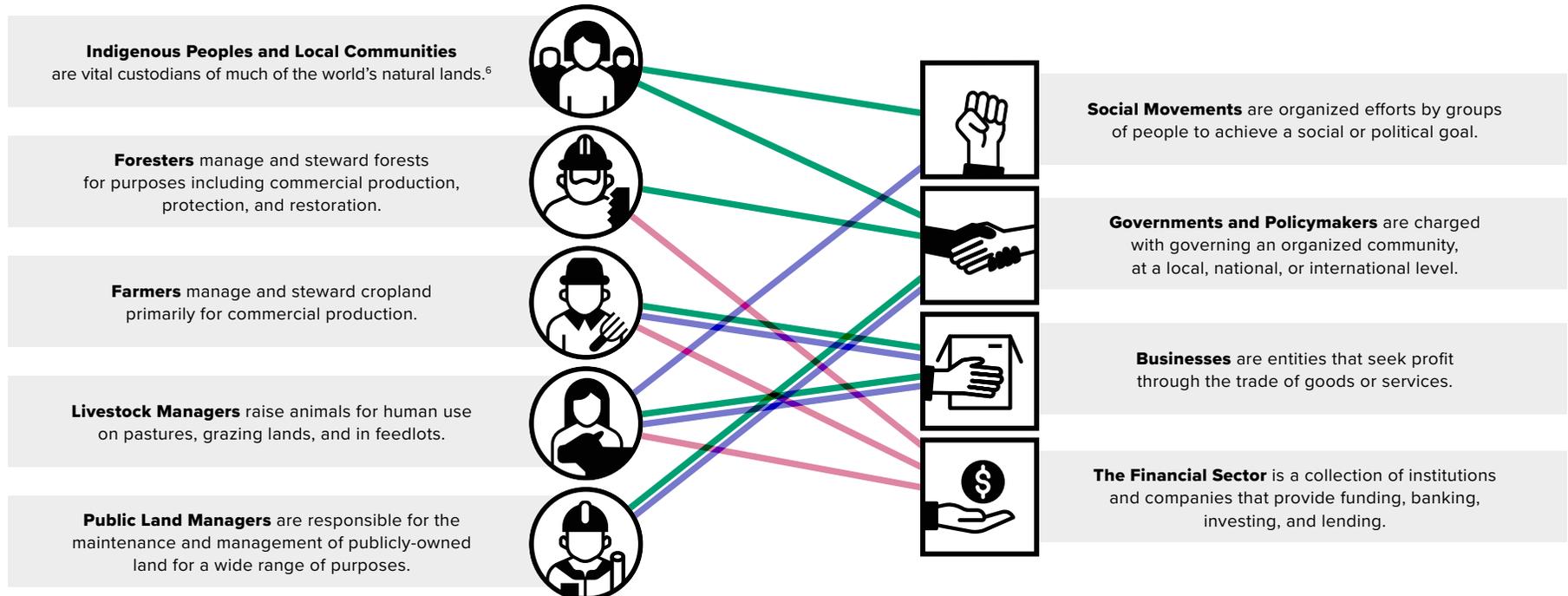
This report, the *Exponential Roadmap for Natural Climate Solutions*, is a **roadmap** for rapidly accelerating the reduction of greenhouse gas emissions and boosting natural carbon sinks through better stewardship of our natural and working landscapes. It's a first step towards charting the path and milestones that the world needs to follow to accelerate nature's contributions to climate mitigation in line with the **Carbon Law for Nature** – the first key innovation in this Roadmap.

The second key innovation is that the routes to action are organized around changes in the ways people interact with land, rather than changes in the amount of carbon in different types of land cover. This involves a necessary focus on **people living and working on the land**, primarily farmers, ranchers, foresters, Indigenous people and local communities, and public land managers. The ability of these groups to steward land is supported by other groups of people who we call **enabling actors**: policymakers, the finance sector, businesses, and social movements.

This Roadmap is organized around the actions that connect these two groups of actors, resulting in changes on the ground – the **Action Tracks**. Action Tracks focus on the interventions in the stewardship of the world's natural and working lands that will generate the greatest climate impact and are also the most likely to scale. Each of the eight Tracks, which are quantified in detail, focuses on a crucial part of the puzzle.

PEOPLE ON THE LAND

ENABLING ACTORS



The third key innovation developed in this Roadmap is a series of **mitigation trajectories** resulting from implementation of the Action Tracks. These trajectories show the pace of change required to meet the Carbon Law for Nature – and are in line with the science regarding the hierarchy of natural climate solutions.⁵

Taken together, the eight Action Tracks deliver the necessary outcomes: **protect** natural systems that are most at risk from agricultural expansion and other threats, rapidly scale climate-smart **management** to shift working lands from an emissions source to a net carbon sink, and begin to **restore** natural ecosystems and contribute to the emergence of a new global restoration sector.

The Roadmap then lays out the key milestones and areas of greatest potential worldwide to realize ecosystem protection, climate smart working lands management, and land restoration. To ensure that we can reduce emissions and grow carbon sinks sufficiently over the coming decades, it's imperative that work begins within all three categories immediately.

These transformations require focused work from enabling actors to create the conditions that make

them possible. For policymakers, our work prioritizes the most effective policy actions. For the finance sector, it directs green investment to where it's most needed, and away from counterproductive business-as-usual actions. For businesses, it identifies key risks and opportunities. For social movements, it shows where attention must urgently be drawn.

Overall, the Roadmap shows us where and how we can foster scientific innovation and large-scale deployment of natural climate solutions to support the people on the ground who will deliver the required nature transition. Its creation is a critical step towards providing communities with resources to support land stewardship, countries with the knowledge to identify and activate the climate potential of their domains, and companies and financiers with clear paths to invest in solutions. This must occur so that the massive potential of natural climate solutions can deliver on the Carbon Law for Nature: providing us all with a stable climate while maintaining biodiversity, delivering clean air and water, sustaining human health and well-being, and fortifying the resilience of our biosphere.

For more information on the assumptions and methodology that went into the creation of this Roadmap, visit conservation.org/roadmap.

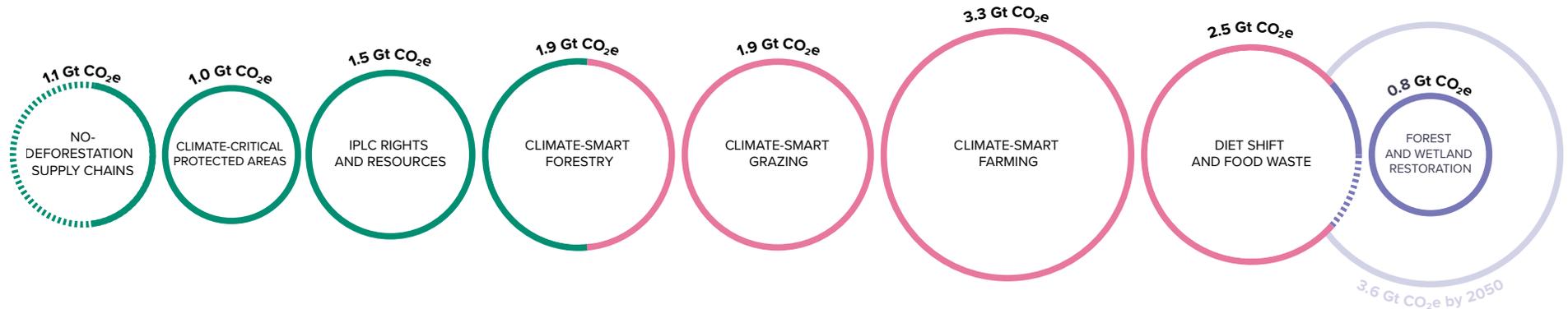


ACTION TRACKS

KEY OPPORTUNITIES TO PROTECT, MANAGE, AND RESTORE

Each circle below represents an Action Track – a collection of natural climate solutions. Larger tracks deliver more emissions savings by 2030. Color indicates whether the track’s solutions contribute to **PROTECT**, **MANAGE**, or **RESTORE**. Dashed circles indicate “non-additive” emissions reductions, which are also accounted for elsewhere in the analysis.

— SOLID LINE = ANNUAL EMISSIONS SAVINGS IN 2030
 DASHED LINE = NON-ADDITIVE CONTRIBUTIONS



No-Deforestation Supply Chains	Climate-Critical Protected Areas	IPLC Rights and Resources	Climate-Smart Forestry	Climate-Smart Grazing	Climate-Smart Farming	Dietary Shift and Food Waste	Forest and Wetland Restoration
Supply chains can send signals to farmers and ranchers, plus the companies and governments that enable their activities, that deforestation will put prices and market access at risk.	High-carbon ecosystems, with “irrecoverable” carbon that is quickly released when disturbed and will not recover for decades if lost, are high priorities for protection.	We must accelerate legal recognition of IPLC lands and rights globally, and supply the financial, political, technological, and legal resources needed to support Indigenous people and local communities in exercising those rights. ⁷	Better management of working forests can reduce emissions and increase carbon sequestration in production areas, while increasing their perceived value can also protect them from deforestation.	Adding trees to grazing areas and taking more care with soil and fodder holds great potential for emissions reductions while improving animal health and creating new economic opportunities for livestock managers.	Soil and cover crop management, agroforestry, and other regenerative farming techniques can dramatically increase carbon sequestration, while increasing biodiversity and resilience to climate risks.	In richer countries, diets must shift toward a healthier emphasis on more plant-based foods, while food loss and waste must be reduced everywhere.	Passive and active reforestation provides benefits for decades and must not be delayed. Restoring wetlands – especially peatlands – can also provide significant and rapid returns.

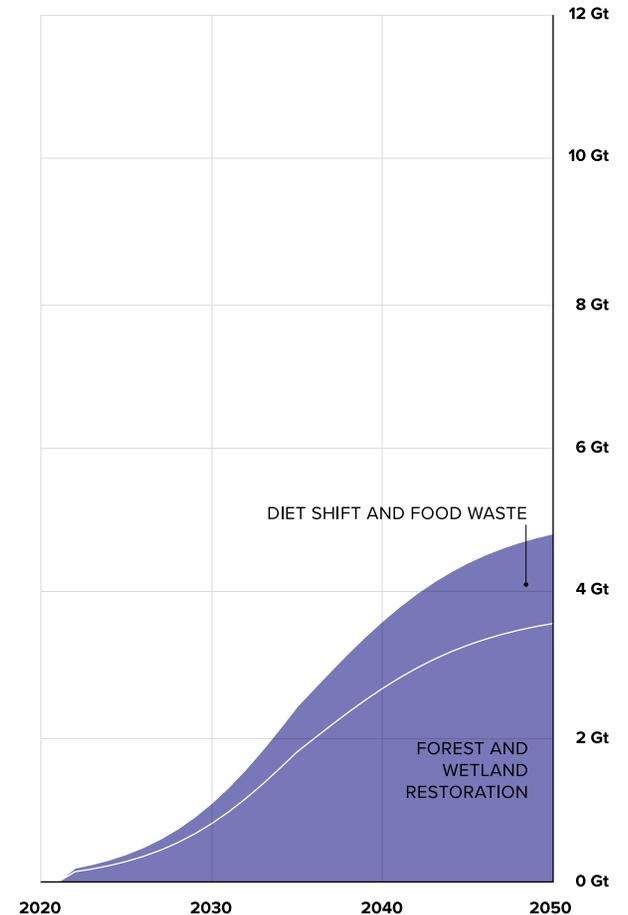
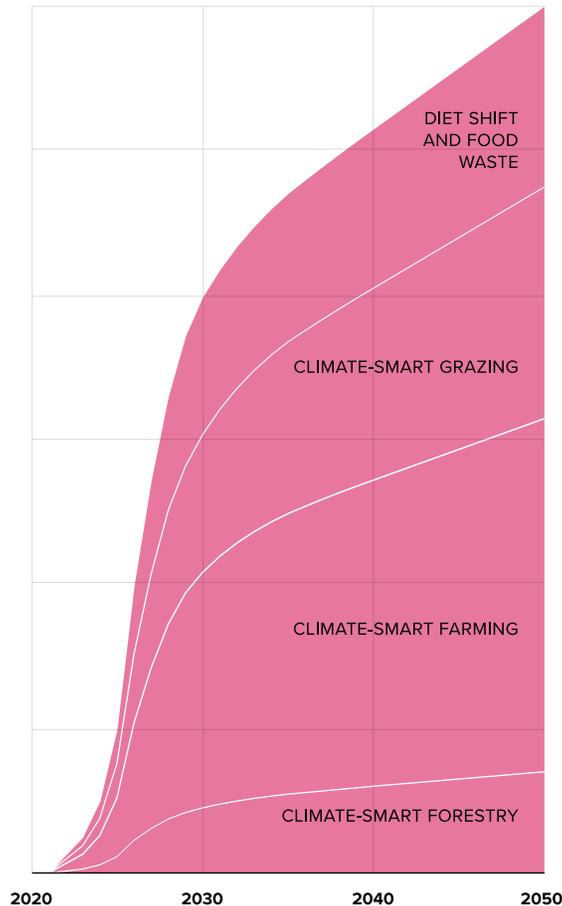
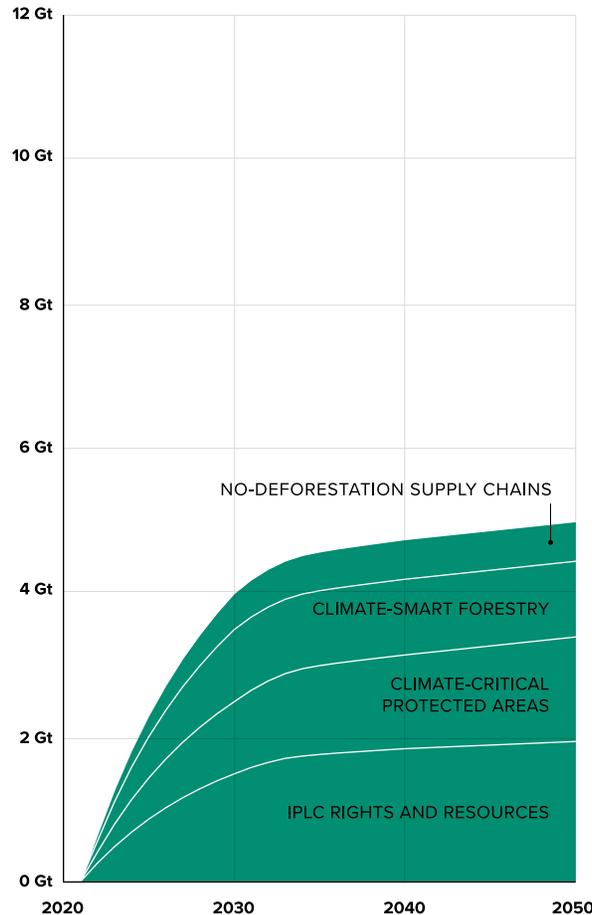
FROM ACTIONS TO OUTCOMES

The Action Tracks detailed in this Roadmap underpin the three categories of natural climate solutions we must accelerate⁸ to meet the Carbon Law for Nature.

 First, they provide a massive and rapid push to **PROTECT** and conserve healthy ecosystems, avoiding emissions from their destruction. Together they achieve a halving of emissions from natural ecosystem loss every five years for the next decade – achieving 2.3 Gt of carbon emissions mitigation annually by 2025 and 4.0 Gt annually by 2030, and saving 45 million hectares of forests and wetlands from destruction by 2030.

 Second, they provide an exponential ramp-up of actions and incentives to **MANAGE** working lands smarter, delivering huge climate benefits while maintaining productivity. Together, they show that we must shift more than 20% of the world’s forests, farms, and grazing lands – over two billion hectares in total – towards climate-smart management, achieving 8.0 Gt of emissions reductions annually by 2030.

 Third, they allow us to **RESTORE** damaged and destroyed ecosystems to a state where they once again reliably store and remove carbon from the atmosphere. A new global restoration sector, underpinned by a transformation of the food sector, can deliver nearly 5.0 Gt of CO₂ mitigation annually over an area as large as 350 million hectares of forests and high-carbon wetlands (such as peatlands) by 2050.



