

Immediate actions in national pathways to net zero

# TRIGGERING SHORT-TERM EMISSION REDUCTIONS

*Immediate $CO_2$ emission reductions are primarily achieved through improvements in power generation, passenger transport and land use in national pathways to net zero. Technical solutions already exist in these sectors and the policies needed to accelerate their deployment are often well identified in each country.*

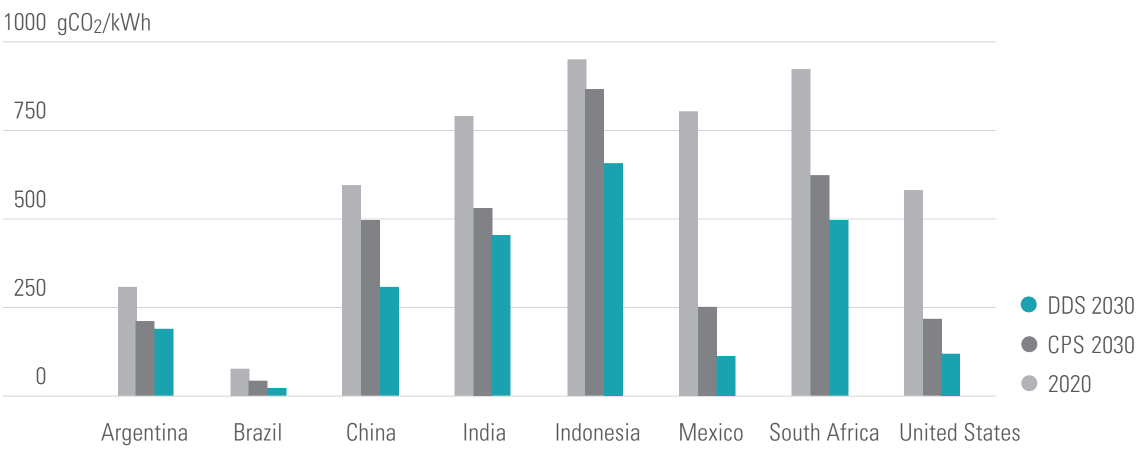
Immediate emission reductions are crucial for putting each country on track with the long-term net zero objective. It is essential that these immediate emission reductions preserve the capacity for deeper, long-term reductions and avoid the creation of new carbon lock-ins (cf. message 2.1). National pathways to net zero highlight three sectors with the greatest potential for immediate emission reductions consistent with the long-term goals: power generation, passenger transport and land use.
These three sectors share the characteristic that technical solutions for $CO_2$ emission reductions are readily available and commercially viable. As a result, achieving immediate emission reductions relies on the establishment of an adequate enabling environment to accelerate the diffusion of these solutions.

## POWER GENERATION

The rapid decarbonization of power generation is critical in national pathways to net zero, because it is the highest energy-related emitting sector in most countries (except Brazil, which already has a very low-carbon electricity system based on hydroelectric power) and, most importantly, because the availability of decarbonized electricity in the medium term is essential for the decarbonization of many end-uses, for which electrification is the best route (see message 1.2). Electricity produced from renewable energy sources, such as hydro, solar, wind or biomass, is cheaper than fossil fuel options in most countries, meaning that economic costs are not a fundamental obstacle to the diffusion of these low-carbon alternatives[28]. However, when examining current trends at the country level, as analyzed in CPS scenarios, the projected adoption of these technologies in the near future is often not as large as required in national pathways to net zero. **Figure 13** shows that, although the carbon intensity of electricity decreases by 2030 in all countries under current trends, national pathways to net zero indicate a significant acceleration of this decrease by the same date.

28 Clarke, L., Y.-M. Wei, A. De La Vega Navarro, A. Garg, A.N. Hahmann, S. Khennas, I.M.L. Azevedo, A. Löschel, A.K. Singh, L. Steg, G. Strbac, K. Wada, 2022: Energy Systems. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change[P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.008.

