

FORESTATION

WHAT IS FORESTATION?

Forestation, including forest restoration, reforestation, and afforestation, is the process of restoring damaged forests or growing forests on currently unforested land. **Forest restoration** involves helping degraded forest land recover its forest structure, ecological processes, and biodiversity. **Reforestation** includes planting trees or allowing trees to regrow on land that had recently been covered with forest. **Afforestation** involves planting trees on land that has not recently been covered with forest. Because forests remove carbon dioxide (CO₂) from the atmosphere as trees grow and can potentially store that carbon for long periods of time, forestation is often counted as a form of [carbon removal](#). Forestation can provide many benefits, which depend on exactly how it is done. Forest restoration, for instance, provides far greater ecological and biodiversity benefits than a monoculture tree plantation does.

CO-BENEFITS AND CONCERNS

- + **Biodiversity:** restoring or growing forests with diverse native species and functioning ecological processes can protect and promote biodiversity of plants and animals.
- + **Improved soil health:** forestation can improve local soil conditions.
- + **Flood and erosion control:** trees can reduce flooding and erosion.
- + **Local economic benefits:** forests can provide economic benefits to local communities, ranging from fuel wood and medicines to recreation.
- **Land use:** at large scales, land for forestation can compete with other uses of land, such as agriculture.
- **Reversibility:** if forests are disturbed or destroyed in the future, whether by humans or by climate change, stored carbon would be released.
- **Saturation:** forests will cease to absorb more carbon, on balance, once they reach maturity after decades or centuries.
- **Albedo effects:** at higher latitudes, replacing light land cover (e.g., snow and ice) with dark forests absorbs more heat, increasing climate change.
- **Carbon plantations:** monoculture plantations designed to maximize carbon removal could threaten biodiversity and would remain more vulnerable to reversal than natural forests.

POTENTIAL SCALE AND COSTS

The maximum amount of CO₂ that could be removed from the atmosphere through forestation depends on the amount of land devoted to afforestation and reforestation. The annual rate of carbon sequestration could **reach up to 3.6 billion tons of carbon dioxide (GtCO₂) per year by midcentury and up to 7 GtCO₂ by 2100, for a total cumulative sequestration of 80–260 GtCO₂.**

Because forests stop sequestering additional carbon once they reach a certain stage of maturity, which happens on a scale of decades to centuries, sequestering more carbon through forestation would eventually require finding more land for afforestation. Up to the point of saturation, however, older trees generally sequester more carbon per year than younger trees, meaning that **avoiding deforestation is a more effective way to reduce climate change than adding new forests or restoring degraded forests**. The direct costs of forestation are likely to be in the range of **\$5–50 per ton of CO₂ sequestered**, with natural regeneration of forests sometimes occurring at no direct cost when recently deforested lands are left to recover on their own.

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TECHNOLOGICAL READINESS

Forest restoration, reforestation, and afforestation are already widely practiced. This makes forestation one of the few approaches to carbon removal that is ready to be implemented at large scale immediately.

GOVERNANCE CONSIDERATIONS

- **Land management:** good governance is needed to ensure environmentally beneficial and socially equitable decisions about land-use.
 - **Social and environmental benefits:** since the social and environmental impacts of forestation depend on implementation, good governance is needed to maximize those benefits and ensure that they are shared fairly.
 - **Monitoring, reporting, and verification:** mechanisms are needed to enable accurate and efficient monitoring, reporting, and verification of carbon removal.
 - For **cross-cutting considerations**, see the [What Is Carbon Removal? fact sheet](#) on our web site.
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FURTHER READING

- Griscom, B. W., et al. 2017. "Natural Climate Solutions." *Proceedings of the National Academy of Sciences* 114 (44): 11645–50. doi [10.1073/pnas.1710465114](https://doi.org/10.1073/pnas.1710465114).
- Brancalion, P. H. S., and R. L. Chazdon. "Beyond Hectares: Four Principles to Guide Reforestation in the Context of Tropical Forest and Landscape Restoration." *Restoration Ecology* 25, no. 4 (2017): 491–96. doi [10.1111/rec.12519](https://doi.org/10.1111/rec.12519).

For more fact sheets on carbon removal, visit <https://carbonremoval.info/factsheets>.