KEY MESSAGES

- 1** → We are in crisis. The Paris Agreement climate goals can only be achieved with rapid decarbonization of energy and industry, coupled with improved land stewardship actions known as **natural climate solutions**.
- 2** → The **Carbon Law for Nature** requires that the land sector must reach net zero greenhouse gas emissions by 2030, a 5 Gt sink by 2040, and a 10 Gt sink by 2050 to keep global temperature rise to 1.5°C.
- 3** → The Carbon Law for Nature is a **universal yardstick for ambition**: actors at every scale, from individual companies to countries, must hit its benchmarks.
- 4** → The **Exponential Roadmap for Natural Climate Solutions** shows how we can meet the Carbon Law for Nature by using existing technologies and the latest science to accelerate natural climate solutions.
- 5** → To do this we must **protect** natural systems that are most at risk from agricultural expansion and other threats. Put simply, we must halve emissions from ecosystem loss every five years for the next decade to protect 45 million hectares of forests and wetlands, delivering 4 Gt of mitigation annually by 2030.
- 6** → We must double the use of climate-smart **management** every year through 2026, reaching over two billion hectares by 2030 – 20% of the world’s working lands – to achieve 8 Gt of mitigation annually and net-zero emissions by 2030.
- 7** → Starting to **restore** natural ecosystems now is more vital than ever. To remove and sequester nearly 5 Gt of CO₂ annually by 2050 requires a new global restoration sector to emerge, restoring at least 350 million hectares of forests and wetlands by 2050.
- 8** → A transformation of **food systems** is at the heart of natural climate solutions and is necessary to achieve most of the needed protection, climate-smart management, and ecosystem restoration, while enhancing global food security.
- 9** → Alongside the Roadmap’s transformative climate benefits, it also offers multiple **co-benefits**: increased biodiversity, clean air and water, human health and wellbeing, rural jobs, environmental justice, and biosphere resilience.
- 10** → The effort needed to deliver natural climate solutions at scale is enormous and requires us all – through solutions delivered by **people on the land** and supported by public and private **enabling actors**. We invite you to join us on this journey.

ACTION TRACKS

Our second key innovation in this Roadmap is that the routes to action are organized around changes in the ways people interact with land, rather than changes in the amount of carbon in different types of land cover. This involves a necessary focus on people living and working on the land, primarily farmers, ranchers, foresters, Indigenous peoples and local communities, and public land managers. The ability of this group to steward land is supported by enabling actors: policymakers, the finance sector, businesses, and social movements.

The actions that connect these two groups of actors to result in changes on the ground are called **Action Tracks** in this Roadmap. These group together the interventions that will generate the greatest climate impact through the stewardship of natural and working lands and are the most likely to scale. Each Track focuses on a crucial part of the puzzle.

Taken together, the eight Action Tracks we lay out in this section will protect natural systems that are most at risk from agricultural expansion and other threats, rapidly scale climate-smart management of working lands within the decade and begin to restore natural ecosystems through the emergence of a new global restoration sector. And together, they are the world's route to achieving the Carbon Law for Nature.

IPLC RIGHTS AND RESOURCES

Evidence clearly shows that strengthening the land and resource rights of Indigenous peoples and local communities (IPLCs) is a scalable, cost-effective natural climate solution.⁹ For example, far more ecosystem carbon is lost outside legally-recognized Amazonian Indigenous territories and protected areas than inside their boundaries.¹⁰

We must accelerate the establishment of legal recognition, stronger rights and safeguards to go from over 1.5 billion hectares of IPLC lands today to cover over 2 billion hectares by 2030 and more than 3 billion hectares by 2050. At UNFCCC COP26, the world pledged \$1.7 billion of financing from 2021-2025 for doing this in 10 developing countries. Financing must accelerate to reach over \$8 billion total by 2030 to support these steps in an additional 14 countries.¹¹

In addition to recognition, Indigenous peoples and local communities need financial, political, technical, and legal support to exercise their rights and address threats to their lands from external pressures.

They need access to the technologies and resources necessary to influence policymaking and monitor the implementation of any agreements. It is also important to ensure that finance is accessible, transparent, and trackable, and that it supports quality outcomes.

For Indigenous peoples and local communities, gaining legal recognition and securing land rights is urgent: The land is linked to their traditional knowledge, cultural identity, and practices. Their rights must be recognized and respected as rapidly as possible.

While climate mitigation is one benefit among many to advancing IPLC rights and resources, rapid action on this solution would result in more than 1.0 Gt of avoided emissions annually by 2025, more than 1.5 Gt annually by 2030, and nearly 2.0 Gt annually by 2050 – largely from improved stewardship of tropical forests.



PROTECT



Following the 1985 Brazil constitution recognizing Indigenous rights, the government formalized tenure recognition for over 100 million hectares of Indigenous lands.¹² A combination of these tenure reforms, other protected areas, forest monitoring, no-deforestation supply chain actions, and enforcement resulted in a 70% reduction in deforestation in the Amazon from 2005–2013.¹³ Rates have increased since then due to weakening legal protections and pressure to expand mining concessions.



The Philippines Indigenous Peoples Community Conserved Territories and Areas Consortium conducted an Indigenous-led effort combining GPS, satellite imagery, and traditional knowledge to map and formally recognize 350,000 hectares of ancestral lands in the Philippines.¹⁴ The project demonstrated the importance of strengthening land rights through technical capacity-building, legal policies, and carbon financing.



CLIMATE-CRITICAL PROTECTED AREAS



PROTECT

Some of the most important places for addressing the climate crisis contain “irrecoverable carbon” that is rapidly released when disturbed and will not recover for decades if lost. This includes mangroves, peatlands, and intact forests. Many of these critical carbon stores – both inside and outside existing protected areas – continue to be threatened by human activities, with six billion metric tons of CO₂ emitted annually from ecosystem destruction in the last decade alone.

While nearly 17% of Earth’s lands and inland waters are already protected in national parks, wilderness areas, community-conserved areas, and nature reserves,¹⁵ these places have been designated primarily to conserve our natural and cultural heritage. However, 52% of Earth’s irrecoverable carbon still lies outside of protected areas or Indigenous lands.¹⁶

To address the twin climate and biodiversity crises, we must significantly increase the area of the planet that is protected and well managed. To maximize impact, these new protected areas should be sited to protect not just species, or cultural sites, but also land with irrecoverable carbon that is most at risk of being

lost to degradation or destruction. At the same time, it is vital to recognize that many protected areas have been established without involvement of local peoples. This has resulted in evictions, and the loss of traditional knowledge, culture and even lives.¹⁷ A new approach to protection that is fair and equitable must be realized within the next decade in collaboration with Indigenous peoples and local communities.

Significant ambition exists to grow the world’s protected areas. Over 100 countries and counting have pledged to protect 30% of the planet by 2030¹⁸ – nearly double the area currently designated as protected. We can safeguard almost 75% of the world’s irrecoverable carbon by effectively protecting just 5.4% more of the Earth’s land surface compared to the extent of protected areas today.¹⁹ The full protection of areas most at risk of conversion and with extensive irrecoverable carbon would save about 1.0 Gt of greenhouse gas emissions annually by 2030.

Policymakers must take several approaches to expand government-led protection of climate-critical lands. The first is to establish new national and regional

protected areas, working with businesses, landowners, and local communities to reduce the pressure on these lands by finding financing, building political will and creating a shared vision. A second is to establish local and community parks and pursue other effective conservation measures that encourage sustainable use, such as community-managed forests. A third is to halt and reverse a wave of legal changes that have eased restrictions on protected areas, shrunk their boundaries or eliminated legal protections entirely. A fourth is to improve the management of existing protected areas and their carbon stocks by allocating sufficient resources, encouraging the participation of communities, building capacity for management, encouraging innovative conservation financing mechanisms, and developing climate resilience plans.

Time is of the essence. Making existing protected areas effective on the ground and extending protection to new areas can take years or even decades. Governments must act fast and start now to expand protected areas and make existing protected areas climate-resilient in order to reach ambitious 2030 goals.



→ In the Chyulu Hills of Eastern Kenya, a carbon credit program is providing financial support to local communities working to conserve about 400,000 hectares of forests and other important carbon stores. In addition to the project's climate impact, it also directly helps support a watershed that sustains Mombasa, Kenya's second largest city, and a critical biodiversity corridor for endangered species in the area.²⁰

→ Yaguas National Park in northeastern Peru was created in 2018 after many years of work by communities in the area seeking protected status. The park spans nearly 1 million hectares of tropical forest storing 48 million metric tons of irrecoverable carbon, and contains 3,500 species of plants, two-thirds of Peru's freshwater fish species, and threatened species such as the giant otter, giant anteater, brown woolly monkey, and South American tapir.²¹

NO-DEFORESTATION SUPPLY CHAINS



PROTECT

Agricultural supply chains can generate significant demand for reduced deforestation, when buyers send clear signals to producers – and the companies and governments that enable their activities – that the market for deforestation products is rapidly drying up. However, supply chains for products linked to deforestation are complex, stretching around the globe and influenced by decisions across sectors and scales. Making this happen in practice, therefore, requires a range of solutions.

The first is improved land-use governance. Producer country governments must dedicate resources to rapidly implement and enforce domestic laws and regulations that have an impact on land-use changes, halting illegal forest conversion, and upholding the customary and legal rights of Indigenous peoples and local communities. Over time, most governments will need to pass new laws to halt what is currently legal deforestation.

Second, manufacturers, retailers, traders, large producers, investors, and lenders must expand

and act on their commitments to no-deforestation supply chains. This means setting ambitious targets (following the guidance of the Science-Based Targets initiative²²), collecting data and transparently reporting on deforestation in their supply chains and portfolios (in line with best practices such as the Accountability Framework initiative²³), and ensuring that no-deforestation objectives are fully integrated into purchasing, trading, and investment decisions. Companies can also go further to catalyze a larger transformation, for example by leveraging purchasing agreements to incentivize better governance and by directly investing in sustainable rural development in sourcing areas.

Finally, countries importing the bulk of the world's goods linked to deforestation must advance trade regulations to ban commodities produced on illegally-deforested land. International trade is a significant driver of deforestation and contributes to undermining the rule of law in forest-rich countries. Trade regulation has shown its power in greatly reducing illegal timber flows and now must do the

same for deforestation. Public and private finance must also be aligned with these principles.

Increased adoption and successful implementation of no-deforestation supply chain commitments, covering 80% or more for all major forest-risk commodities, would help avoid deforestation equivalent to more than 1.0 Gt of emissions per year by 2030.



→ The palm oil industry currently has the broadest coverage of no-deforestation commitments – about 65% of global production moves through at least one company with a commitment. However, such commitments only cover a small proportion of most other major forest-risk commodities – ranging from around 11% to 17%.²⁴

PALM OIL	65%
COCOA	17%
PULP AND PAPER	12%
SOY	11%
PASTURE	11%
RUBBER	7%
COFFEE	0%

→ Forest conversion for oil palm plantations in Indonesia, the world's largest producer, dropped following the implementation of supply chain commitments by palm oil producers, traders, and users.²⁵ In 2021, despite price increases, both Indonesia and Malaysia saw the lowest level of palm-driven deforestation in 20 years, at less than 5% of the highest historical levels. While there are many drivers behind this positive trend, including the Indonesian government's moratorium on new palm plantations in forests, it illustrates the importance of action by supply chain companies alongside government and civil society.²⁶

CLIMATE-SMART FORESTRY

Just over half of the world's natural and semi-natural forests are managed for timber, fiber, or other forest products, while also contributing other benefits to society, including climate change mitigation, conservation of biodiversity, sustaining livelihoods, and providing the basis for food and water security as well as a stable climate. Changing the management of these working forests can result in climate mitigation from both protection – when increasing their social, economic, and environmental value prevents their conversion to agriculture – and from better carbon management compared to previous regimes with changing practices.

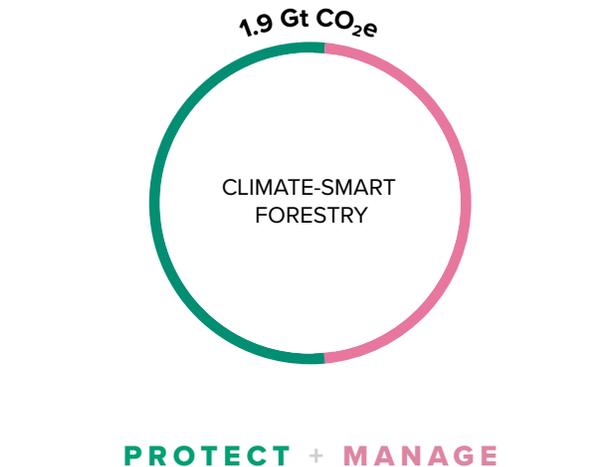
Forest managers operating on private land and concessions, along with policymakers, finance, and businesses, all have roles to play in protecting working forests from conversion. In largely intact publicly-owned forests, degradation is usually caused by poorly planned road networks and irresponsible logging practices due to insufficient oversight and enforcement, and few incentives for sustainability. Better planning of roads, oversight, and improved

forest management techniques can help protect these productive forests – along with their long-term social and environmental value – from deforestation.

Privately-held landscapes tend to be more fragmented than public working forests, but degraded forests are still at risk of conversion – especially when ownership changes. Legal agreements known as easements that forbid deforestation but permit sustainable production have been shown to protect forests during this risky transition.²⁷

By focusing on the role that forest owners and managers can play in protecting forests, Climate-Smart Forestry can protect 2.5 million hectares of working natural forests from conversion annually, yielding 1.0 Gt of equivalent annual emissions reductions by 2030.

Climate-Smart Forestry can deliver additional emissions mitigation through improved practices. Reduced-Impact Logging for Climate (RIL-C) is a technique that allows for timber production



in these forests to be maintained while minimizing ecosystem damage. It emphasizes improved harvest planning and practices, building fewer and narrower access roads, and replacing heavy machinery with long-line cable winching systems that avoid damage to non-commercial trees. RIL-C allows loggers to cut impacts to, and emissions from, forests in half while maintaining timber yields, and could deliver 0.4 Gt of annual emissions reductions across the tropics alone.²⁸ Emerging science suggests even more opportunity from new Climate-Smart Forestry solutions, including the potential for removing some of the over-abundant vines from degraded tropical forests to increase tree growth.²⁹

Plantation forests, which are planted with fast-growing species and managed and harvested intensively, account for roughly 4% of global forests. Shifting these areas to more species-diverse, multi-aged systems can maintain wood production while increasing biodiversity and carbon sequestration. In both natural and plantation forestry, extending the average age of trees before harvesting timber has

the most significant carbon mitigation potential.³⁰ However, it also places immediate constraints on timber production, even while increasing long-term yields, so must be sensitively managed in response to price and demand signals.

Doubling these and other Climate-Smart Forestry solutions globally every year through 2026 would reach nearly 0.5 Gt of emissions mitigation annually by 2026, doubling again to nearly 1.0 Gt annually in 2030. However, achieving this rapid expansion will require policymakers, businesses, and financial institutions to rapidly align their policies and financing approaches with these solutions. That means equipment replacement, training programs for forestry workers and managers, incentives such as carbon pricing, and supporting long-term shifts to balance carbon storage with timber production, including by addressing harmful subsidies and incentives.



The Maya Biosphere Reserve in Guatemala spans over 2.1 million hectares of Mesoamerican forests. Unlike a typical protected area, communities sustainably manage these forests for timber production based on the principle that people who make their living from the forest have the strongest incentive to protect it. The success of this community forestry initiative in protecting forests is evident from the near-zero deforestation rate over the last decade.³¹



The Borneo Initiative³² provides training and financial support to help forestry companies and local communities adopt low impact logging practices. As a result, over a million hectares of forests in Indonesia have been certified as sustainably managed by the Forest Stewardship Council (FSC). If these practices were extended to include the latest Climate-Smart Forestry methods at this scale and rate of proven FSC adoption, they would cut emissions in half to deliver millions of metric tons of CO₂ mitigation without reducing wood yield.

