A multi-objective optimisation approach to explore decarbonisation pathways in a dynamic policy context

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Abstract

Climate policy is changing fast in the EU, with country leaders raising the bloc's ambition to reduce greenhouse gas emissions by 2030 and 2050. However, there is uncertainty about the allocation of decarbonisation effort between EU member states. This paper develops a multi-objective optimisation framework to provide insights to decision-makers in this policy context by exploring trade-offs between stronger decarbonisation goals and higher costs. Applying this approach for Cyprus, we find that the maximum achievable abatement for the EU Effort Sharing sectors corresponds to a 35% target. The current 24% ambition can be achieved with net social benefits, but the transition to higher abatement results in positive costs with a gradual rate of increase. The picture changes when decision-making explicitly accounts for external costs of emissions of greenhouse gases and air pollutants in the optimisation procedure. In this case, the least-cost solution delivers an abatement of about 32% and can yield social benefits of more than one billion Euros'2020. Regarding public expenditures, it requires about 3% of the annual GDP of Cyprus each year. This indicates that the socially optimal policy mix for attaining decarbonisation of the Cypriot economy is feasible but requires a consistent allocation of public funds to build infrastructure, overcome investment barriers and mobilise capital to enable the uptake of clean technologies across the economy. Although the modelling framework has been developed for a specific country and is tailored to the specific EU policy circumstances, the proposed methodology is entirely suitable for other world regions with a demanding decarbonisation roadmap.

Keywords: Climate change mitigation; Emissions abatement; Pareto set; Policy formulation

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