Using Real Option Valuation to Evaluate Optimal Threshold for Renewable Energy Technologies of a Tax Credit Based on Cost of Carbon Offset

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Abstract:

Despite significant cost reduction over the years, most renewable energy technologies still depend for deployment on federal subsidies and tax incentives in the form of Production Tax Credits (PTCs) and Investment Tax Credits (ITCs). As per a McKinsey report[1], the recently passed Inflation Reduction Act (IRA) provisions around $260 billion dollars in the form of consumer and corporate tax incentives over the next ten years to support clean energy technologies and reduce greenhouse gas emissions by 40% by the next decade. While most of these tax incentives are based on the costs involved in the project such as ITCs and the amount of electricity production or PTCs, there arises the question of whether the total value of tax credits that each technology gets holistically represents its lifetime avoided carbon emissions. In other words, how green is the technology?

This thesis proposes an alternate approach to the tax credit structure which integrates the value of avoided carbon emissions using avoided emissions methodology and the standardized Benefit Per Ton (BPT) method published by the Environmental Protection Agency (EPA). This method uses the Social Cost of Carbon (SCC) as a measure of quantifying the benefits of avoided emissions. To value the new proposed tax credit structure and assess the benefits of this approach, the thesis uses and compares the Discounted cash flow (DCF) and Real Options Analysis (ROA) financial valuation methods. The Binomial Option Pricing method is used to obtain the value of the American-style option embedded in the project to help the understand the value of tax credits and their optimal threshold needed to drive the investors to accelerate their investments.

Both valuation models are done for a hypothetical 100 MW utility-scale solar power plant connected to the Austin Energy Node (AEN) inside the state of Texas. The binomial option

approach uses Margrabe's formula to compute the blended volatility of the value of the project by reducing the number of uncertainties to one. To value the option, we consider the role of the time-dependent declining strike price, which is the unit installation cost of the project. The real option model is found to have a greater value than the DCF model as it not only incorporates the latter but also the feature of optimal exercise date. If the volatility becomes zero, the real option model reduces to the DCF model. The thesis further evaluates the optimal threshold where the investor will do optimal early exercise of this option with the new proposed tax credits as a constraint. Eventually, the thesis also computes a break-even cost of carbon to induce early exercise.

[1] McKinsey Report "The Inflation Reduction Act: Here's What's in it"