CLIMATE-SMART FARMING

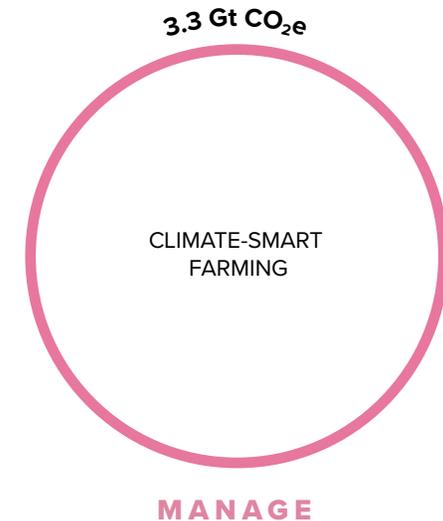
Croplands around the world must rapidly begin drawing down carbon from the atmosphere to counterbalance emissions from fertilizers and animals, shifting from a net source to a net sink of emissions. Farmers must achieve this while simultaneously expanding food production for a growing population and without expanding agriculture's land footprint. This Roadmap only includes solutions for Climate-Smart Farming that do not compromise long-term yields.

The most immediate solution is to increase soil carbon sequestration through “regenerative farming” practices that reincorporate the nutrients and carbon from the stems, leaves, and roots of crops back into the soil. Low-cost practices such as cover cropping, reduced tillage, and mulching crop residues could absorb 0.9 Gt annually into farmland soils by 2030 with the right incentives. Crop residues may be converted into biochar, a carbon-rich organic material, and mixed back into the soil, potentially achieving another 1.8 Gt of annual sequestration by 2030, while improving soil fertility and water retention.

Agroforestry – or integrating trees into croplands and pastures – is another key regenerative farming solution. While its adoption has been historically slow, as farmers associate productivity increases with removing trees to plant every square inch, new research shows that introducing a limited number of trees into farms provides carbon benefits without reducing crop productivity.³³ Given current barriers to agroforestry adoption that include culture, cost, and the slow growth rates of trees, this Roadmap envisions reaching 0.2 Gt of annual sequestration in 2030, accelerating to 1.4 Gt in 2050.

Farmers must also rapidly adopt practices to reduce methane and nitrous oxide (N₂O) emissions, delivering immediate climate benefits. Farmers can save money by using nitrogen fertilizers more efficiently while delivering a 10% reduction of N₂O emissions annually by 2030, or 0.2 Gt CO₂e. Improved water management practices, such as mid-season draining of rice paddies, can reduce a significant source of methane emissions by 0.15 Gt CO₂e by 2030.

Governments, businesses, and financial institutions must accelerate these practices by providing direct incentives and support: transforming harmful agricultural subsidies and investments to reward climate-smart farming and deploying transition assistance programs and other extension services. Key support needs also include investing in research and development of tree varieties that minimize competition for growing space with crops, speeding the design and deployment of mechanized farming equipment which specializes in mixed crop-and-tree systems, and adopting business and financing models that reward carbon sequestration and other regenerative farming solutions.





→ Europe has led temperate regions in policy support for agroforestry. The Agforward Agroforestry for Europe Project (2014–2017) was funded by the European Commission to promote agroforestry practices in Europe and advance sustainable rural development.

→ Techniques for integrating trees into agricultural lands have transformed vast areas of Niger from severely degraded farmland into agroforests. Farmers agreed to encourage tree growth on their land in exchange for food aid, and the improved agricultural yields convinced skeptical neighbors. The same principles are now practiced in many other countries, in Africa and beyond.³⁴

→ The “4 per 1000” global initiative, aimed at increasing the quantity of organic matter in soils to meet a target of 0.4% increase per year, emerged out of UNFCCC COP21 to encourage sustainable practices across global agricultural lands.³⁵ As of May 2022, 39 countries have joined the movement alongside 31 international organizations and funding bodies, 67 farmer and forester associations, and hundreds of research and civil society entities.³⁶

CLIMATE-SMART GRAZING

Livestock managers must improve their management of existing pasture and grazing lands, in addition to enhancing their role in ecosystem protection (see No-Deforestation Supply Chains). Just as with farming, governments, businesses, and financial institutions must radically change their policies and practices to support Climate-Smart Grazing. This can be done through efforts to formalize the livestock sector, enforce land-use regulations, and reward transparency while supporting sustainable local livelihoods and the cultural practices of vulnerable groups such as Indigenous pastoralists.

Nomadic and semi-nomadic Indigenous pastoralists have been “rotating” their animal herds sustainably across grassland landscapes for hundreds of years, with deep connections to culture going well beyond food production. Storing carbon in intensively managed pasture soils can be accelerated quickly by replicating this rotation of animals with movable fencing, as well as through improvements such as seeding legumes – a practice which improves soil fertility and carbon content. Introducing basic soil

management practices into degraded areas of rangelands (if not reforested) will also sequester carbon. These solutions can deliver 0.9 Gt of annual sequestration in 2030, reaching 1.2 Gt by 2050.

Integrating trees with grazing lands – or silvopastoralism – provides many benefits for the climate, livestock, and land managers. Animals may consume fodder from trees, especially when low-lying forage is not available due to drought. The trees may also provide economic products such as wood, cork, or fruits, and provide shelter from rain, wind, snow, and sun. The shade from trees is particularly valuable and will get more valuable with the advance of climate change – extending the growing season for grasses in drier climates and improving the health of animals and agricultural workers alike, especially through thermoregulation and reducing sunburn. Livestock can also be introduced into farmland to feed on the residues and food left over after harvest. This can replace some use of human-edible crops to feed animals, reducing emissions from livestock by 19–50% by 2050.³⁷

In combination, these silvopasture techniques can reach about 0.8 Gt of annual sequestration by 2030, doubling to 1.7 Gt by 2050.

While most mitigation on grazing land involves storing carbon in soils and vegetation, cost-effective solutions also exist for reducing the sector’s non-carbon emissions. Improved management of cattle feed and feed additives can reduce methane released from digestive processes, while manure management systems such as anaerobic digesters can reduce both methane and nitrous oxide emissions. Accelerating these solutions can contribute an additional 0.2 Gt of mitigation annually by 2030.



MANAGE



→ The Neutral and Regenerative Livestock Project in Brazil³⁸ promotes improved cattle management, including silvopastoral methods like the addition of trees for fodder and timber, and soil carbon enrichment through field rotation in the wet and dry seasons. They have also developed a certification for beef and milk which guarantees that emissions from the production system are lower than the carbon added to the soil.

→ The Herding for Health program in South Africa's drylands has helped Indigenous and local herders sustain their livelihoods while maintaining the region's ecological integrity. Covering about 250,000 hectares and 1,600 rangeland pastoralists, the project has helped improve nutrient concentration, remove alien species, and introduce climate-resilient breeds. Local herders' costs of management have decreased, while the project has created new eco-ranger jobs and market incentives to encourage further sustainable livestock production. This success will be scaled up in a new Green Climate Fund project in Botswana.³⁹

DIET SHIFT AND FOOD WASTE

At present, about 30% of the Earth's land area is grazed by about 20 billion animals, and this is where the greatest opportunity can be found to “release” previously forested land for restoring nature and to remove vast amounts of CO₂ from the atmosphere.^{40,41} About 34% of the global total area of cropland is also currently used to grow animal feed.

In richer countries, where animal-derived foods are over-consumed to the detriment of both human health and natural ecosystems, a major opportunity exists for beneficial diet shifts. This will reduce the pressure to convert lands for livestock, while enabling poorer countries to tackle undernutrition by using existing cropland to deliver more calories to people per hectare,⁴² easing the global land squeeze and reducing food prices (see Moving Forward). As alternative proteins gain market share, it will also be important to ensure that the agricultural commodities used for these products (pea protein, lentils, etc.) do not result in expansion of agriculture lands.

There is limited potential to release cropland for restoration, even with shifts towards healthier diets. Cropland currently used to grow animal feed will be required to grow food for human consumption instead. This means that the primary source of restoration opportunity lies across the significant areas of low-productivity grazing land in places that would naturally be covered by forests.⁴³

Diet shift is not the only option for reducing land demand from food systems – we must also reduce food loss and waste. About a third of all food produced for human consumption is lost along the supply chain or wasted by retailers, food service providers, and consumers.⁴⁴ An emerging solution to food waste – a circular approach that uses either food waste or byproducts from crop production to feed livestock – could free up 300 to 450 million hectares of land currently used to grow livestock feed to instead grow crops for human consumption.



The power of social movements will be critical to transforming food systems. Governments also have a role to play – for example by adjusting national dietary guidelines to diets consistent with both health and planetary boundaries (the “planetary health diet”). Businesses and finance are also enablers, for example by funding technological advances such as improved meat alternatives.

A person wearing brown pants is standing in a field of green plants. They are holding a blue bucket filled with yellow melons. The sun is low in the sky, creating a warm, golden glow. The background shows more of the field and some trees.

→ In Brazil, famous for meat consumption, the number of vegetarians has doubled over a six-year period. Thirty million people, or 14% of Brazilians, reported being vegetarian or vegan in 2018.⁴⁵

→ Canada recently launched a food guide that recommends half a plate of vegetables, a quarter of a plate of protein and a quarter of a plate of wholegrain foods, with water as the drink of choice. The guide recommends that protein should come from plant-based sources rather than animal sources.⁴⁶

FOREST AND WETLAND RESTORATION



RESTORE

Competing demands for land – for food production, biodiversity conservation, and more – set the bounds of ecosystem restoration. But where forests and wetlands naturally belong and competing demands allow, there are several effective solutions for sequestering and storing carbon through restoration, depending on a location’s environmental, cultural, and economic characteristics, as well as the national and local policy landscape.

Reforestation through natural regeneration relies on vegetation’s ability to regrow given sufficient seed sources and appropriate growing conditions. It is a relatively low-cost approach to restoration that can be rapidly scaled by simply protecting areas in which forests are regenerating. Currently, re-clearing of naturally-regenerating forests is a major challenge for scaling reforestation efforts. Regional studies suggest that carbon sequestration in existing forests would immediately increase by a factor of four if regenerating landscapes were protected.

The simplicity and low cost of natural regeneration aside, the policies needed to enable it are less direct than tree planting programs. For example, in regions of insecure land tenure, governments must bring together incentives to maintain naturally regenerating forests with strengthened property rights. Vegetation is commonly cleared in areas with poorly defined ownership to demonstrate the right to use and profit from it, so reforming land ownership can help to end this practice.

Active forest restoration – planting of seedlings or seeding of the landscape – is an order of magnitude more expensive than natural regeneration, as it requires sufficient seed sources, tree nurseries, labor for planting, and long-term monitoring of planted seedlings. A recent study in Brazil found that planting seedlings was about six times more expensive than assisted natural regeneration with fences – and that shifting from an 80-20 ratio of active to natural regeneration to a 50-50 ratio would lower costs from about \$1300 per hectare to \$760 per hectare.⁴⁷

Not all forests will regenerate naturally, however, and some places will require active restoration. If seedlings are well-tended during the critical first decade of establishment (at some expense), active restoration can be a highly effective approach for reforestation. The scientific community (including both academia and non-profits) has a key role to play in identifying where this is the case.

Given the cost of active restoration, governments and the private sector must rapidly scale up the capacity of seed-producers, nurseries, and a trained workforce to support widespread reforestation. In the United States, for example, existing nursery capacity will need to more than double to meet current restoration goals. In countries with less-developed nursery systems, even greater resources for scaling reforestation infrastructure and workforce will be required.

Critically, active reforestation provides the opportunity to further climate justice goals by planting tree species of direct use to local communities.

This can help to diversify livelihoods and encourage local support for restoration projects. Active restoration should therefore be directed towards areas in which natural regeneration is unlikely, and where tree-based goods (e.g., fruits, nuts, fuelwood, or timber) would be valued by the community.

Solutions for restoring wetlands generally involve first restoring natural surface and soil water flow by removing human influence such as drainage or water control structures. Once hydrology has been restored, the next step is promoting the revegetation of wetland areas. This sequesters and stores carbon, and stabilizes the ecosystem to safeguard it from future damage and changes in weather patterns as a result of climate change.

High priority must be placed on rewetting peatlands. Although the climate benefit of restoring these ecosystems is partially offset by their methane emissions, rewetting peatlands slows emissions of carbon that takes centuries to accumulate, and results in massive climate benefits over long timescales.⁴⁸

Coastal wetlands such as mangroves, seagrasses, and tidal marshes (known as “blue carbon” ecosystems) are another priority for restoration, as the climate benefits are immediate and unambiguous. One proven framework for approaching this is “community-based ecological mangrove restoration”,⁴⁹ where communities are employed to do the boots-on-the-ground work while local barriers to natural regeneration are eliminated. The aim of this approach is to support communities in their efforts to restore and steward their mangroves while deriving sustainable livelihoods from the restored ecosystem.

Countries should also prioritize the inclusion of coastal wetlands in their climate mitigation and

adaptation policies and plans wherever possible (e.g., in Nationally Determined Contributions under the Paris Agreement⁵⁰).

In many cases, the upfront costs of restoration – whether forests or wetlands – will need to be offset by governments or through carbon finance mechanisms to encourage their uptake. This can be done through cost-share programs, or the provision of technical support and guidance, or through the establishment of sustainable and profitable community-based forestry industries at scale.

The return on investment into restoration could be enormous. Rapidly scaling a new global restoration sector provides tremendous opportunity for job creation and development of stronger and more resilient local economies.⁵¹ For example, a Brazilian target of restoring 12 million hectares of forest is expected to create 1 million to 2.5 million direct jobs, or roughly 0.4 jobs per hectare of restoration.⁵² Scaling this level of job creation to international restoration targets such as those of the United Nations Decade on Ecosystem Restoration⁵³ demonstrates the potential for the creation of tens to hundreds of millions of jobs globally.



In response to devastating fires in drained peatlands in Russia in 2010, a Russian-German partnership has rewetted about 75,000 hectares of peatland by damming drainage ditches with local materials. The emissions reductions from the project are estimated at approximately 0.7 Mt annually.⁵⁴



In Thailand, Hmong villagers partnered with Chiang-Mai University researchers to reforest degraded areas in the Doi Suthep-Pui National Park. Over 16 years, scientists developed the restoration plots, while villagers were paid to collect seeds and plant trees. Diverse native trees and birds rapidly recolonized planted sites, while internal social conflicts over resource shortages were reduced and the community’s public image improved.⁵⁵

FROM ACTIONS TO OUTCOMES

The Carbon Law for Nature provides an overarching destination: a **science-based benchmark** for the total mitigation amount required from natural climate solutions to maintain the biosphere and keep in line with global climate goals. The Action Tracks then provide the **cost-effective interventions** that will generate the greatest climate impact, and are the most likely to scale. The mitigation trajectories, laid out in this section, are the crucial third innovation in this Roadmap: They reveal the **necessary speed and scale** at which we must implement solutions on the ground in order to meet the Carbon Law for Nature.

We created these trajectories by grouping the mitigation potential underpinning each Action Track according to the three categories of natural climate solutions used by land emissions accountants: protect, manage, and restore. These curves map out the mitigation that must result from implementation of the Action Tracks, if we are to achieve the Carbon Law for Nature.

They are guided by a long-standing natural resource decision-making framework that prioritizes mitigation of environmental harms: first avoid negative impacts; second minimize unavoidable negative impacts; and finally remediate or compensate for the negative impacts that remain. This so-called “mitigation hierarchy” was recently adapted to natural climate solutions, with criteria based on magnitude, immediacy, cost, and co-benefits, demonstrating that protect, manage, and restore are an ordered hierarchy.

Following this approach, this section of the Roadmap first lays out the key milestones and areas of greatest potential worldwide to **protect** natural systems that are most at risk from agricultural expansion and other threats, achieving 4 Gt of carbon emissions mitigation annually by 2030. It recommends shifting more than 20% of the world’s forests, farms, and grazing lands towards climate-smart **management**, achieving 8 Gt of emissions mitigation annually by 2030. Finally it requires that actors begin to **restore** natural ecosystems and contribute to the emergence of a new global restoration sector, achieving 5 Gt of carbon mitigation annually by 2050. To ensure that we can accelerate mitigation action sufficiently over the coming decades, it’s imperative that work begins within all three categories immediately.

PROTECT, MANAGE, AND RESTORE

PROTECT

In the realm of natural climate solutions, “protection” refers to **actions that avoid emissions from conversion** of forests, grasslands, or wetlands, or from changing wetland hydrology.

