UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

Designing an incentive-compatible efficient Renewable Electricity Support Scheme

EPRG Working Paper 2107

Cambridge Working Paper in Economics 2128

David Newbery

Faced with an economy-wide net-zero carbon target by 2050, the electricity industry will have to reach near zero emissions far sooner. That requires a massive increase in variable renewable electricity (VRE). Most existing renewables support schemes distort location and dispatch decisions. Many impose unnecessary risk on developers, increasing support costs. Existing policies reflect past compromises to reconcile conflicting objectives and to disentangle past unintended consequences. Thus the EU Emissions Trading Scheme fixed a cap on emissions, but the subsequent *Renewables Directive* increased renewable targets without reducing the cap commensurately. The unintended result was the additional renewables had zero impact on EU emissions.

The EU Clean Energy Package (EU 2018/20010, §19) requires that "Electricity from renewable sources should be deployed at the lowest possible cost to consumers and taxpayers. … Market-based mechanisms, such as tendering procedures, have been demonstrated to reduce support cost effectively in competitive markets in many circumstances." Well-designed auctions dramatically reduced the clearing prices of successive auctions for off-shore wind in the North Sea. The paper designs an auctioned contract to deliver Variable Renewable Electricity (VRE) "at the lowest possible cost to consumers and taxpayers".

There is a tension between accelerating investment in renewable electricity (RE) and providing unnecessarily generous payments that risk excessive public cost. Price support schemes like Feed-in-Tariffs (FiTs) that set the price and allow all entrants to claim these FiTs can lead to excessive public cost and rapid cancellation of the scheme, or in some cases, to retrospective withdrawal, notably in Spain. Quantity-based schemes - green certificates - place excessive risk on developers, leading either to under-delivery or over-compensation. The solution is simple but took surprisingly long to rediscover – auction either a fixed volume or a fixed sum of funds to secure the least cost solution that meets the target or fits the budget.

The paper applies first principles to identify the market failures and considers how best to correct them. If the only externality facing renewables is a learning spill-over, and carbon is properly priced there is no case for subsidizing current output. The starting point of this analysis is that carbon is correctly priced as there is an appropriate and directed instrument to address

that externality, at least in the EU. June 2021 carbon price levels in the EU and UK were over €50/t CO_2, consistent with the Paris target-consistent carbon price.

Least system cost requires that new VRE is the right design, locates in the right place and is dispatched optimally. Least cost to consumers includes the cost of any subsidies to persuade VRE of the commercial case to enter. Auctions are the best way to deliver least cost procurement, while giving control over the volumes of RE or cost of the RE subsidy schemes (RESS). For auctions to work well, bidders need clarity on the future market design, future carbon prices and system rules or Grid Codes (including differential locational transmission charges) that will prevail over a reasonable fraction of the life of the investment.

The main future sources of renewable electricity are wind and solar PV. They have high capital costs but low running costs. Variable running costs for PV are zero, while for wind they are modest. It follows that their major cost is the financing cost – the weighted average cost of capital, WACC. The more predictable and certain are the costs and revenue streams at the time of final investment decision, the higher the share of debt:equity and the lower the WACC. Risk increases the WACC, so reducing risk is the most effective way of lowering RE costs. Controllable generation hedges risk through Contacts-for-Difference (CfDs) that are purely financial obligations. The CfD transfers $(s - p).M$ to (or from if negative) the generator, where s is the strike price, p the market price and M a fixed amount *independent of generation*. As such output decisions are based on p not s. The main distortion of almost all RE support schemes is that support is paid on metered output and so contingent on generation. As a result the subsidized price, not the actual spot value of electricity, drives location and dispatch decisions. The main contribution of this paper is to propose a new long-term financial contract that hedges risk, assures revenue, but ensures location and operation decisions are guided by market prices. It does so by designing a CfD whose covered volume is based on local *predicted* output, providing a hedge that ensures offers to supply will be guided by market, not subsidized prices.

VRE has a peak output that is a considerable multiple of its average output. For wind this might be 3:1; for Northern solar PV 10:1. As VRE penetration increases the surplus output will need to be curtailed. An efficient RESS should encourage VRE to choose not to generate if the value of its output is less than its avoidable cost, partly dealt with by prohibiting VRE making negative offers. Similarly, the value of electricity, not the subsidized price, should guide location decisions.

The proposed solution is a novel auctioned contract to address both location and dispatch distortions: a financial Premium Contract for Difference (PCfD) with hourly contracted volume proportional to the day-ahead forecast local output/MW, with a life specified in full operating hours (e.g. 30,000 MWh/MW). That hedges price risk and the problem of over-rewarding high resource costly locations but removes the incentive to locate where local RE output has a low correlation with national RE output and hence higher value. The strike price is an auctioned premium added to the forecast future local value of VRE output per MWh, made by the contract counterparty and announced before the auction. This volume-limited yardstick PCfD delivers efficient dispatch while assuring but limiting the total amount of subsidy, providing efficient location and operating signals. The revenue assurance, with a government-backed counterparty, allows a high debt share, dramatically lowering the subsidy cost.