MULTI-OBJECTIVE EVALUATION OF RENEWABLE TECHNOLOGY SUBSIDY PORTFOLIOS FROM COVID-19 RECOVERY PACKAGES

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Overview

To support member states' economic recovery from the effects of COVID-19, the EU has mobilised financial resources as part of the long-term budget of 2021-2027 (European Commission, 2020a). Among the proposed recovery efforts, the EU launched the Recovery and Resilience Facility (RRF) to provide €672.5 billion of financial support to Member States in the coming years (European Commission, 2020b). To support the green transition, national recovery and resilience plans should allocate at least 37% of investments towards battling climate change and be alligned with the updated target of the European Green Deal of 55% emissions reduction by 2030. Among the objectives of the recovery and resilience plans is to support the sector integration of 40% of the 500GW of renewable energy required by 2030. Considering these allocations, it is expected that €250 billion will be used to support investments in clean energy and renewables, energy efficiency of buildings, and sustainable transport. In the context of the societal challenges emerging from COVID-19 and the EU pledges for an economic and sustainable recovery, this study aims to optimise the impact of the proposed fiscal program and the budget allocated towards the "green" transition in terms of jobs created in the energy sector and further reduction of GHG emissions. For this purpose, GCAM, an integrated assessment model, is coupled with AUGMECON-R, a portfolio analysis model for multi-objective evaluation under uncertainty. To increase the robustness of the results, our analysis is further coupled with a Monte Carlo simulation, where stochastic uncertainty is assumed for the impact on jobs and emissions of each portfolio.

Methods

We propose a two-level integrated assessment and portfolio modelling study, to investigate the optimal allocation of the currently announced recovery plans at the EU level to support the green transition. Considering that 37% of the RRF budget will be allocated in clean energy and renewables, energy efficiency of buildings, and sustainable transport, we assume three potential subsidisation levels for the former; €100, €150 and €200 billion budgets. Based on these budgets, different subsidisation levels are also explored for eight low-carbon technologies: biofuels, solid biomass, concentrated solar power (CSP), geothermal, solar photovoltaics (PV), electric vehicles (EVs), wind, and biogas. The GCAM model is employed to assess different levels of subsidisation on these technologies on top of an EU current policy scenario that explores where EU emissions are headed given currently implemented and/or announced policies in the EU (Sognnaes et al., 2021). This means that the results should be interpreted as additional to the already pledged measures and targets established. Given that the recovery and resilience funds have to be spent by 2024, it is assumed that the different subsidies are applied between 2021 and 2025 and affect total capital costs of the related technologies, using the subsidies to lower initial investment costs. For GHGs, we calculate the cumulative emissions impacts from 2021 to 2030, extracting GCAM results in 2030. This way, and considering that green investments contribute to reducing long-term emissions, the analysis provides an indication on the contribution of the emergency funds to help reach the updated 2030 target of 55% emissions cuts. In terms of employment, we externally calculate the net impact of jobs compared to the baseline (current policy) scenario depending on the increase or decrease in the demand for each technology provided by GCAM and examine the effect of subsidisation up to 2025, assuming that the funds are used to make up for the upcoming recession in a shorter term. The results are then fed into a portfolio analysis based on AUGMECON-R (Nikas et al., 2020), where three optimisation models are solved for the three distinct budget levels, in order to identify optimal strategies for each case that maximise the creation of jobs and the reduction of GHG emissions. Finally, to increase robustness of the results and deal with the inherent uncertainty and stochastic nature of the basic parameters of the model, namely GHG emission reduction and impact on jobs, a Monte Carlo simulation is carried out in a plus-minus 5% range for both parameters per subsidy package, in an approach similar to

(Forouli et al., 2020). The simulation is executed iteratively 1,000 times for each of the three portfolio analysis configurations.