**Figure 13.** Carbon intensity of electricity ($gCO_2$/kWh)



This gap can be attributed to specific constraints affecting the diffusion of low-carbon options, which are proactively addressed in national pathways to net zero through targeted and country-specific sectoral policies. Among these, the organization of the power market plays a particularly important role. Indeed, the power market has been historically structured around thermal power plants and fossil fuel usage, so that the penetration of alternative energy sources at scale requires a profound change in the management and distribution of power generation.

Country analyses illustrate that the accelerated adoption of low-carbon energy sources in electricity production may depend significantly on targeted measures that adjust market rules. These measures aim, for example, to incentivize public and private investments, to facilitate the participation of private companies in the power market, and to create clear market signals in favour of low-carbon options. Depending on specific country circumstances, this can be achieved by allowing independent private participation or joint ventures, through public auctions, or through improved production quotas and associated penalties (Case study - Mexico and Argentina)

**CASE STUDY – MEXICO**

### Public auctions and private participation to accelerate and lower power sector costs

In 2013, Mexico enacted an energy reform to open the electricity generation market to private entities, while maintaining state control over energy planning, grid operation, development of transmission and infrastructure, and electricity distribution. Previously, these functions were exclusively carried out by the two state-owned utilities: CFE and PEMEX. After 2013, private electricity suppliers were then allowed to sell their energy to a wholesale market from which distributors could sell electricity to final users. Private generators could operate independently or in public-private partnerships.

During the period from 2015 to 2018, Mexico enacted public auctions as a mechanism to allow private electricity generators to install renewable production capacities and exploit renewable resources in competitive long-term energy supply contracts. This boosted private investment in the sector during those years, while reducing the production costs of electricity and facilitating the development of transmission infrastructure.

However, the previous administration (2018-2024) stopped this mechanism, without explicitly revoking the reform, which remains enshrined in law. The result has been a lack of investment in renewable energy infrastructure, which has been cited as one of the main reasons for a low overall investment in the economy and a slowdown of the nearshoring process of North American companies relocating to Mexico.

As a complement to ensuring the transition of electricity generation towards renewable sources, the Secretary of Energy set up specific long-term targets for clean energy participation in electricity generation from 2020 to 2030, aligned with NDC objectives. This clean energy participation could be achieved through their own production assets or through the exchange of Clean Energy Certificates, which can be traded by independent renewable electricity producers. These certificates are awarded by a decentralized Energy Regulatory Commission.

**CASE STUDY – ARGENTINA**

### The need of state planning to design comprehensive energy policies

The existence of laws and regulations with quotas is a necessary condition to induce renewable energy penetration; however, in many cases it may not be sufficient.

In Argentina, Law 27,191 (2015) established a periodic target for renewable energy in electricity consumption, aiming for 20% from renewable sources by 2025. The regulation explicitly mandates for large energy users to individually comply with the specified percentage of renewables in their consumption. Additionally, the government launched various tenders to incentivize the installed capacity of different technologies (RenoVAr) and implemented a bidding system known as *Mercado a Término de Energías Renovables* (MATER), among others. However, as of 2024, these quotas have not