While the overall area of protected land globally has increased steadily in the last 30 years through the expansion of existing protected areas, community-based conservation, and Indigenous land designations, 52% of Earth’s irrecoverable carbon currently remains outside of protected areas and Indigenous lands.⁵⁶ Many of these critical carbon stores continue to be threatened by human activities – including inside existing protected areas – with 6 Gt of CO₂ emitted annually from ecosystem destruction in the last decade alone. This represents nearly 15% of global CO₂ emissions.⁵⁷ Accelerating protection as described in the No-Deforestation Supply Chains, Climate-Critical Protected Areas, IPLC Rights and Resources, and Climate-Smart Forestry Action Tracks can avoid the bulk of these emissions, delivering 4 Gt of emissions mitigation annually by 2030 and 5 Gt annually by 2050.

MANAGE

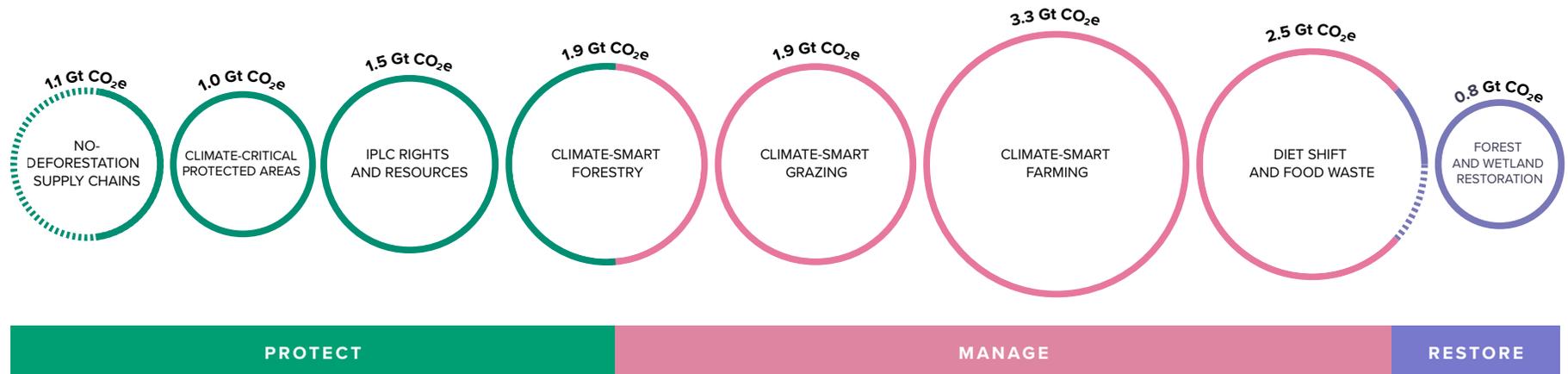
Natural climate solutions in the “improved management” category reduce **emissions from working agricultural, grazing and forest lands** and can also **regenerate and enhance carbon stores**, without a change in land use and while delivering the food and materials we need. If the same land is used to graze livestock (or grow crops, or harvest trees) after the implementation of a natural climate solution, then we put it in the “manage” category.

The majority of Earth’s 13.4 billion hectares of ice-free land is working land. About 3.5 billion hectares (26%) are used to graze livestock, another 0.5 billion hectares (4%) to grow crops fed to livestock, over 1 billion hectares (8%) to grow food for people, and over 2 billion hectares (17%) for harvesting trees.⁵⁸ The agriculture sector is a massive source of emissions – nearly 6.5 Gt CO₂e of methane and nitrous oxide greenhouse gas emissions, plus another 6.0 Gt of emissions from agricultural expansion into existing ecosystems.⁵⁹ Working forests are a small global carbon sink. Accelerating action on Climate-Smart Forestry, Climate-Smart Grazing, Climate-Smart Farming, and Diet Shift and Food Waste can deliver 8 Gt CO₂e of mitigation on working lands annually by 2030 and 12 Gt annually by 2050.

RESTORE

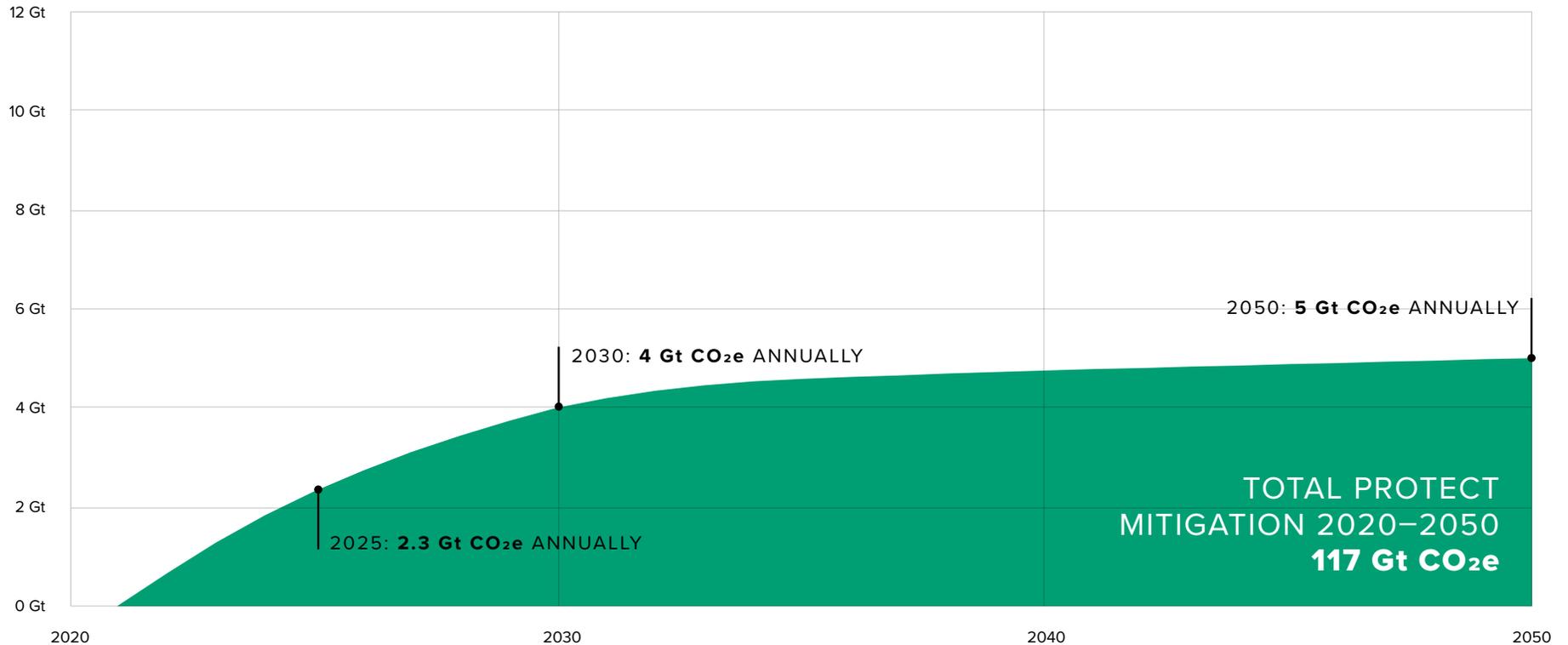
These natural climate solutions **restore native forests, wetlands and grasslands in places where they historically occurred**. In this Roadmap we use restoration narrowly to describe the recovery of an ecosystem that had previously been converted to working land. In other uses, restoration can also describe actions to recover existing degraded ecosystems or to improve the health of working lands, which we include in the Roadmap as “manage” mitigation.

Limiting global temperature rise to close to 1.5°C will likely require the removal of 200–300 gigatons of CO₂ total through 2100. One of the cheapest and most technically feasible ways to do this is to increase the amount of carbon stored in the land by restoring previously converted ecosystems – especially forests. Political will for ecosystem restoration has grown significantly over the last decade.⁶⁰ Stopping deforestation is important but not enough – we must also dramatically accelerate restoration across both tropical and temperate latitudes, including through “release” of marginal grazing lands as a result of changes to our food systems. Accelerating action on the Forest and Wetland Restoration and Diet Shift and Food Waste Action Tracks can deliver nearly 1.1 Gt of mitigation by 2030 rising to 5 Gt by 2050.



PROTECT KEY MILESTONES

→ EMISSIONS HALVING EVERY FIVE YEARS FOR THE NEXT DECADE



→ EMISSIONS FROM NATURAL ECOSYSTEM LOSS HALVE EVERY FIVE YEARS FOR THE NEXT DECADE, SAVING 45 MILLION HECTARES OF FORESTS AND WETLANDS FROM DESTRUCTION BY 2030

→ MORE THAN TWO BILLION HECTARES OF IPLC LAND ARE RECOGNIZED BY 2030, INCLUDING SIGNIFICANT AREAS OF TROPICAL FORESTS

→ THIRTY PERCENT OF GLOBAL TERRESTRIAL, FRESHWATER AND MARINE ECOSYSTEMS ARE PROTECTED BY 2030, ESPECIALLY HIGH-CARBON ECOSYSTEMS

→ ILLEGAL DEFORESTATION ENDS BY 2025 AND 80% OF MAJOR FOREST-RISK COMMODITIES ACHIEVE NO-DEFORESTATION SUPPLY CHAINS BY 2030

PROTECT ACCELERATING ACTION

WHO NEEDS TO TAKE ACTION?

→ People on the land managing and protecting ecosystems, including public land managers, foresters, farmers, and ranchers. Indigenous peoples and local communities have proven to be the most effective stewards in many places.

→ Social movements, policymakers, businesses, and the finance sector must support the full and effective participation of actors on the ground.

WHAT DO THEY NEED TO DO?

→ Governments, social movements, businesses, and the finance sector must support the recognition and securing of IPLC land and resource rights.

→ Policymakers must expand and create new protected areas, while adequately funding their management.

→ Farmers and ranchers need incentives, capacity, and regulatory support to transform their management practices and avoid expanding into natural ecosystems.

→ Businesses and the finance sector must switch from models centered around deforestation to those which support the conservation of natural ecosystems, while policymakers and social movements hold them accountable.

HOW QUICKLY MUST THIS HAPPEN?

→ We must halve emissions from natural ecosystem loss every five years for the next decade – achieving 2.3 Gt CO_{2e} of mitigation annually by 2025 and 4.0 Gt by 2030.

→ This means saving more than eight million hectares of forest and 250,000 hectares of peatland and mangroves annually from conversion and degradation, and improving protection of vastly more land than that.

→ This rapid acceleration of ecosystem protection is already part of a global vision. It aligns with the Glasgow Leaders' Declaration on Forests and Land Use and the 30x30 target proposed under the Convention on Biological Diversity.

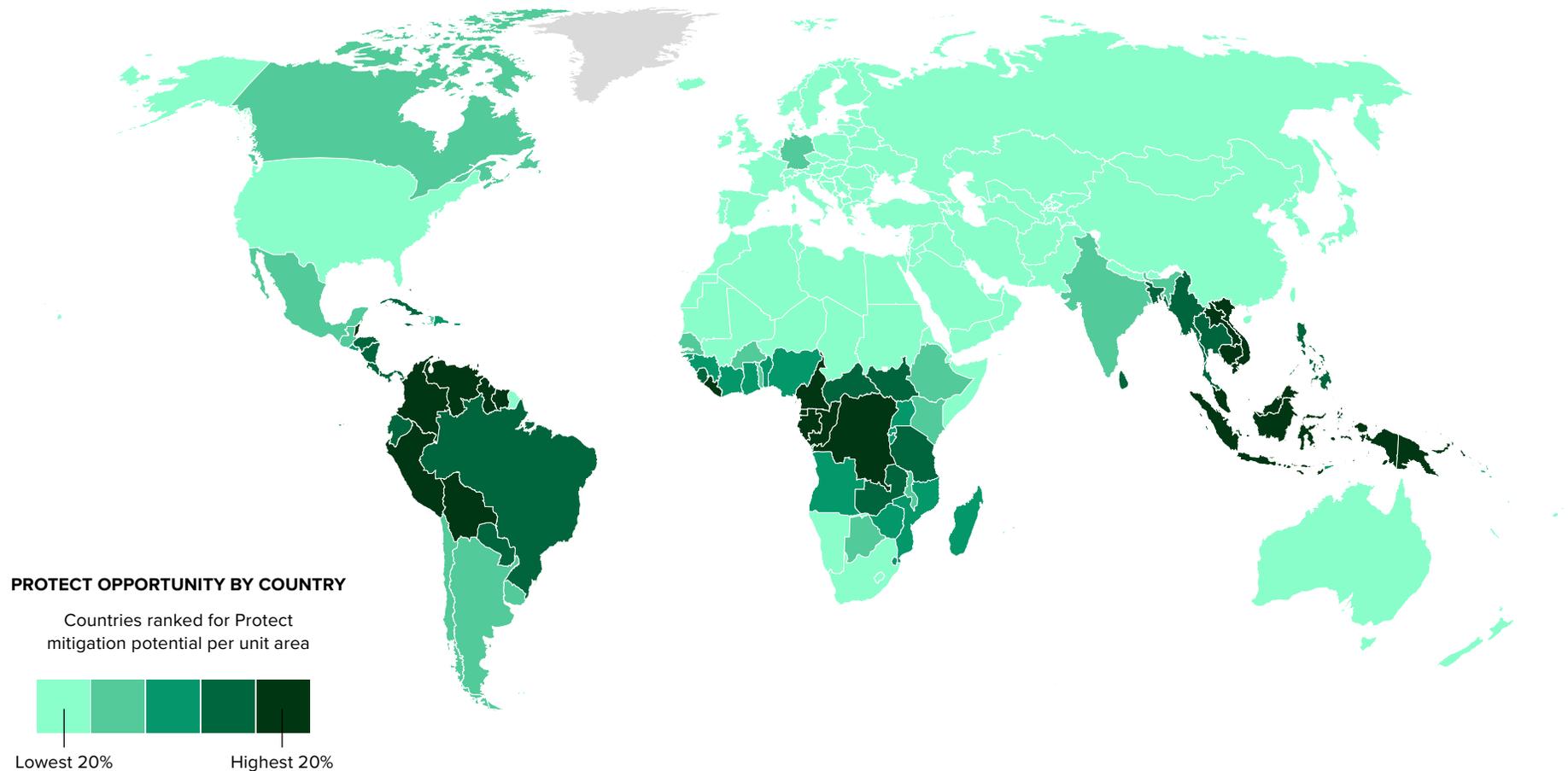
PROTECT WHERE IS THE GREATEST POTENTIAL?

➔ In tropical forests in developing countries, expanding resources for Indigenous peoples and local communities and legal recognition of IPLCs lands and rights would achieve more than a third of the global emissions reduction opportunities from natural ecosystem protection.

➔ Expanding and creating new “climate critical” protected areas in the Amazon, the Congo Basin, the Malay Archipelago and elsewhere would add another 1.0 Gt of mitigation per year by 2030.