Results

We highlight that, based on a provisional budget of €100-200 billion, about 230-432k new jobs can be created by 2025 and 50-233 MtCO2e can be cut by 2030 on top of a current policies scenario, which will bring the EU targets slightly closer, corresponding to a 0.2-1% drop further down from the current policy trajectories. These results are mainly driven by investments in biofuels, wind, and biogas and in smaller amounts in geothermal energy. This is mainly due to their optimal performance in both criteria of emissions cut and jobs created. We can also see that the potential of geothermal power generation is limited, but participates in all near-optimal portfolios due to its low cost and positive impacts along both axes. For that reason, it was preferred as a supplementary investment against CSP and solid biomass, which performed poorly and were excluded from the majority of the portfolios created. A key trade-off observed was that portfolios relying mostly on wind investments created more jobs than second-generation biofuel-based mixes, which in turn improved the reduction of emissions. Biogas was usually a “middle of the road” technology, balancing both criteria and for that reason it was almost always included in the investment mix. However, when considering uncertainty, wind-based portfolios prioritising employment gains appear more robust, dominating the majority of the portfolios. This can be traced to the small differences in emissions cuts between technologies compared to the larger differences on jobs created, with the analysis prioritising maximising the latter. Finally, the portfolio analysis strayed from further investments in technologies like PVs, which are already deployed extensively in the EU current policy scenario due to strong cost reductions over the past decade, and additional deployment requires relatively large back-up or storage invesments, reducing it´s cost-effectiveness. This shows that identified optimal portfolios should be interpreted as additional measures and not substitutes to the current pledges.

Conclusions

The emergence of COVID-19 has forced governments to mobilise funds and establish generous fiscal plans to address the financial impact caused by the disruption of ordinary activity from the pandemic. Although the provision of these funds provide a perfect opportunity to lead an economic recovery in conjunction with battling climate change, only a small share of the global budget is allocated towards a green transition. On the other hand, the EU has pledged that at least 37% of the recovery package will be used to support investments in clean energy and renewables, energy efficiency in buildings, and sustainable transport. In this study, we use budgets aligned with the announced EU plans, and couple integrated assessment modelling with a technological portfolio analysis to optimise the allocated funds. Towards further mitigating emissions and creating new jobs in the green transition, on top of a current policies scenario, we find that for a €100-200 billion investment budget in 2021-2025, about 230-432k new jobs can be created by 2025 in the energy sector. The support package could also bring the EU closer to the new 2030 climate target: 50-233 MtCO2e can be cumulatively cut by 2030, corresponding to a 0.2-1% drop further down from the current policies scenario. Also, interpreting modelling dynamics shows that we can in fact gain financially back on these investments, in terms of pushing down the costs of existing low-carbon policies in the EU. Due to their optimal performance both in terms of emissions cuts and jobs created, the model prioritised portfolios based on wind investments, which were the most robust choice, as well as biofuels and biogas, avoiding further investing in solar that is already projected to reach a saturated deployment in the context of current policies up to 2030.

References

European Commission. (2020a). Annual Sustainable Growth Strategy 2021. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0575&from=en

European Commission. (2020b). Recovery plan for Europe. Retrieved from: https://ec.europa.eu/info/strategy/recovery-plan-europe_en

Forouli, A., Nikas, A., Van de Ven, D. J., Sampedro, J., & Doukas, H. (2020). A multiple-uncertainty analysis framework for integrated assessment modelling of several sustainable development goals. Environmental Modelling & Software, 131, 104795.

Nikas, A., Forouli, A., Fountoulakis, A., & Doukas, H. (2020). A robust augmented ε-constraint method (AUGMECON-R) for finding exact solutions of multi-objective linear programming problems. Operational Research.

Sognnaes, I., Gambhir, A., Van de Ven, D.-J., Nikas, A., Anger-Kraavi, A., Bui, H., Campagnolo, L., Delpiazzo, E., Doukas, H., Giarola, S., Grant, N., Hawkes, A., Koberle, A., Kolpakov, A., Mittal, S., Moreno, J., Perdana, S., Rogelj, J., Vielle, M., & Peters, G.P. (2020). A multi-model analysis of long-term emissions and warming implications of current mitigation efforts. Nature Climate Change. Under Review.