

Affording the Energy Transition: Findings from the EU Marginal CO₂ Abatement Cost Curve in 2050

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Extended Abstract

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Abstract Summary

Achieving climate neutrality by 2050 requires the European Union (EU 27) to implement large scale CO₂ abatement measures while maintaining affordability. Marginal abatement cost curves (MACCs) provide a useful framework to compare cost-effectiveness in terms of CO₂ mitigation across technologies and sectors. In light of recent trends in energy price assumptions, this contribution reassesses the EU 27 transformation by analyzing and comparing the major CO₂ abatement measures on a MACC. It covers 128 CO₂ abatement measures from the buildings, energy supply, industry and transport sectors, addressing 2555 Mt CO₂ (93 %) of the EU's total abatement potential. The scenario year 2050 is chosen in line with the EU's target of achieving net-zero emissions.

Results show that 52 of the analyzed measures have negative abatement costs, accounting for 51 % of the total abatement potential. Electrification measures – most notably electric vehicles and heat pumps – and renewable energy integration dominate the negative-cost segment. By contrast, hydrogen-, synfuel- and CCS-based measures, particularly in industry as well as air and maritime transport, account for the majority of positive abatement costs. Despite sectoral and technological heterogeneity, cumulative negative abatement costs exceed positive abatement costs.

Overall, the results indicate that the EU's path to climate neutrality in 2050 can be cost-effective in terms of CO₂ mitigation from a system perspective, but requires targeted policy instruments to address sector-specific cost disparities and implementation challenges.