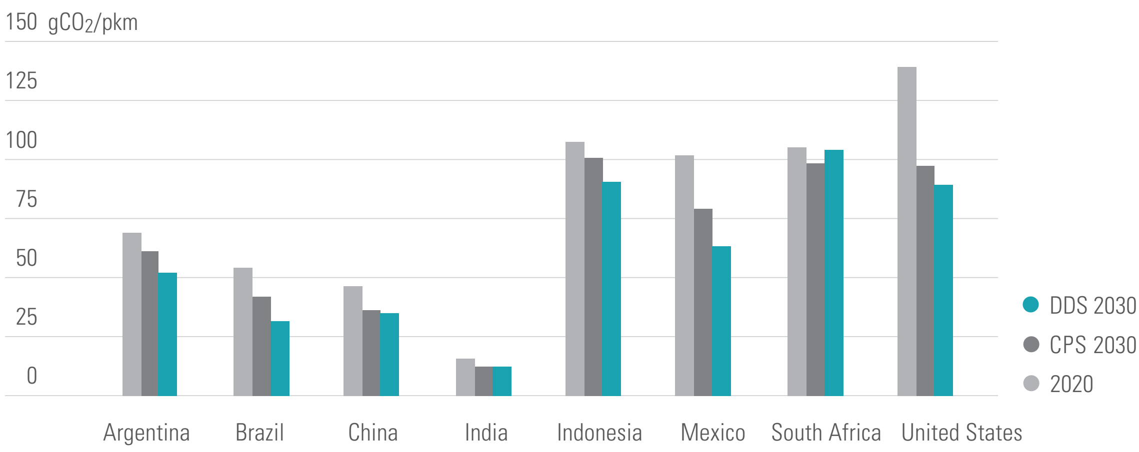
been met in any year, and energy experts believe that the 20% target is unlikely to be achieved.
Neither the obligations for major electricity users nor the implementation of specific auctions have proven sufficiently effective. This is the combined result of several factors, including the impact of international shocks (such as the financial crisis, which caused many projects selected during the bidding process to be abandoned) and a lack of effective enforcement (including the absence of penalties for non-compliance with renewable penetration quota for large users). In addition, limitations in electricity transmission capacity create negative signals regarding the installation of new generation facilities.

These recent experiences call for a careful evaluation to determine whether current private companies in various areas of the energy sector should be nationalized. This would then allow the enforcement of public planning investments, initially focusing on strengthening and expanding the high-tension transmission system through state-owned companies. Following this, tenders for renewable energy projects could be issued. This state-owned regulated natural monopoly would then also increase tax revenues, giving further support for comprehensive energy, climate and economic policies.

## PASSENGER TRANSPORT

Passenger mobility is among the main emitting sectors in most countries, and mobility demand is expected to increase rapidly due to population growth and economic development. Therefore, decarbonizing the sector is a key component of national pathways to net zero. Given the significant inertia in the sector in its infrastructural and behavioral dimensions, decarbonization strategies should be implemented rapidly.
A variety of technical solutions are already available and could be developed without delay to reduce sectoral emissions, notably the shift to public transport (PT) and non-motorized transport (NMT) as well as the substitution of internal combustion vehicles with electric vehicles (EVs). Beyond their role in reducing $CO_2$ emissions, NMT and PT development policies offer important co-benefits such as improving public health by increasing active mobility among the population, reducing inequalities by lowering mobility costs, and alleviating car congestion and traffic jams. Furthermore, ongoing technical progress and cost reductions

**Figure 14.** Carbon content of passenger mobility ($gCO_2$/pkm; CPS VS DDS in 2030)



in EV technologies are expected to make them cost-competitive during this decade.

However, despite these apparently favourable conditions, current trends fall short of deploying these low-carbon options at the pace required in national pathways to net zero. While **Figure 14** shows that the carbon intensity of mobility decreases in most countries under current trends, national pathways to net zero highlight a significantly faster reduction in carbon intensity by the same date. In contrast South Africa is an example where the motorization rate increases faster than the electrification of cars in the DDS compared to the CPS.

The delay in sectoral decarbonization under current trends can largely be attributed to existing transport infrastructure and priorities, inherited from a sectoral paradigm favouring the development of car ownership and travel. In addition, electric vehicles remain unaffordable for middle and low-income households in many countries, leading these segments of the population to continue opting for internal combustion engine vehicles by default.

National pathways to net zero incorporate short-term targeted measures to counterbalance these trends and accelerate the shift towards low-carbon modes of transport and vehicles. Analyses of different countries show that the shift to PT and NMT depends significantly on targeted measures aimed at improving access, safety, speed, and quality of PT and NMT options, as illustrated in the Case study on Mexico. In addition, these analyses highlight that the shift to EVs relies heavily on targeted measures to reduce the upfront cost of EVs for consumers, to facilitate EV charging infrastructure, and incentivize car manufacturers to increase sales, as illustrated in the Case study on the US.