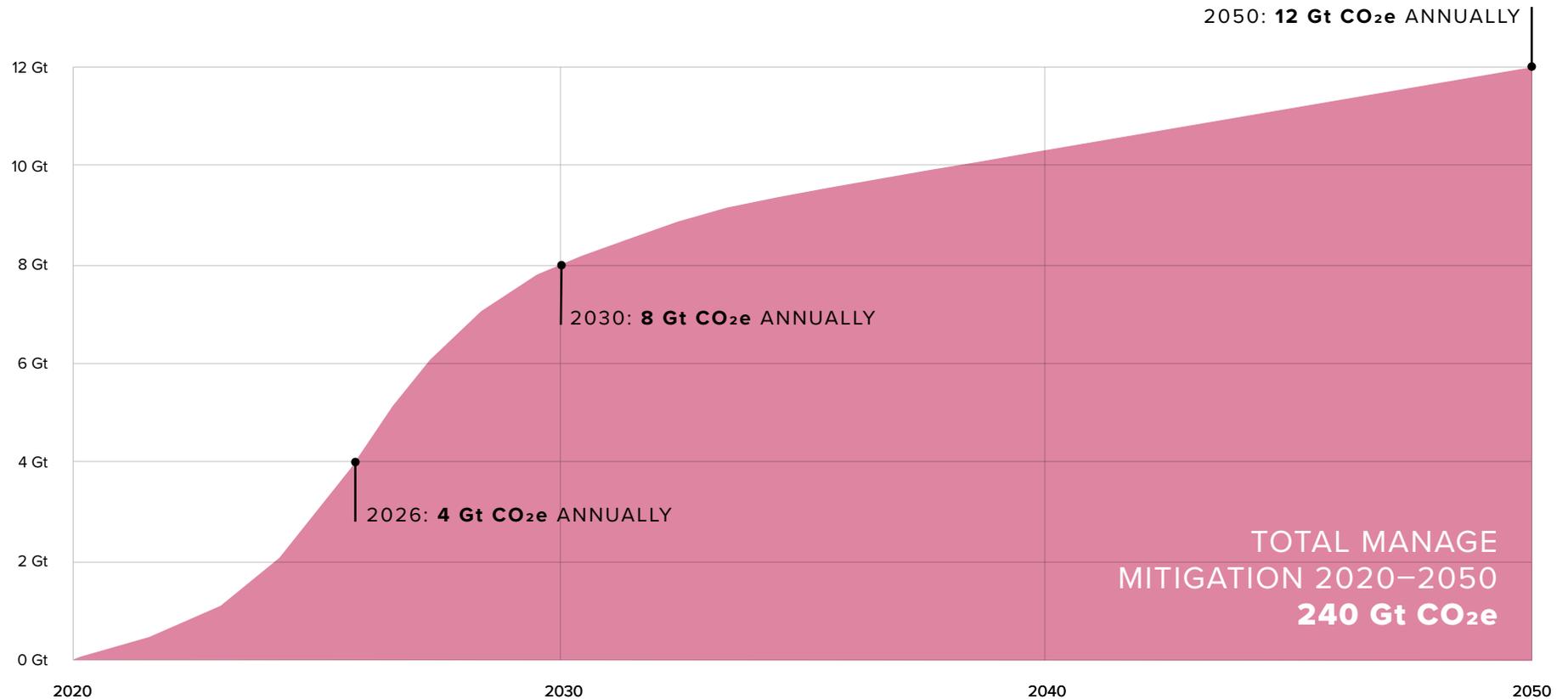
➔ Protecting working natural forests from conversion to non-forest land uses, even as they are managed actively for timber production, would contribute an additional 1.0 Gt of mitigation per year by 2030.

➔ Expanding and implementing No-Deforestation Supply Chain commitments can significantly accelerate ecosystem protection in Brazil, Bolivia, and Colombia where cattle pastures are expanding rapidly, and in Indonesia and Malaysia where palm oil plantations are replacing natural forests.



MANAGE KEY MILESTONES

➔ MITIGATION DOUBLING EVERY YEAR THROUGH 2026



➔ MITIGATION FROM WORKING LANDS DOUBLES EVERY YEAR THROUGH 2026 AS FORESTRY AND FOOD SYSTEMS BEGIN TO TRANSFORM

➔ MORE THAN 20% OF THE WORLD'S WORKING LANDS – TWO BILLION HECTARES – HAVE SHIFTED TOWARDS CLIMATE-SMART MANAGEMENT BY 2030

➔ CLIMATE-SMART FOREST MANAGEMENT IS ADOPTED ON 65% (1.3 BILLION HECTARES) OF THE WORLD'S TIMBER-PRODUCING NATURAL FORESTS BY 2030

➔ \$300 BILLION OF HARMFUL AGRICULTURE AND FORESTRY SUBSIDIES ARE REDIRECTED INTO INCENTIVES FOR REGENERATIVE PRODUCTION MODELS BY 2030

MANAGE ACCELERATING ACTION

WHO NEEDS TO TAKE ACTION?

- ➔ The people who most directly manage working lands – crop farmers, livestock producers, dairy farmers, and foresters.
- ➔ These groups are most likely to adopt climate-smart management practices in response to decisions made by businesses buying their products, financial institutions, and policymakers.
- ➔ Social movements and other enabling actors are key to advancing global food systems towards more sustainable diets and reduced waste.

WHAT DO THEY NEED TO DO?

- ➔ Farmers and livestock managers must rapidly adopt practices that capture carbon in soils and incorporate more trees into agricultural and grazing lands,⁶¹ while reversing the expansion of these lands into native ecosystems.
- ➔ Foresters must improve their practices to sequester more living carbon in working forests, while protecting them from degradation and deforestation.
- ➔ The finance sector and governments must enable the transformation of working lands by accelerating carbon pricing, reforming incentives, and enforcing regulation.
- ➔ Companies must respond to demand for climate-smart products like plant-based food options and greenhouse gas labeling, while reducing food waste.

HOW QUICKLY MUST THIS HAPPEN?

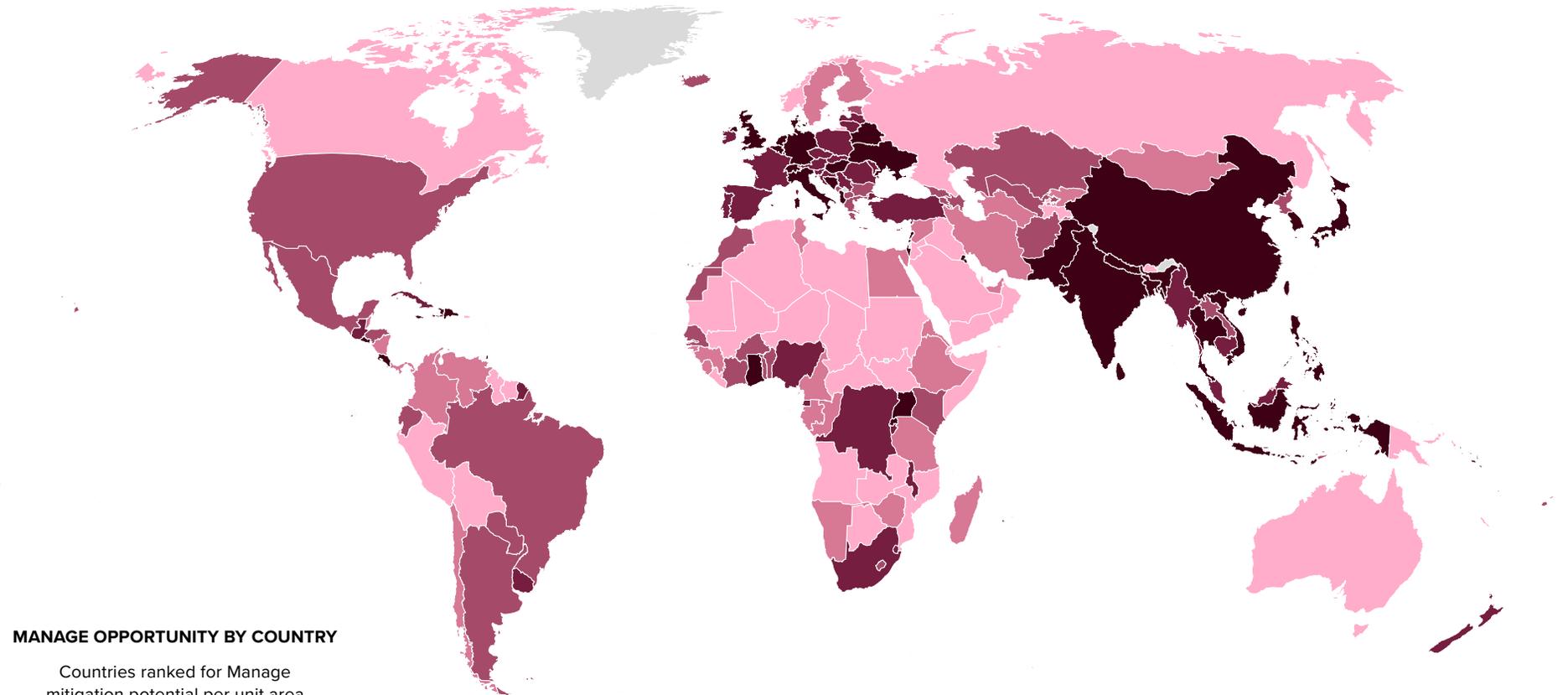
- ➔ More than 20% of the world's working lands – two billion hectares – needs to shift towards climate-smart management by 2030.
- ➔ Improved land management can achieve 1.0 Gt of emissions reductions and another 5.0 Gt of sequestration annually by 2030.
- ➔ We can achieve an additional 2.5 Gt of annual mitigation on working lands by 2050 if 50% of the world's population choose a healthier and more sustainable diet and food loss and waste are reduced by 50%.
- ➔ If these happen in tandem, global agriculture can reach net zero emissions by 2030 while ensuring healthy diets for a growing population.

MANAGE WHERE IS THE GREATEST POTENTIAL?

➔ Changes in soil management across vast areas with modern industrial agriculture, like North America, Europe, China, and India, can add up to very significant carbon sequestration.

➔ Deforested agricultural regions worldwide, including North America, South America, and Central Asia have great potential for integrating more trees into grazing and croplands while improving sustainability of yields.

➔ Climate-smart forestry holds huge potential in highly forested countries including Brazil, Suriname, Gabon, Indonesia, and the United States.



MANAGE OPPORTUNITY BY COUNTRY

Countries ranked for Manage mitigation potential per unit area

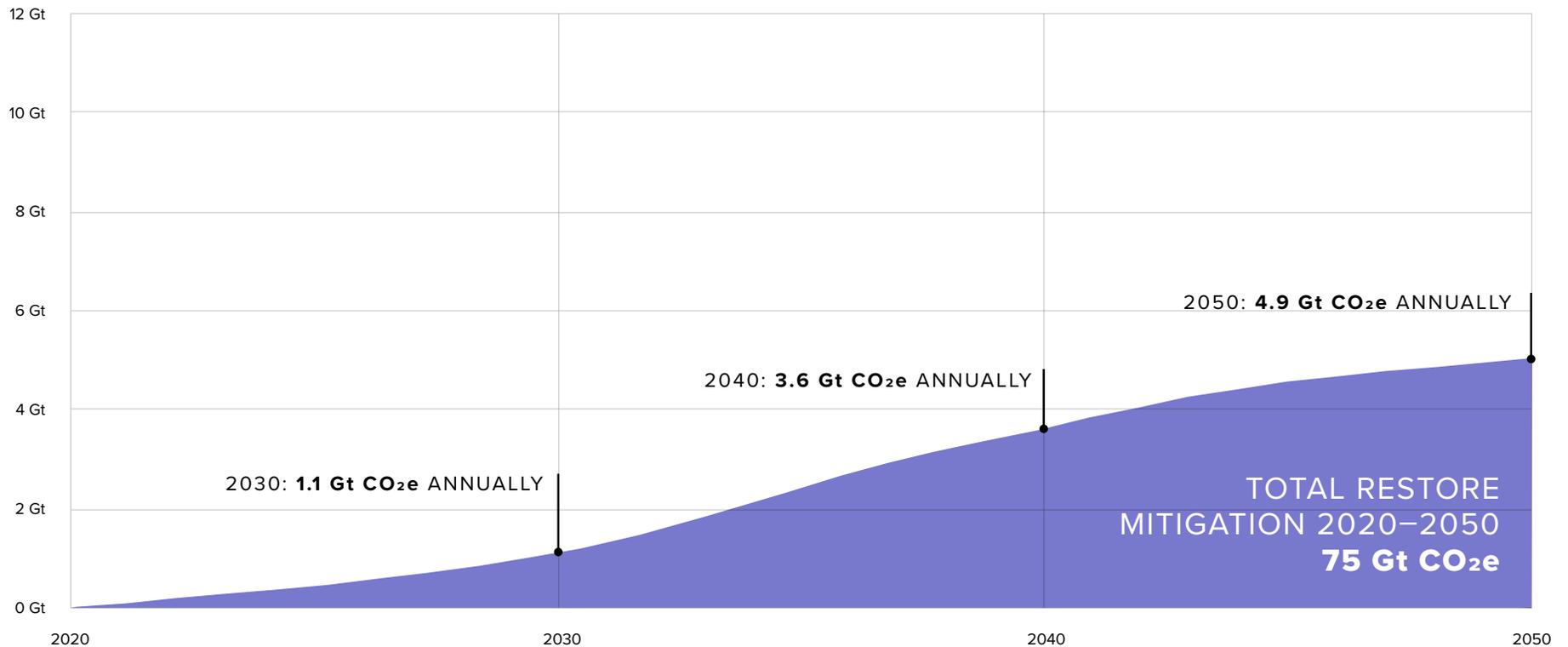


Lowest 20%

Highest 20%

RESTORE KEY MILESTONES

➔ MITIGATION FROM RESTORATION IS CURRENTLY MORE EXPENSIVE AND GROWS MORE SLOWLY THAN PROTECT OR MANAGE, SO WORK MUST START IMMEDIATELY



➔ THE COST OF RESTORATION SOLUTIONS IS HALVED BY 2030 THROUGH WIDER ADOPTION OF NATURAL REGENERATION AND INCREASED SEED AND NURSERY CAPACITY

➔ A GLOBAL RESTORATION SECTOR EMERGES, RESTORING 15 MILLION HECTARES OF PEATLANDS BY 2030 AND 350 MILLION HECTARES OF FORESTS AND WETLANDS BY 2050

➔ BY 2050, 50% OF THE WORLD'S POPULATION IS CHOOSING A MORE SUSTAINABLE DIET, AND FOOD LOSS AND WASTE ARE HALVED, CREATING VAST RESTORATION OPPORTUNITIES

➔ BY 2050, LIVESTOCK ARE NO LONGER FED CROPS THAT HUMANS CAN EAT. INSTEAD, THEY GRAZE ON TREE FODDER, CROP BYPRODUCTS, AND FOOD WASTE, EASING THE GLOBAL LAND SQUEEZE

RESTORE ACCELERATING ACTION

WHO NEEDS TO TAKE ACTION?

→ Public land managers are key to restoration, often in partnership with managers of private working lands and Indigenous peoples and local communities.

→ Social movements, governments, businesses, and the finance sector are all crucial enablers of restoration solutions.

WHAT DO THEY NEED TO DO?

→ Public land managers and landowners must identify target areas, plan assisted or natural regeneration, restore natural flows of water, improve soil conditions, and monitor restored lands.

→ Governments, business leaders, and financial institutions must make restoration more economically feasible through incentives, planning, and regulation.

→ Wealthy and emerging economies must reduce food waste and shift to a healthier and more sustainable diet, to both relieve deforestation pressure and release low-productivity grazing lands to be restored back to natural ecosystems.

HOW QUICKLY MUST THIS HAPPEN?

→ Emissions mitigated through restoration accumulate more slowly than from ecosystem protection and working lands management, so work must start immediately for large mid-century carbon removal.

→ Restoration solutions are currently more expensive than protection and management solutions; nevertheless, climbing carbon prices can trigger large-scale restoration activities this decade, accelerating to deliver nearly 5 Gt of CO₂ mitigation annually over an area as large as 350 million hectares by 2050.

