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Overlapping carbon pricing and renewable support schemes under political uncertainty: Global lessons from an Australian case study

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HIGHLIGHTS

- Uncertainty over overlapping energy and climate policies affects investment choices.
- An integrated real options and portfolio optimisation model is used in a case study.
- Interacting carbon pricing and renewable supports can create private and social hedge.
- Political uncertainty may justify overlapping carbon pricing and renewable supports.

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ABSTRACT

The translation of a greenhouse gas (GHG) emissions reduction policy objective to the required investment in low emissions technologies may be hindered by political contest over the policy instruments employed to achieve it. Political contest may also result in enactment of overlapping policy instruments which, from a 'policy purist' perspective, may not appear well calibrated to a shared GHG emissions reduction objective. This paper reports insights gained from an integrated real options and portfolio optimisation model of electricity generation investment behaviour under political uncertainty over the futures of interacting carbon pricing and renewable portfolio standard (RPS) instruments. We compare modelling results and actual outcomes in Australia, where an emission reduction target has had bipartisan support but the means to achieve it has not, to test the assertion that overlapping policy instruments must always increase the social costs of GHG abatement. Results suggest that overlapping a politically contested carbon pricing policy with an RPS may result in a lower risk, renewable energy (RE) investment environment, as the overlap allows investors to hedge their portfolio against political uncertainty through RE additions. Consequently, GHG abatement objectives may be achieved at lower cost than would be the case without the policy interaction. The policies overlap can provide a 'safety valve' or 'hedge' to both private investors and policymakers when deep uncertainties over the future of energy and climate policies influence investment strategies.

1. Introduction

In recent decades, governments around the world have implemented climate policies to reduce greenhouse gas (GHG) emissions, most often by discouraging investment in, and use of, high GHG emitting technologies. Motivated by the issues of fuel security and environmental impact, governments have often put in place regulatory incentives to expedite the deployment of renewable energy (RE) technologies [1,2]. RE support and GHG emissions reduction policies are often employed in conjunction with one another. The conventional view on overlapping carbon abatement and RE support policy instruments is that their co-existence increases the social cost of meeting a GHG reduction target (see [3–7]) relative to the case where a carbon price is used as a standalone instrument. This view reflects the fact that a broad-based carbon price targets the GHG reduction objective directly, so that entities have an incentive to identify the lowest cost investments and activities that will reduce their liabilities under such a scheme.

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A RE subsidisation mechanism, on the other hand, motivates GHG reductions by encouraging or mandating investment in a specific technology class. The implementation of the policy is also justified by a range of other objectives such as energy supply diversity, creation of green jobs, and innovation. However, RE investments will not always offer the lowest marginal cost GHG reduction option across an entire economy (e.g. [5,8]). Therefore, if meeting a GHG reduction target is the objective of a renewable support mechanism, the conventional view is that the policy will be a high-cost means of achieving it.

'Policy purity' from this conventional point of view is often expressed as an advocacy for the use of carbon pricing without government support for RE technologies as a first-best optimal measure. If, however, the first best solution is not feasible because of policy failure, then it has been suggested [9] that a RPS may be accepted as a second best [10] policy instrument. But under what circumstances would the co-existence of both instruments be considered appropriate when their shared objective is to facilitate the level of investment required to achieve a GHG reduction target?