**CASE STUDY – MEXICO**

### Accelerating non-motorized transport and public transport adoption by 2030

In Mexico, PT and NMT could meet the increasing demand for mobility by 2030. Key actions could be implemented immediately in the largest metropolitan areas to improve the access, safety, speed and quality standards of PT and NMT solutions, making them more attractive than private cars and accelerating their adoption.

Proposed measures include:

- reallocating road space to create dedicated lanes for PT and NMT on existing roads,
- converting road space into parking areas and increasing integration with PT and NMT services,
- regulating informal public transport to create higher quality standards for public transport through the creation of a charter of engagement, which would include incentives and associated command and control measures,
- updating planning and expenditure decision-making protocols to ensure that current road infrastructure investments are allocated only if correctly linked with safe and convenient PT and NMT alternatives.

Implementing these measures will contribute to improved quality of life and a better urban experience, enabling citizens to reclaim public spaces and continue to support local policies.

**CASE STUDY – UNITED STATES**

### Short-term policies to accelerate EV adoption by 2030

In the US, federal, state, and local governments have implemented different policies and incentives aimed at accelerating the adoption of electric vehicles (EVs) by 2030. To incentivize EV uptake, the Clean Vehicle Credit under the Inflation Reduction Act (IRA) provides up to $7,500 to reduce the upfront cost of EVs. The credit is structured to ensure that it benefits the US workforce, requiring EVs to meet strict battery assembly and mineral sourcing requirements. Several states, including California, Delaware, Maryland, and New York, also offer rebates and tax credits for purchasing or leasing a new or used EV, ranging from $1,000 - $12,000. In Maryland, these tax credits helped increase EV sales by more than 59% in 2023.[29]

To support the expansion of EV charging infrastructure, the IRA has a property credit aimed

29 https://www.mdot.maryland.gov/tso/pages/newsroomdetails.aspx?newsId=779&PageId=38 (2024).

at expanding access to EV charging stations in underserved areas. Additionally, the Bipartisan Infrastructure Law (BIL) allocates $10.7 billion for LDV EV charging infrastructure. The National Electric Vehicle Infrastructure (NEVI) Formula Program established by BIL, for example, provides funding for states to deploy EV charging stations, covering up to 80% of eligible project costs.[30] Cities have also implemented EV ready ordinances, requiring new buildings and major remodel projects to integrate EV charging infrastructure.[31] At the same time, many utilities offer discounted charging rates and rebates for customers to install EV chargers. [3233]

Regulatory measures are also driving EV adoption in the short term. The EPA has finalized stringent multi-pollutant emissions standards for LDVs and MDVs of model years 2027 and later, increasing the average fuel economy of their fleets and correspondingly, new EV sales.[34] At the subnational level, California's Advanced Clean Cars (ACC) II legislation, adopted by 14 states, targets 68% electric passenger car sales by 2030 and 100% by 2035. Similarly, California's Advanced Clean Trucks (ACT) and Advanced Clean Fleets (ACF) regulations require an increased share of medium and heavy-duty EV sales between 2024 and 2035, and private and public fleets to phase in the use of zero-emission vehicles (ZEVs) starting in 2024. Corresponding commitments from automakers, for example Stellantis' partnership with California[35], and business fleet targets, like Amazon's plan to incorporate 100,000 electric delivery vehicles by 2030[36], further increase EV adoption. Together, these short-term policies from both federal and nonfederal actors form a comprehensive strategy to drive the penetration of EVs, build necessary infrastructure, and decrease overall transportation emissions by 2030.

30 https://afdc.energy.gov/laws/12744
31 https://www.columbus.gov/Services/Public-Utilities/About-Public-Utilities/Office-of-Sustainability/Equitable-Electric-Vehicle-Parking.
32 https://www.alabamapower.com/residential/save-money-and-energy/energy-saving-products/electric-vehicles/ev-home-charger-rebate.html.
33 https://www.aelp.com/Energy-Conservation/Electric-Vehicles.
34 https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-multi-pollutant-emissions-standards-model
35 .California announces partnership with Stellantis to further emission reductions. California Air Resources Board https://ww2.arb.ca.gov/news/california-announces-partnership-stellantis-further-emissions-reductions (2024).
36 https://sustainability.aboutamazon.com/climate-solutions/transportation.