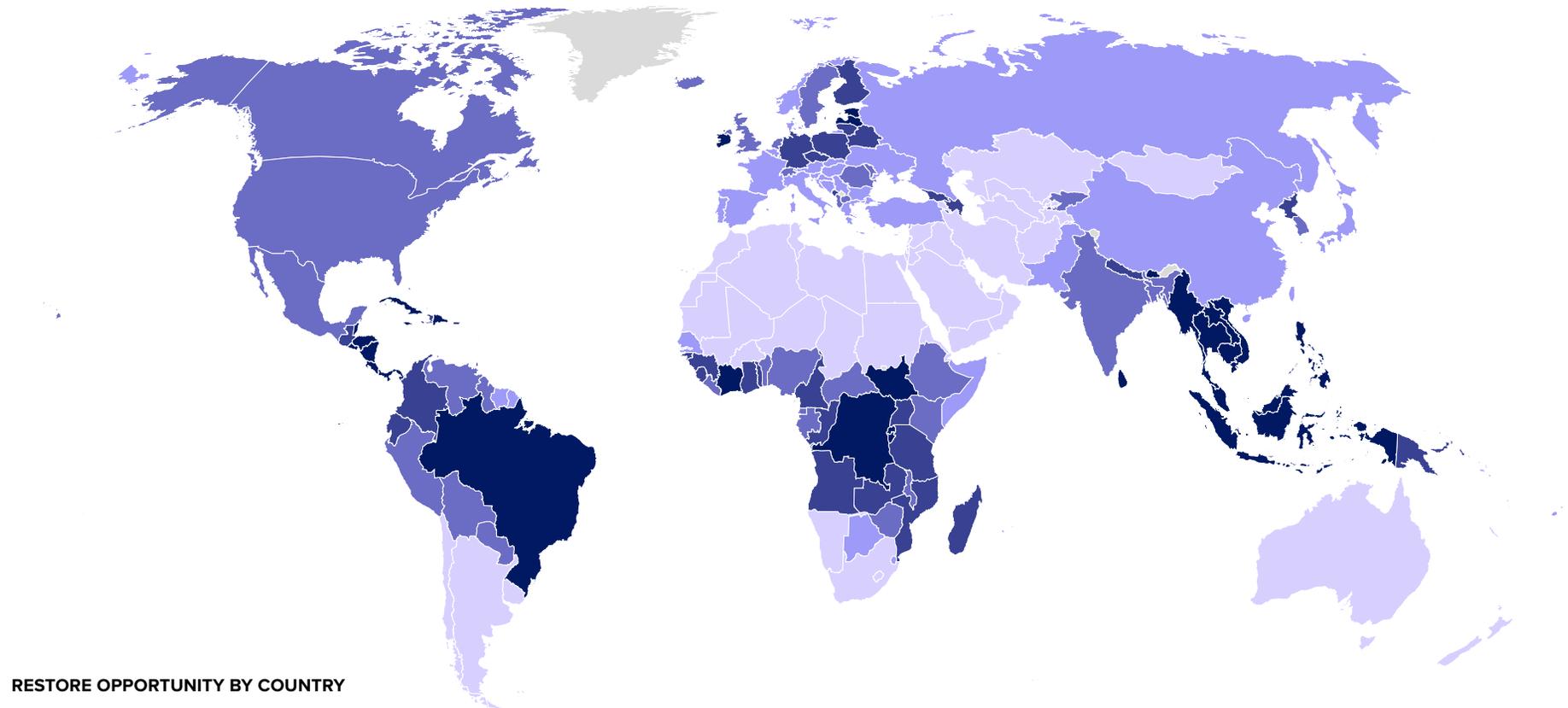
→ We can achieve an additional 1.25 Gt of annual mitigation by 2050 if half the world's population chooses a more sustainable diet, and food loss and waste is reduced by 50%, releasing additional land for restoration.

RESTORE WHERE IS THE GREATEST POTENTIAL?

➔ Peatland and mangrove restoration in tropical Southeast Asia and peatland restoration in the Eurasian boreal zone is the most urgent and cost-effective opportunity.⁶³

➔ Reforestation opportunities are greatest in five large countries: Brazil, the United States, Canada, Indonesia, and India,⁶⁴ but also offer more than half of the cost-effective mitigation potential in a number of smaller countries.⁶⁵

➔ Food waste reduction and diet shifts are urgently needed in high-income nations and in middle-income countries with high consumption of animal-sourced foods, to release lands for forest restoration, decrease demand for agricultural lands, and improve human health.



RESTORE OPPORTUNITY BY COUNTRY

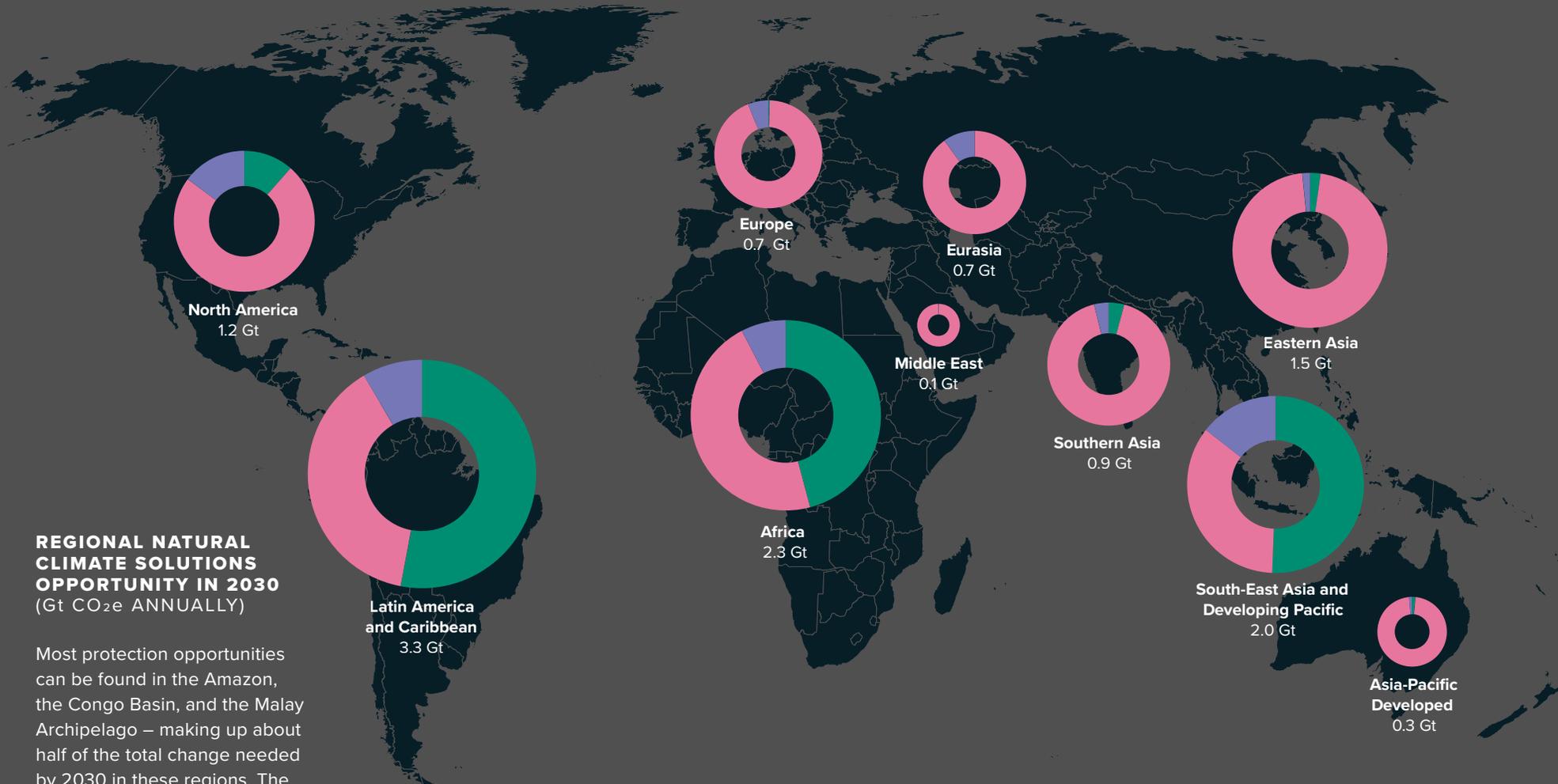
Countries ranked for Restore mitigation potential per unit area



Lowest 20%

Highest 20%

ADDING UP THE OPPORTUNITIES IN 2030



REGIONAL NATURAL CLIMATE SOLUTIONS OPPORTUNITY IN 2030
(Gt CO₂e ANNUALLY)

Most protection opportunities can be found in the Amazon, the Congo Basin, and the Malay Archipelago – making up about half of the total change needed by 2030 in these regions. The bulk of needed change by 2030 elsewhere in the world is from climate-smart management of working lands. Restoration is a smaller, more evenly distributed opportunity in 2030, which accelerates through 2050.

PROTECT

MANAGE

RESTORE

ENABLING ACTORS

People living and working on the land deliver natural climate solutions – ecosystem protection, climate-smart management, and nature restoration – through their everyday decisions and practices. Enabling actors, on the other hand, accelerate these changes through decisions taken at a distance. These groups are part of the foundation of this Roadmap.

We group enabling actors into four categories:

- ➔ **Policymakers** at the local, national, or international level can accelerate natural climate solutions through planning, regulation, and government spending.
- ➔ Profit-seeking **businesses** in land-intensive sectors can accelerate natural climate solutions through purchasing and investment decisions, with opportunities for innovation, investment, and leadership across all sectors.
- ➔ Institutions and companies that provide **financial services** can accelerate natural climate solutions by shifting finance away from destruction and towards nature-positive investments.
- ➔ Finally, groups of people organized into **social movements** can play critical roles by holding all other actors accountable, envisioning a better future, and creating the momentum to overcome powerful interests in the status quo.

POLICYMAKERS



UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY



Scaling natural climate solutions as fast as is necessary requires coordinated policy action from all governments at all scales. While some bright spots of political action exist, such as Indonesia's concerted efforts to slow forest loss over the last five years, most countries have never achieved the speed and scale of transformation required by the Carbon Law for Nature.

Rapid transitions are possible where effective policy frameworks are in place and governments support both the implementation of that policy and its enforcement on the ground. In the case of natural climate solutions, therefore, policymakers everywhere must urgently begin to create the conditions for the success and scaling of these solutions.

First, national governments must establish emissions reduction targets for agriculture, forestry, and other land use. These must be consistent with the Carbon Law for Nature in each successive update of their Nationally Determined Contribution (commitment to climate action) under the Paris Agreement, starting in 2025, as well as with the outcomes of the global stocktake process of the same agreement.

The goals and ratcheting-up processes must also be enshrined in domestic policy and institutional frameworks. Targets should be set and implemented to ensure cross-sectoral actions are coordinated and consistent with rapid decarbonization across the economy, while increasing climate resilience and safeguarding biodiversity and human rights. International processes must urgently improve the ability of governments to set and implement these ambitious targets for nature, through a combination of training and technical assistance.

Second, governments must work to dramatically increase international climate finance for natural climate solutions to achieve the Carbon Law for Nature. Natural climate solutions are the climate mitigation solutions with the greatest proportional

funding gap, receiving only 3% of international climate finance in 2020.⁶⁶ While the costs of these solutions are significant, they are vastly outweighed by the climate *and* non-climate benefits – for example, the World Economic Forum recently estimated that more than half of world’s GDP (\$44 trillion) is moderately or highly dependent on nature.⁶⁷

Scaling up climate finance starts with new and repurposed public investment, and therefore donor governments must do more – starting with the recent call from civil society for \$60 billion annually in international finance to achieve global biodiversity goals in developing countries by 2025.⁶⁸ Public funding is particularly essential for ecosystem protection, where domestic governments provide about 57% of financing⁶⁹ – including investments in integrated land-use planning and research and development. Policymakers must also transform public subsidies to cut emissions and close the funding gap, redirecting \$300 billion or more per year in harmful subsidies to agriculture, fisheries, and forestry into positive incentives that help these industries advance climate-smart practices. This will then create positive knock-on effects to stimulate private investment.⁷⁰

Public finance alone will not be enough, however. Policymakers must also change economic incentives and facilitate more private funding to achieve the Carbon Law for Nature. One of the most effective economic policy tools is to establish a carbon price, either through a carbon tax or an emissions trading scheme that reflects the social cost of carbon by 2030. To drive funding to natural climate solutions, such a system must allow for trading credits from the land sector. Additionally, policies are needed to support the generation of high-integrity carbon credits from natural climate solutions and allow for international trading of those carbon credits. By 2050, the estimated size of the global carbon market will be one trillion dollars per year,⁷¹ from which at least 30% should be from natural climate solutions, commensurate with its

mitigation potential.⁷² Public funding can also be used to unlock private investment by directly providing early finance to climate-smart business models that may not yet be deemed investible by the private sector or by de-risking these investments.

Third, governments must mainstream climate action. This means delivering a just transition for workers and businesses, ensuring all citizens can enjoy a life with dignity in a new nature-positive economy, and creating conditions where all parts of society can be allies in achieving in the Carbon Law for Nature. This includes rapidly expanding the legal recognition of the lands and rights of Indigenous peoples and local communities. Governments also need to strengthen their role as key providers of data, information, and education needed for climate sensitive decision-making, such as publishing ‘planetary health’ dietary guidelines and requiring related labeling. It means integrating natural climate solutions into national curricula and sharing data with businesses for agricultural supply chain traceability initiatives. Policymakers can also build nature and climate into the heart of national government decision-making by fully and promptly reporting environmental harms and benefits in national accounts⁷³ and requiring the same from the private sector.⁷⁴

Finally, legal and regulatory approaches cannot be effective without good governance and enforcement. Fully enforcing existing land-use laws in tropical countries could eliminate more than 40% of illegal commercial deforestation,⁷⁵ and save forest countries more than \$17 billion per year of losses.⁷⁶ Incorporating climate outcomes into spatial planning and environmental regulations can also speed adoption of climate-smart agriculture and forestry practices, while a requirement for transparency in supply chains can level the playing field for businesses that already avoid deforestation.

POLICYMAKERS AND GOVERNMENTS IN ACTION

Over the past 25 years, policymakers in Costa Rica have been leading the way in creating incentive frameworks that have effectively transformed their economy from being reliant on deforestation to one that captures all the benefits of ecosystem conservation. Costa Rica’s 1997 fossil fuel tax now raises more than \$26.5 million per year for forest conservation, restoration, and agroforestry, and has provided direct benefits to landowners across 23.5% of the country – over a million hectares. To ensure its continued popularity, the funds are managed in a fully transparent manner, and the government prioritizes social development for smallholder farmers and Indigenous communities. More than 40% of the beneficiaries of payments for these environmental services live below the poverty line.⁷⁷ Costa Rica continues to build upon this legacy: not only committing to carbon neutrality by 2050, but also building the necessary policy framework to reach this target.⁷⁸

In a similar effort, Colombia’s 2016 carbon tax of \$5 per tonne for fossil fuel-related carbon emissions has also helped critical conservation activities while enjoying popular support, yielding revenues of \$148 million in 2017 and \$91 million in 2018. A quarter of the revenue is used to manage coastal erosion, reduce and monitor deforestation, conserve water sources, protect strategic ecosystems, and combat climate change, and an additional 5% is used to strengthen protected areas. A built-in mechanism allows companies to reduce their tax burdens by buying certified carbon credits from conservation and restoration projects in Colombia that adhere to internationally recognized standards, providing more flexibility while maintaining positive outcomes for conservation. Analyses show that if 12 other countries implement a tropical carbon tax similar to Colombia’s, they could raise \$1.8 billion each year between them to invest in natural habitats that benefit the climate.⁷⁹

BUSINESSES



Businesses are the channels through which a majority of the world's raw materials flow. Their decisions about what, where and how to purchase, manufacture, market, and sell their products drive transformation of the land sector. Businesses, and the customers that influence them, therefore have a critical role in enabling natural climate solutions. To do so, businesses operating in land-intensive sectors⁸⁰ should follow the four-pillar strategy for businesses introduced in *The 1.5°C Business Playbook*,⁸¹ which we adapt here to meet the sectoral demands of the Carbon Law for Nature.

The first and second pillars are the most important and focus on a company's direct and value chain activities to reduce emissions and increase sequestration,⁸² aligned with the Carbon Law for Nature. Businesses must immediately eliminate demand for deforestation-linked products by establishing No-Deforestation Supply Chains (NDSCs). Around 60% of tropical deforestation is linked to commercial agriculture.⁸³ We estimate that an expansion of NDSCs from current levels (less than 20% for most commodities) to 60–80% would contribute to forest protection resulting in more than 1.0 Gt of emissions reductions annually by 2030.

Businesses that purchase agriculture and forestry products can also drive acceleration of natural climate solutions by sourcing from producers that are transitioning to become carbon sinks. Preferential sourcing is critical, especially during early phases of the adoption curve as farmers and livestock managers learn and share practices such as conservation agriculture, biochar, and improved grazing. Businesses can use preferential purchasing at the scale of entire regions to encourage transformational land-use governance changes beyond a single production unit or company. Businesses should also invest in their sourcing regions more broadly to drive landscape-scale transformations, which require financing for small- and medium-sized producers especially.

The complexity of supply chains currently limits the reach of company climate actions. Improving traceability and transparency can help to drive both reduced deforestation and increased adoption of climate-smart land management practices. Companies should know their suppliers, be able to track raw materials to the source, and transparently report on their commitments and implementation, following guidance of the Accountability Framework initiative.

