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Evaluating the terrestrial carbon dioxide removal (tCDR) potential of large-scale aff-/reforestation and improved forest management in Norway

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As a carbon dioxide removal measure, the Norwegian government is currently considering a policy of large-scale planting of spruce (*Picea abies* (L) H. Karst) on non-forested lands (i.e., aff-/reforestation) and secondary forested lands dominated by early successional broadleaved tree species (i.e., improved forest management). Given the need to achieve net zero emissions in the latter half of the 21st century in effort to limit the global mean temperature rise to "well below" 2 °C, the mitigation potential of such a policy is unclear given relatively slow tree growth rates in the region. Further convoluting the picture is the magnitude and relevance of surface albedo changes linked to such projects, which typically counter the benefits of an enhanced forest CO_2 sink in high latitude regions. Here, we carry out a rigorous empirical assessment of the terrestrial carbon dioxide removal (tCDR) potential of large-scale aff-/reforestation (AR) and improved forest management (IFM) projects in Norway, taking into account transient developments in both terrestrial carbon sinks and surface albedo over the 21st century and beyond. We find that surface albedo changes would likely play a negligible role in counteracting the carbon cycle benefit of tCDR, yet given slow forest growth rates in the region, meaningful tCDR benefits from AR and IFM projects would not be realized until the end of the 21st century, with maximum benefits occurring around 2150. We estimate Norway's total accumulated tCDR potential at 2100 and 2150 (including surface albedo changes) to be 447 (± 240) and 852 (± 295) Mt CO_2-eq. at mean costs of US$ 29 (± 18) and US$ 26 (± 14) per ton CDR, respectively. For perspective, the accumulated tCDR potential at 2100 represents around 8 years of Norway's total current annual production-based (i.e., territorial) CO_2-eq. emissions.