## LAND USE AND FORESTRY

The land use, land use change and forestry (LULUCF) sector plays a critical role in achieving short-term emission reductions in all countries. In some countries, the national pathway to net zero shows significant immediate sectoral emission reductions, while in others, the annual $CO_2$ absorption levels of 2020 are maintained, ensuring negative sectoral emissions and highlighting the preservation of net carbon sinks. The DDS for all countries analysed in this context show negative LULUCF emissions by 2030, whereas in 2020 the sector is a net emitter in half of these countries (**Figure 15**).

In countries where sectoral emissions reduce significantly in the short term, the effective implementation of current policies plays a critical role.[37] A policy can be formally adopted by a policymaking institution without being effectively implemented by line ministries or other governmental agencies. Improving the implementation of a policy requires formal adoption to be accompanied by

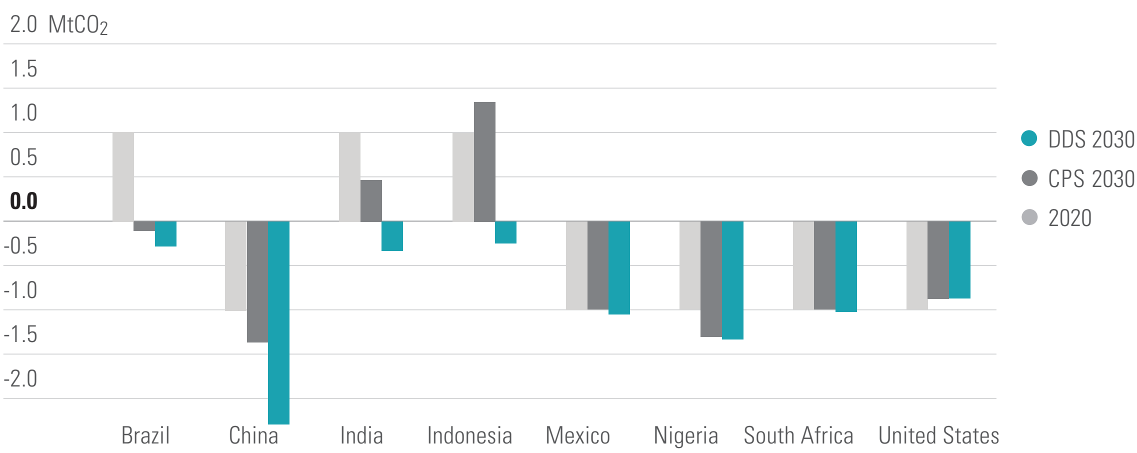
37 In Brazil's case, the CPS assumes that the current effectiveness of policy implementation continues, while a variation of the CPS assumes that the implementation of policies targeting deforestation improves, leading to a faster reduction in deforestation in this alternative CPS.

a clear designation of responsibilities within the public administration, as well as ensuring that the responsible institutions receive sufficient training, budget and appropriate tools for policy execution. It also requires that the effects of the policy are monitored, evaluated and that feedback is integrated. Policy implementation in LULUCF poses significant challenges, given that actors in agriculture and forestry are predominantly small-scale and that policies often address large territories.

Across Brazil and Indonesia, more effective implementation of forest conservation laws leads to a sharp decline in deforestation by 2030 in their DDS, as well as reductions in peatland fires and degradation in Indonesia. In India, an improved implementation of the existing afforestation programme and policies on participatory management drives afforestation and a significant increase in agroforestry by 2030 (Case studies on Brazil, Indonesia and India for more detail).