Several jurisdictions around the world, including California, Australia, and many parts of the European Union (EU), have deployed carbon pricing and renewable support mechanisms in parallel to meet a range of policy objectives. In 2013, California launched a cap-and-trade mechanism, aimed at reducing GHG emissions from liable entities by more than 16 per cent over the period 2013–2020. This policy mechanism overlaps with a range of other emissions reduction instruments, including a RPS originally enacted in 2002. Shortly after an expansion of the RPS target in 2015 to supply half of the state's electricity from renewable sources by 2030, California's carbon auction prices collapsed to below the market's price floor [12]. Studies have revealed the distorting effects of the policies' overlap in California [11], including an '*intentionally thin market*' for carbon allowances [12]. In Europe, a substantial fall in the EU Emission Trading Scheme's (ETS) carbon price has been attributed to the interacting effect of various RE support mechanisms in the region [13] leading to an erosion in the policy's cost-effectiveness [14,15]. In some jurisdictions (including Australia, the case study to be presented in this paper) GHG emissions reduction targets have not been the subject of overt political contest, whereas the best means to achieve those targets have.[1] As a result, carbon abatement and RPS policy instruments have often lacked stability and/or clarity as to the timing of their implementation and their contribution to the targets.[2] In 2012 a carbon pricing mechanism was implemented in Australia after a long period of political negotiation. This mechanism started with a fixed price of $A\$23/tCO_2e$, to be followed by an ETS with a floating price and an emissions cap.[3] However, lack of bipartisan support threatened the policy's sustainability and it was repealed in 2014. Overlapping with the carbon pricing mechanism in Australia, a RPS, called the Renewable Energy Target (RET), was in operation with a legislated growth path to expand RE generation from 9500 gigawatt hours (GWh) in 2010 to 41,000 GWh by 2020; at the time the legislation was enacted it was anticipated that the 2020 target would result in at least 20 per cent of total electricity demand being met by renewable sources [17]. The policy faced an uncertain future after the Federal Government announced a review of the mechanism in mid-2014. Despite the regulatory and market uncertainties and a coinciding decline in electricity demand, 6000 megawatts (MW) of new renewable electricity generation capacity was added to the Australian National Electricity Market (NEM) in the decade to 2014 [18]. In each of the three aforementioned jurisdictions, interactions between the carbon pricing and RPS policies, combined with energy market and policy uncertainties, have made it difficult to decompose the contribution of each policy's impact on the energy sector and the broader economy. Under such conditions, market participants are subject to unanticipated strategic behaviour, the dynamics of which are unable to be captured by existing theoretical models [19].

The primary aim of the current study is to assess whether policy longevity and design uncertainties at critical points in the political cycle may justify the combination of a carbon pricing and RPS when their shared objective is to achieve reductions in GHG emissions. Based on the examination of a real world wholesale electricity market, this paper will argue that energy supply agents' perceptions of uncertainties in the energy market can justify the interaction of an ETS with a RPS. The contribution of this paper lies in three areas:

1. The study of the effect of such policy overlaps on large-scale electricity generation investments, where the problem is addressed from the viewpoint of a private investor. This methodological approach gains significance noting that the assessment of policy effects and interactions have been commonly conducted based on a social planning view (see a review of relevant literature in Section 2) and under narrow and idealistic assumptions. We emphasise that in a liberalised electricity generation market the value proposition of private investors and associated investment strategies are the major driver behind generation capacity additions and retirements.
2. Providing insight to energy regulators and investors based on a comparison of modelling results with historical investments in generation assets. To the best of the authors' knowledge, this is the first study that takes the advantage of hindsight to query whether those policy interactions can provide a 'safety valve' or 'hedge' to both private investors and policymakers when deep uncertainties over the future of energy and climate policies influence investment strategies.
3. Expansion of the integrated real options-CVaR portfolio optimisation model introduced by Shahnazari et al. [20] to account for market growth, policy uncertainty and interacting scenarios.

The remainder of this paper is structured as follows. Section 2 provides a review of the most relevant literature. Section 3 briefly explains the modelling of the investment decision-making framework employed in this paper, including the description of the portfolio model. To maintain our focus in this paper, a brief explanation of real options and carbon and electricity price modelling, introduced by Shahnazari et al. [20,21], is presented in Appendix A. Adaptations to the previous models are described in Section 3. Section 4 provides a case study and a comparative discussion of actual outcomes in Australia over the past few years to investigate the impact of policy uncertainties and interactions on electricity. Implications of the findings for investors and policy makers are also discussed. The major findings of the study are conveyed in Section 5.

2. Review of literature

There is a substantial body of literature that has analysed the effect of interactions between energy and climate policies.[4] The approach in such studies ranges from narrative explanation [3,5,9,23–28] to analytical or computational modelling of the energy

[1] The fact that existing instruments are more often contested than existing targets might be explained by the fact that targets are often committed to through multilateral negotiations, most recently through the Paris Agreement. In this context, see [16] on why domestic governments may have strong electoral reasons not to violate international agreements.

[2] Another example is renewable portfolio standard in the U.S. state of Ohio, which was frozen in 2014 and remains so at the time of writing.

[3] All monetary values reported in this paper are in Australian dollar (A$).

[4] For a detailed and systematic review of the literature see Refs. [22,23].