The third pillar is to align the company's vision, strategy, value proposition, products, and services with the Carbon Law for Nature – creating major business opportunities. For example, innovation is needed to push food consumption towards sustainable diets and plant-based foods. Companies that identify and scale innovations, driving a reversal from land exploitation toward land regeneration, will thrive in coming decades, as witnessed by sales of plant-based foods increasing in the United States 250% faster than total food sales between 2018 and 2020.

The fourth pillar is to contribute beyond the company's own business, for example by influencing government policy and funding natural climate mitigation outside the company's value chain. Why? Because all businesses – not just those in land-intensive sectors – have a role in maintaining a livable climate and stewarding the biosphere. Companies should loudly support timely and aggressive policy action, including carbon pricing and regulation. These carbon markets and credits – including offsets – have a role as a complement to deep decarbonization by companies, particularly in sectors where emissions are harder to reduce.

Cutting across all four pillars is an action cycle for implementation. Companies should set ambitious science-based targets and strategies in line with the Carbon Law for Nature, following processes and guidance such as that provided by the Science Based Targets Network.⁸⁴ Implementation has to follow – putting targets and strategies into practice. Companies should also measure and disclose their

progress in line with global best practices such as the Accountability Framework initiative⁸⁵ and the Taskforce on Nature-related Financial Disclosures.⁸⁶

Finally, all companies should follow the mitigation hierarchy when it comes to natural climate solutions – avoiding impacts first, reducing impacts second, and only then compensating for unavoidable harms through credits and other investments in natural climate solutions.

BUSINESSES IN ACTION

Coffee crops cover more than 11 million hectares of land globally and support the livelihoods of some 125 million people.⁸⁷ For decades, many coffee companies have leveraged their supply chain networks to encourage the use of improved management practices. One example is Starbucks' Coffee and Farmer Equity (C.A.F.E.) Practices program, developed in collaboration with Conservation International and first launched in 2004. C.A.F.E. Practices is a verification program that evaluates farms against economic, social, and environmental criteria, with the aim of incentivizing transparent, profitable, and sustainable coffee-growing practices. The program consists of more than 200 indicators and is applied across Starbucks' entire supply chain of more than 400,000 farmers in 30 countries. The 2014–2018 performance assessment of C.A.F.E. Practices revealed high performance across income, environment, and traceability indicators, together with growing compliance on key climate indicators – including calculation of greenhouse gas emissions at the level of individual farms.⁸⁸ Through a verification system like C.A.F.E. Practices, Starbucks has direct insight into farmer practices and challenges and can leverage this data to better address climate challenges.

In 2016, Walmart committed to more sustainably sourcing 20 key commodities by 2025.⁸⁹ While certification programs support improved agricultural production, they are primarily aimed at improving

on-farm practices and are less suited to addressing sustainable land use in wider production landscapes. Recognizing the need to fill this gap, Walmart invited Conservation International to assess its global sourcing footprint for 13 strategic commodities. The resulting analysis identified priority landscapes and seascapes for enhancing Walmart's sustainable sourcing and inspired the announcement of a "nature goal" to protect, restore, and more sustainably manage 50 million acres of land and 1 million square miles of ocean by 2030 with the Walmart Foundation. This goal complements Walmart's efforts to achieve zero emissions across its operations globally by 2040 and builds upon its Project Gigaton™ initiative that seeks to work with its global supply chain to avoid or reduce a billion tons of greenhouse gas emissions beyond its own operations in the global value chain. Walmart's sustainability initiatives reveal a strategic progression from reducing negative impacts like deforestation through sourcing requirements, towards more comprehensive alignment of business and philanthropic investments in place-based initiatives that integrate conservation and restoration with improved production.

In January 2021 Conservation International and Kering, the global luxury group, launched the Regenerative Fund for Nature. The aim of the fund is to help finance the transition towards practices that benefit nature, climate, and people, transforming one million hectares of farms and landscapes to regenerative agriculture over five years. The fund provides grants to farmers, non-governmental organizations, and other stakeholders testing and scaling regenerative practices focused on cashmere, cotton, leather, and wool – core raw materials for the luxury sector – and is actively seeking to support new projects. Seven grantees across South America, Central Asia, India, Europe, and Africa have received financing from the fund to date and are working with 60,000 producers to improve agricultural practices on 840,000 hectares, and delivering measurable outcomes for nature, climate, and livelihoods.⁹⁰

THE FINANCE SECTOR



Government policy and shifts in business practices are critical to making investment in natural climate solutions as profitable and easy as investment in clean energy. But finance sector actors must innovate and act too, to increase the flow of financing toward natural climate solutions while also halting financing that drives deforestation.

As noted in the Policymakers section, natural climate solutions currently receive just 3% of global climate finance. The latest IPCC report finds that keeping the Paris goals within reach will require investment in natural climate solutions to scale by 10 to 29 times the current level by 2030. This is the largest proportional investment gap among all climate sectors, with \$400 billion needed annually in forest-related solutions⁹¹ alone – representing not just a critical need, but also a major investment opportunity.

Filling this investment gap can only happen if the sources of that finance shift. Private sector actors (like commercial financial institutions, investors, corporations, and philanthropies) provide just 14% of current global finance for nature-based solutions. This is a much lower proportion than for climate overall, where 56% of investment comes from private capital.⁹²

In addition to the investment opportunities available from natural climate solutions, the finance sector must also assess its risks from potential deforestation exposure in portfolios. The duty of financial institutions to act in the best long-term interests of their investors, clients, and beneficiaries means that this risk cannot be overlooked. Finance sector action on deforestation is foundational to mitigating risks to financial institutions themselves, as the sector safeguards against growing environmental, social, governance, market, regulatory, reputational, and litigation-related risks affecting agricultural commodity sectors in particular.

To address the demand for investment in natural climate solutions, mitigate deforestation risks, and accelerate the low-carbon transition, we suggest three specific measures, again adapted from *The 1.5°C Business Playbook*,⁹³ to align with the demands of the Carbon Law for Nature.

First, the finance sector must immediately stop financing deforestation and ecosystem destruction. In alignment with the Business section above, all major international financial institutions should immediately put in place commitments and policies to ensure their portfolios are free from commodity-driven deforestation, ecosystem conversion, and associated human rights abuses. They must then promptly complete the actions recommended in guidance such as the Finance Sector Roadmap for Eliminating Commodity-Driven Deforestation⁹⁴ by 2025.⁹⁵

Second, financial institutions should focus on engagement and active ownership to accelerate change. Setting and implementing deforestation policies will send a strong signal from financiers that will create collective momentum, allowing them to leverage their power to accelerate corporate supply chain actions and disclosure practices on deforestation.⁹⁶

The Task Force on Climate-Related Financial Disclosures (TCFD) and the Taskforce on Nature-Related Financial Disclosures (TNFD) are examples of initiatives that provide recommended standards and methodologies for companies to transparently report on their risk exposures, allowing financial markets and investors to price climate- and nature-related risks appropriately. Action is accelerating: By the end of 2021, twelve governments and dozens of central banks and regulators had formally expressed support for the TCFD recommendations, while more than 2,600 organizations had endorsed them.⁹⁷ Now is the time to urgently convert support and endorsement into action.

Third, the finance sector should urgently increase its investments in deforestation-free producers, as well as projects, programs, innovation, and technology involving natural climate solutions. Initiatives, funds, and investment models are starting to emerge to help direct banks, investors, and companies toward positive investments. For example, UNEP's Climate Finance Unit is working with funds and facilities like the Agri3 Fund, a catalyst and 'de-risking' vehicle for driving the switch towards more sustainable food production.

Income-generating investments in climate-smart land management will also need to flow through existing farm and forestry loan products and investment funds, and through corporate debt instruments, capital markets offerings, and producer services businesses. The extraordinary efforts needed from working lands to reach 8 Gt of mitigation and a net zero land sector by 2030 is matched by the extraordinary investments needed to accelerate climate-smart forestry, farming, ranching, and food-systems change.

THE FINANCE SECTOR IN ACTION

Banking giant BNP Paribas recently published its "conditions to provide financial services to companies producing or buying beef or soybeans from the Amazon and the Cerrado regions."⁹⁸ This internal policy statement is more important than it appears on the surface: Verifying such "conditions" is already part of a bank's "due diligence" workflow and will directly impact decisions. Their customers will now be required to have a strategy to achieve zero deforestation in their production and supply chains, as well as full traceability of beef and soy products, by 2025. Of 20 deforestation-linked agribusinesses analyzed for finance-sector links, BNP Paribas had investments and business relationships in nineteen – representing \$5.71 billion in deals and \$37 million in estimated proceeds for the bank from 2016–2020.⁹⁹

Similarly, 33 financial institutions with more than \$8.7 trillion in combined management assets committed to eliminate commodity-driven deforestation from their investment and lending portfolios by 2025 at COP26 in Glasgow.¹⁰⁰ This commitment uses engagement and active ownership to encourage and enable the transition away from high deforestation-risk supply chains and towards sustainable production. Supported by the UNFCCC High-Level Champions, Conservation International, Global Canopy, WEF Tropical Forest Alliance, and Nature4Climate, this sends a critical signal from leading finance institutions to the rest of the finance sector that collective action can drive change to reverse deforestation at scale, which is imperative to achieve net-zero goals set by financial institutions.

SOCIAL MOVEMENTS



Protecting the climate requires collective action – not just individual behavior change. Traditional centers of power, like governments, businesses, and the finance sector, are not moving quickly enough to address the climate crisis. Social movements – organized efforts by groups of people to achieve a social or political goal – are needed to help drive the transformative changes necessary and hold traditional powers accountable.

Natural climate solutions are deeply entwined in the lives, values, and social structures of all people. This not only includes those living and working on the land, but also the larger global urban population. Anyone making – or influencing – choices about the food we eat, the clothes we wear, or where we live is influencing critical land stewardship decisions.

In this Roadmap, we recognize the particularly vital role of social movements when it comes to reimagining our food, fiber, and fuel systems, including amplifying calls for social justice. Most natural climate solutions involve the transformation of food systems, given that agriculture is the driver of more than 90% of net emissions from land. Three barriers have hindered action to date: first, scientific understanding of the global impacts of diet choice and food waste, which has only recently advanced sufficiently; second, the challenge of downsizing the problem into smaller, national-scale solution sets; and third, businesses, policymakers, and even individuals freezing in the face of radical transformation at the scale needed.¹⁰¹

Breaking through the remaining barriers will require the power of social movements, with the UN Food Systems Summit of 2021 providing a turning point in the global effort to build them. Momentum is spreading rapidly through efforts such as the Global Action Platform on Sustainable Consumption and Diets, which will help facilitate targeted national solutions in major countries around the world.

A second area where social movements are already having an impact is in supporting Indigenous peoples and local communities in their fight for land rights and social justice – further growth of which we estimate could lead to 1.5 Gt of mitigation by 2030. Platforms like Land Rights Now have helped accelerate this movement by connecting organizations and communities around the world, sharing best practices, and increasing the political power of the movement by aligning outreach and messages.¹⁰²

Organizing efforts have also emerged directly in support of natural climate solutions seeking to build a movement behind nature’s critical role in our climate future. Greta Thunberg is certainly the best-known young climate activist. But the movement is also being led by youth on the front lines of the intertwined nature and climate crises – like Nina Gualinga of the Kichwa community of Sarayaku in the Ecuadorian Amazon, who has been fighting for climate justice, indigenous rights, and stronger protection of nature since the age of eight.¹⁰³

Social scientists and psychologists have shown that a powerful shift in mindset from hopeless paralysis to shared power can happen when individuals begin defining themselves as members of a larger “we” with shared social identity and collective capabilities.¹⁰⁴ Many of the required transformations described here – across protect, manage, and restore actions – depend upon an exponential acceleration of these emerging social movements, which often become the foundation of actions taken by our political representatives and private sector actors.

SOCIAL MOVEMENTS IN ACTION

The Brazilian soy moratorium is often cited as one of the most effective success stories in reducing tropical forest conversion to agriculture, and social movements were at the root of its success. In the late 1990s, soy expansion was a major driver of deforestation in the Cerrado and was beginning to cause an increasing amount of forest loss in the southern Amazon region.

In 2006, civil society groups drew broad attention to the impacts of soy on the Amazon rainforest through a campaign targeted at well-known consumer brands and retailers.¹⁰⁵ In response to negative publicity, these companies used their market power to change the procurement policies of major agricultural commodity traders, such as Cargill, which pledged to only purchase soy from producers in compliance or working towards compliance with the Brazilian Forest Code.

As a result of building momentum from external pressures, tightened regulations, and ongoing discussion with civil society groups, nearly all soy processors and exporters in Brazil voluntarily agreed not to trade in soy produced on deforested land. The moratorium was renewed annually for more than a decade, with soy-driven deforestation continuing to fall even as soy production increased. Collective action was at the heart of this amazing Brazilian success story, still providing lessons despite recent national increases in forest loss.¹⁰⁶

OTHER ACCELERATORS

TECHNOLOGY

No new technological advances are necessary to meet the Carbon Law for Nature, but technology can help to rapidly decrease costs, scale up, and accelerate the delivery of emissions reductions from several Tracks.

These “Natural Climate Technologies” can be grouped into three themes:

- *Monetization* technologies improve the operation of carbon markets and help generate investment in natural climate solutions, for example by crowdfunding reforestation, linking satellite monitoring to automatic payments via farmer’s cell phones, and by improving auditability of carbon credits. Monetization technologies could boost every category of solutions: protect, manage, and restore.
- *Monitoring, reporting, and verification* technologies improve the ability of investors, businesses, and governments to validate actions and results of natural climate solutions, for example through automated soil sampling, satellite monitoring of pest and disease outbreaks, and high-accuracy geospatial data collection from drones. Advances in these technologies can accelerate every category of solutions: protect, manage, and restore.
- *Direct physical enabler* technologies improve the inputs, preparations, seed stocks, crop and field analyses, and planting and harvesting machinery that are involved in farming, grazing, and tree planting. These diverse technologies range from AI and robotics systems that can automate nurseries or identify and remove invasive species or weeds, to next-generation microbial and fungal treatments that improve soil nutrient access by plants. These types of physical enablers have the potential to significantly accelerate manage and restore solutions in particular.

LEADERSHIP

The Carbon Law for Nature shows what we must achieve in the coming decades, and this initial version of the Roadmap is the first step in showing how we can get there. But it won’t be possible without climate leaders who are willing to step up, try new things, share their results and enthusiasm, and inspire others.

These leaders must show themselves at every level of society. They include companies setting targets and taking action in their supply chains, innovative farmers and ranchers taking the risk of trying new practices, individuals choosing healthier and more sustainable diets, city authorities meeting the huge demand for climate action among their citizenry, and regional and national policymakers accelerating climate solutions through smart regulation and incentives.

Change does not happen linearly. It starts slowly, but can accelerate exponentially when a critical mass is achieved. Most, if not all, natural climate solutions have the potential to cascade up society’s chains of influence and back down again. But they need a spark – and that’s where climate leaders come in. Without leadership, there is no change.

MOVING FORWARD

There has never been more demand for land on our planet. Under a business-as-usual scenario, land use for croplands, grazing lands, and urban areas will increase by nearly 700 million hectares by 2050 – an area nearly the size of Australia.¹⁰⁷ Yet, land is vital for many, sometimes competing, purposes – including maintaining biodiversity, solving climate change, and providing healthy diets to a growing population. Meanwhile, countries negotiating a new global biodiversity framework under the Convention on Biological Diversity are considering targets to protect 30% of the world’s land and ocean by 2030, and elsewhere have pledged to reforest as much as 350 million hectares or more by 2050.¹⁰⁸

Local and national governments must play a critical role in managing this “global land squeeze” by developing and implementing climate-sensitive, integrated land-use plans capable of guiding the necessary transition. These plans should be developed transparently, with the best available science to balance competing land needs. Policymakers will need to consult with local

stakeholders to generate buy-in and ensure cultural traditions and rights are protected, while powerful social movements will be needed to provide additional accountability. Many land-use plans of this type already exist, but only on paper – so governments also need to provide incentives and direct support to turn them into reality. This might mean funding land registries, implementing monitoring and enforcement initiatives (ideally which support local livelihoods), and much more.