However, additional sectoral policies are required to achieve emission reductions compatible with carbon neutrality, with a focus on increasing the finance available to sectoral actors. The DDS in Brazil, India and Indonesia all achieve deeper net emission reductions in LULUCF than the respective CPS due to the adoption of additional policies. In Brazil, the reduction in deforestation is similar in the variation of the CPS and the DDS, but reforestation/afforestation and improvements in the management of standing forests occur at an accelerated pace due to improved financial incentives for land managers, particularly through the implementation of the Brazilian carbon market. In Indonesia, a key additional policy assumption in the DDS compared to the CPS is a strengthened system for payments for ecosystem services, which provides stronger incentives for land managers to conserve existing forests and integrate more perennial vegetation into their land. In India, the difference between the emission reductions achieved in the CPS and the DDS by 2030 can be attributed to afforestation and reforestation efforts, as well as an increase in carbon sequestration on croplands. This is supported by policies that strengthen the technical and financial support for farmers to adopt tree planting for energy production alongside crops and to establish energy plantations on wastelands (Case studies on Brazil, Indonesia and India for more detail).

**Figure 15.** $CO_2$ emissions from LULUCF ($MtCO_2$)




* Values are normalized to 1 for countries where LULUCF net emissions are positive in 2020, and to -1 for countries where LULUCF emissions are negative in 2020. For Brazil, the CPS shown in the graph is a variation of the CPS which assumes improvement in the implementation of policies targeting deforestation, which contributes to faster eemission reduction compared to the standard CPS.

**CASE STUDY – BRAZIL**

## 2030 mitigation strategy for LULUCF

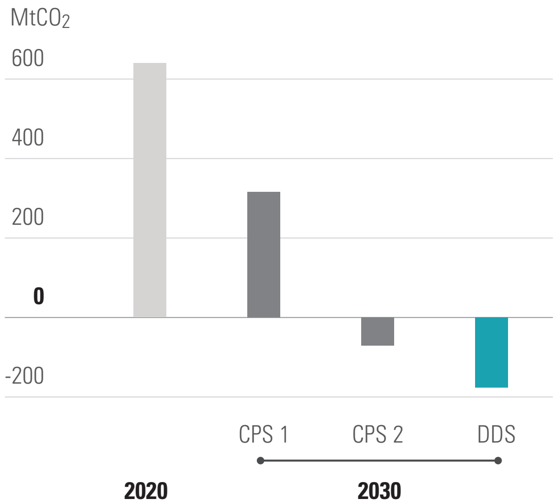
The Brazilian LULUCF scenarios clearly illustrate the significant mitigation potential that can be achieved by improving the implementation of existing policy mixes the sector. The current policy scenario in Brazil assumes that existing deforestation policies remain in place without further additions. These policies include strengthened public monitoring and enforcement of forest protection laws, such as the 2012 Forest Code, which aims to reduce deforestation and protect Brazil's vital ecosystems. The Forest Code requires landowners to set aside between 20% and 80% of their property for nature conservation, with the exact percentage varying by biome (80% in the Amazon biome and 20% in the Cerrado and Atlantic Forest). While complete success in implementation has not yet been achieved in the current policy scenario (CPS1), past experiences in reducing deforestation suggest that, despite their flaws, these policies are likely to lead to a moderate decrease in LULUCF emissions from deforestation. In this scenario, mitigation is projected to reach 318 $MtCO_2$/year (from 637 to 319 $MtCO_2$) between 2020 and 2030 (**Figure 16**).

By improving the implementation of existing policies in LULUCF, the sector can achieve emissions of -73 $MtCO_2$ by 2030 through reduced deforestation, representing an additional 396 $MtCO_2$/year, in the variation of the current policy scenario (CPS2) (**Figure 16**). The main difference between the CPS and its variation lies in the effectiveness of policy implementation, which depends on government enforcement capacity and the availability of financial resources.

The Brazilian case also shows that to achieve net emission reductions in LULUCF by 2030 that align with long-term carbon neutrality goals, additional policies must be adopted to complement existing policy mixes. In the Brazilian DDS, LULUCF emissions decrease from 637 to -177 $MtCO_2$ between 2020 and 2030 – a reduction of 104 $MtCO_2$/year (**Figure 16**). Deforestation is reduced at the same pace as in the more ambitious current policy scenario (GPS2). However, the DDS assumes more drastic improvements in the management of standing forests, increased protected areas (Conservation Units and Indigenous Lands), and the implementation of a carbon market allowing for LULUCF offsets for private native forest areas. In Brazil's case, while the CPS2 scenario includes policies to protect forests, there are insufficient financial incentives for land managers to conserve or sustainably manage ecosystems on their land. In addition to the effective implementation of existing policies in the land use sector, the Brazilian deep decarbonization scenario assumes improved access to finance for land managers who engage in conservation or sustainable management practices on their land.

**Figure 16.** Emission change in LULUCF by 2030 in Brazil

relative to 2020 levels



**CASE STUDY – INDIA**

## The effect of improving implementation of existing policies and strengthening the policy mix for enhancing carbon sinks

In the current policy scenario, LULUCF emissions in India are projected to decrease from -150 to -204 $MtCO_2$/year between 2020 and 2030. The main drivers of this reduction include increased carbon storage in trees and soils of croplands, as well as afforestation/reforestation. India is currently seeing improvements in the implementation of its policies impacting LULUCF, and the CPS assumes that these trends continue. A portfolio of policies is currently being implemented in the LULUCF sector, including the national forest policy, participatory forest management, the national bamboo mission, and the Nargar Van Yojana (Urban forests), to name just a few. For instance, the Nagar Van Yojana (Urban Forests) policy launched in 2020-21 for a five-year period (2024-2025) initially targeted the creation of 200 urban forest parks. However, due to an effective implementation that exceeded expectations, this target has been updated to 1,000 urban forest parks by 2024.

In the ENDC scenario, LULUCF emissions decrease from -144 to -345 $MtCO_2$/year, which is 141 $MtCO_2$/year more than in the CPS. This is due to accelerated afforestation/reforestation and an increase in carbon sequestration on croplands. India's DDS assumes that new policies will be introduced in the LULUCF sector, which will help achieve the additional mitigation and increased forest cover. Policies promoting tree-based energy plantations on wastelands contribute to increasing the forest cover, and a general policy on energy plantations is extended to include plantations on croplands, supporting farmers to grow trees for energy production alongside their crops. This is expected to supplement farmers' income in the long run, although they may need initial financial support to adopt agroforestry practices. This policy has been tested at a pilot stage in the state of Maharashtra, where subsidies are provided to farmers under the Employment Guarantee Act for cultivating bamboo alongside other crops.

**CASE STUDY – INDONESIA**

## Transforming LULUCF into a net carbon sink by 2030 and aligning with global climate targets

In the current policy scenario for Indonesia, LULUCF emissions decrease from 303 to 120 $MtCO_2$/year between 2020 and 2030. The main drivers are a reduction in deforestation rates, especially in illegal and unplanned deforestation, as well as reduced peatland/forest degradation and afforestation/reforestation. The scenario assumes no additional policy measures in LULUCF; rather, these transformations are driven by the assumption that existing policies and regulations in the LULUCF sector will be better enforced and more effectively implemented, for instance forest conservation policies and policies that strengthen forestry surveillance to reduce illegal logging, policies that promote the restauration of peatlands and mangroves, and continued reforestation and natural forest regrowth at slightly increased rates.

In the DDS, LULUCF emissions decrease from 303 to -37 $MtCO_2$/year between 2020 and 2030, which is 157 $MtCO_2$/year more than in the current policy scenario. This additional reduction is achieved through accelerated actions to halt deforestation, enhance afforestation/reforestation, and more rapidly reduce peatland degradation. These transformations are supported by the introduction of new and more ambitious policies, including stricter deforestation bans, limits on peatland emissions, stronger land-use governance, and more aggressive restoration targets for peatlands, mangroves, and degraded forests. It is also assumed that conservation efforts will be significantly scaled up, along with economic incentives for ecosystem services which involve stronger mechanisms for payments for ecosystem services (PES), biodiversity conservation, and the integration of land-use policies with climate mitigation goals. A more rapid expansion of forest cover is expected through afforestation, reforestation, and agroforestry practices, aligning land use with climate targets and promoting the rapid adoption of more climate-friendly agricultural practices and further integration of carbon sequestration into agricultural systems, including much larger scale restoration efforts for peatlands and mangroves.