In this section, we look more closely at several crosscutting issues that are closely linked to accelerating natural climate solutions. Most notable is the way the world grows and consumes food, which relates to almost all of our Action Tracks. But the growth and/or substitution of bioenergy crops for fossil energy, or wood for other building materials, could in the future present similar challenges and opportunities for the acceleration of natural climate solutions. These and other issues deserve additional attention, and we will address them more explicitly as we refine and improve this Roadmap.

FOOD SYSTEMS

Agriculture is the world’s largest cause of ecosystem loss and associated emissions. Since the year 2000, over 100 million hectares of land (an area the size of Egypt) has been converted to croplands,¹⁰⁹ and about 75 million hectares to grazing lands and tree crops.¹¹⁰ This conversion is the source of about 5 Gt of emissions annually, while crop fertilizers add another 2 Gt and livestock another 4 Gt at least.¹¹¹

In total, the global food system is currently responsible for about 27% of all greenhouse gas emissions, and so it also looms large in opportunities to reduce those emissions.¹¹² The connection between natural climate solutions and future dietary patterns comes down to land. The global land squeeze forces us to make choices – as policymakers, businesses, and individuals. If our food production and consumption choices don’t collectively change in the coming decade, we give up any real chance of limiting global temperature increase to no more than 1.5°C, or stemming the tide of deforestation and biodiversity loss.¹¹³

Major emissions reductions can be achieved by increasing the intensity, productivity, and sustainability of existing food systems through climate-smart farming and climate-smart grazing.

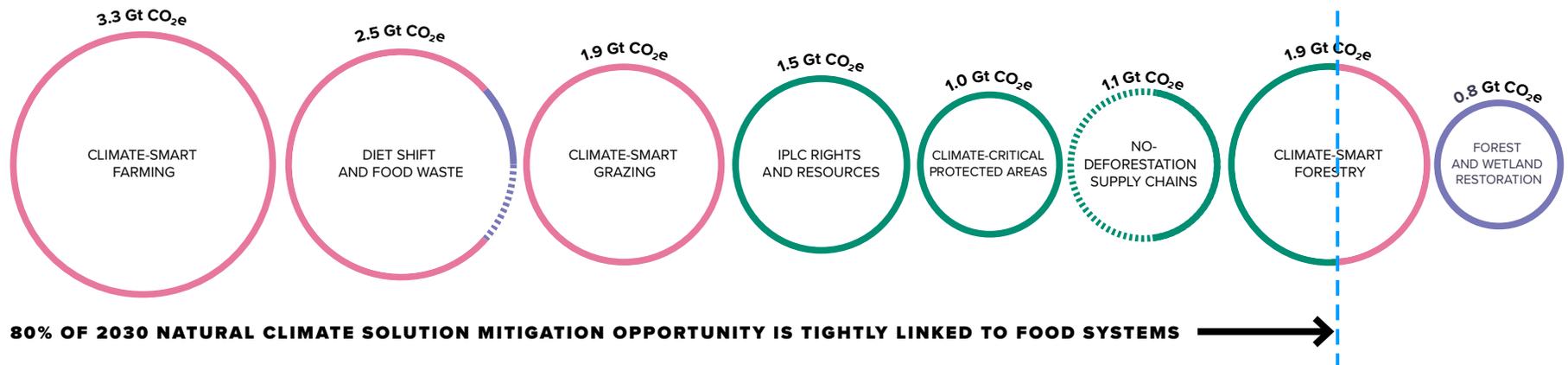
But feeding 10 billion people while staying within planetary boundaries requires more – including the following food system shifts:

- Reducing consumption of animal-sourced foods in many countries, while allowing for potential increases in countries or regions where consumption is currently low and burdens of undernutrition are high.
- Reducing global methane emissions by better managing cattle feed and waste.
- Reducing land area used for livestock, releasing cropland used to grow livestock feed to be used for human food crops instead, and releasing grazing land where appropriate to allow for nature restoration and carbon sequestration.
- Increasing the demand for lower-emissions and regenerative agricultural practices and products by lowering their costs to consumers and accurately and clearly labeling nature-positive goods.
- Reducing food loss and waste by measuring, disclosing, and setting targets to address it, improving infrastructure where needed, repurposing food streams as animal feed, and addressing supply chain inefficiencies.¹¹⁴

Together, these measures can reverse food systems’ destruction and exploitation of nature, taking us toward a future that brings human food consumption within planetary boundaries.

In fact, the biggest and most cost-effective opportunities for reducing emissions and removing carbon from the atmosphere through natural climate solutions all directly involve food production systems: soil management practices, introducing trees in croplands and grazing lands, and releasing unsuitable grazing lands for restoration to forest.

Overall, more than 80% of the 2030 mitigation from following this Roadmap is tightly linked to food systems. Climate-Smart Farming and Diet Shift and Food Waste actions together represent half of the opportunity offered by natural climate solutions, while avoiding deforestation (most of which is caused by agricultural expansion) represents another 30%.





OTHER CHALLENGES AND OPPORTUNITIES

Alongside food systems, several other challenges – and opportunities – also cut across Action Tracks.

The intersection of land and energy is one such challenge. About 7% of global cropland is currently used to produce biofuels – liquid fuels such as bioethanol and biodiesel largely used for transportation. Europe and the United Kingdom, meanwhile, have become major importers of wood pellets from around the world, burning them to generate electricity.

These types of bioenergy solutions – including as-yet-unproven “Bioenergy with Carbon Capture and Storage” (or BECCS) systems – play a significant role in many of the IPCC’s mitigation scenarios that achieve less than two degrees of warming. At these scales of deployment, bioenergy would contribute to the “global land squeeze”, with potentially large tradeoffs against food production and diet choices, ecosystem protection, climate-smart management, and forest and wetland restoration.

The most recent analyses of mitigation potential suggest that BECCS is an alternative to ecosystem carbon sequestration – we can choose one or the other given current land availability, but not both.¹¹⁵ We have, therefore, not included bioenergy in this version of the Roadmap.

This is also the case with clean cookstoves – a solution that reduces demand for wood, but does not provide additional mitigation beyond reduced forest degradation, which is already accounted for elsewhere.

There are also solutions like substituting wood (so-called “mass timber”) for steel as a building material, which would reduce emissions from other parts of the economy while also “locking up” carbon in the built environment.¹¹⁶ Our Roadmap does not include the potential mitigation from these types of biomaterial substitutions, nor their potential impacts on carbon stored in living ecosystems.

Shifting agriculture systems¹¹⁷ and small-scale deforestation for subsistence farming are additional challenges that cut across ecosystem protection and climate-smart management solutions. These two processes are difficult to tease apart, but are globally significant drivers of around a quarter of annual tree cover loss.¹¹⁸ While our Roadmap does not address these processes explicitly, we recognize that they will likely play a role in the livelihoods of many rural communities well beyond 2050. Our “protect” curves do not fully eliminate ecosystem losses for this reason.

While we have been careful to avoid double counting or undercounting the global opportunity provided by natural climate solutions in relation to the above actions and solutions, we will address them more explicitly as we refine and improve this Roadmap.

A NATURE ROADMAP BEYOND CARBON?

The diversity of life on Earth is the foundation for healthy ecosystems, which in turn are critical for human well-being. Diverse ecosystems are also more resilient to disturbances such as fire, disease, and climate change – illustrating that biodiversity can be a stabilizing force against ongoing and future stressors.¹¹⁹

However, human activity over the past half century in particular has steadily eroded the planet's biodiversity, and the global decline in species richness and abundance has accelerated alongside increasing global temperatures. Earth's remaining biodiversity is imperiled by both climate change and destruction of natural habitat.

By maintaining and stewarding biodiversity, therefore, we can help ensure the longevity and effectiveness of natural climate solutions. These solutions will be more successful at keeping carbon out of the atmosphere over the long term if they are planned and implemented with an understanding that species

are exposed to unprecedented climatic change, that their ranges are shifting as a result, and that diverse, intact ecosystems are more resilient to disturbance.

The relationship goes the other way too. Meeting the demands of the Carbon Law for Nature and rapidly accelerating natural climate solutions would go a long way towards meeting the world's biodiversity objectives (including the species and area conservation goals under the Convention on Biological Diversity), even though we have not yet explicitly optimized the Roadmap to maximize biodiversity protection. Partly this is because the climate and biodiversity crises are driven by the same ecosystem destruction. But it is also because many of the underlying analyses of carbon mitigation potential from land in the Roadmap include safeguards for biodiversity. For example, locations for reforestation are limited to prevent the conversion of ecologically important grassland and savannah into forest. Restoration efforts must focus on these diverse native systems, not monoculture, non-native tree plantations.

Our future work will bring biodiversity into the underlying analyses more explicitly. For example, our team is currently using high-resolution mapping techniques to simultaneously maximize both biodiversity and carbon benefits from the restoration of low-yield grazing land back into natural ecosystems, given the potential release of lands from dietary shift and food waste (see Restore).

Scientists around the world are also developing maps of the global distribution of a variety of ecosystem services related to water, food, and livelihoods.¹²⁰ These maps will help guide choices for how different resources are managed to ensure that these places remain healthy – both at global and national scales. And these elements, too, must be brought into the underlying analyses more explicitly, to ensure that we achieve not just a climate-positive, but a fully nature-positive future.

WHAT'S NEXT?

It's clear that much more work is needed if the Exponential Roadmap for Natural Climate Solutions is to achieve a transformative impact. This initial Roadmap report, therefore, is only a first step. It sets out the destination (the Carbon Law for Nature), the people-centered Action Tracks the world must take to reach it, and the timeline – the mitigation trajectories – on which we must act if we are to be successful.

To match the progress being made in the energy transition however, and turbocharge the nature transition, we must do two things: We must enhance the resolution and specificity of the Roadmap – identifying the minor roads and trails, as well as the major highways, that make up each Action Track, along which actors may travel to reach the Carbon Law for Nature.

And we must exponentially accelerate its implementation – shifting from target-setting to action – from simple outcome curves measured in aggregate gigatons of CO₂e, to uptake curves of specific natural climate solutions and their delivery of real, measurable gigatons of mitigation.

To do this, **we see four major interlinked areas requiring transformative investment in innovation** – innovation that must be pursued urgently, justly, transparently, and inclusively (see figure on the next page).

We will be driving forward over the next three years in each of these innovation domains, seeking partners and collaborators to co-design the more detailed workstreams within each area and catalyze progress.

Yet we also recognize that to achieve the Carbon Law for Nature, and to deliver an even broader equitable and just nature transition, this Roadmap is just one of many necessary pieces of the puzzle. The science is now clear and the pathway is rapidly coming into focus. But to tackle the remaining barriers, and empower all countries and communities to benefit from the transition, this journey requires a coalition – a coalition that collaboratively sets and tracks the global agenda for the nature transition driving forward with credibility and inclusion. We invite you to join us on this journey.

BASIC SCIENCE

We need new basic science that, for example, quantifies and values the benefits that achieving the Carbon Law for Nature will provide. This includes biodiversity benefits, the benefits in terms of livelihoods for local communities, and the broader resilience benefits that reduce the risk of ecosystem tipping points.¹²¹ We also need to better understand the scale of nature-based mitigation already assumed to be delivered in many modeled climate futures, and the potential opportunities for accelerating mitigation that falls within versus outside the scope of businesses’ climate targets. For some natural climate solutions – most notably soil carbon – rapid and accurate measurements of carbon stocks and flows remains a basic science challenge.

MAINSTREAMING

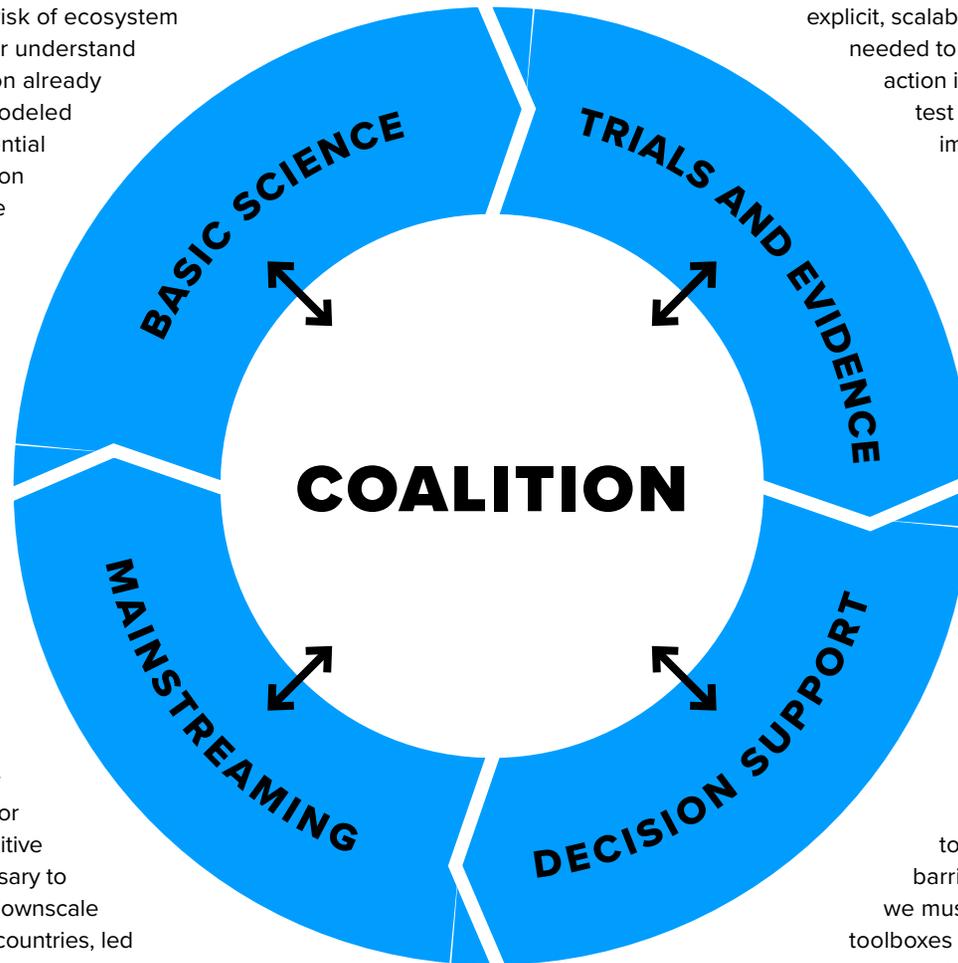
We must embed the Carbon Law for Nature and the broader Roadmap into the hearts and minds, the strategies and plans, of enabling actors across the globe – in the same way that the broader Carbon Law’s “halving emissions every decade” has become a lodestone for the energy sector. To catalyze the positive behavioral tipping points¹²² necessary to move at the required pace, we must downscale the Roadmap to specific regions and countries, led by in-country stakeholders, as well as develop individual sector- and business-specific Roadmaps consistent with the Carbon Law for Nature, starting with industry leaders. By embracing the Exponential Roadmap for Natural Climate Solutions, policymakers, businesses, the finance sector, and social movements will have a tool to start shifting the balance of incentives and regulations to guide the hundreds of billions of dollars needed to deliver on the Carbon Law for Nature – and an even broader, equitable and just nature transition.

TRIALS AND EVIDENCE

To generate the necessary supply of mitigation through natural climate solutions to meet the unprecedented demand that will be created by the Carbon Law for Nature, we need to identify and co-design natural climate solution “models.” These represent the explicit, scalable, policy or financial interventions needed to trigger and exponentially accelerate action in each Action Track. We then need to test the most promising of these models by implementing trials at a truly transformative scale – deploying the latest methods in experimental design and impact evaluation to drive accountability and exponentially accelerate learning, in order to de-risk investment. We must also design and facilitate a “Natural Climate Solutions Evidence Network” that has a mandate to collect, synthesize and share the results as a vital global public good.

DECISION SUPPORT

We need to support equitable and just decision-making from enabling actors and actors-on-the-ground by delivering the right information in the right way. This can be done by repurposing old and leveraging new technologies to accelerate investment and reduce barriers to implementation. For example, we must develop and disseminate science toolboxes for effectively implementing the most promising natural climate solution models – toolboxes that include advanced carbon accounting methodologies, best-practice guidance for maximizing mitigation outcomes while safeguarding biodiversity and food security, and “natural climate technologies” that can help accelerate adoption and scaling of these models. At the same time, we need systems that can monitor the world’s progress on each Action Track and towards achieving the Carbon Law for Nature.



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