# Carbon Pricing: Not Such a Clean Option

By Serguei Netessine , INSEAD Professor of Technology and Operations Management and The Timken Chaired Professor of Global Technology and Innovation

**Carbon pricing has been hailed as the best way to bring down emissions and drive investment in cleaner technologies. New research suggests it could do just the opposite.**

Over the past decade the world's capacity for renewable (green) energy has outpaced expectations as a significant source of global energy. Wind and solar capacity has grown 10-fold, while solar PV capacity is 50 times what it was in the early 2000s. The benefits are obvious; renewable energy brings with it energy security and diversity, it reduces local air and water pollution and provides accessible, affordable energy to communities who previously could not afford it or lived off-grid.

Despite these advantages renewable technology has high investment costs and yields an intermittent supply of electricity. Among the many government strategies introduced to overcome these obstacles – renewable portfolio standards, minimum prices for "clean" energy and penalties for environmental damage caused by fossil fuel generation – the most significant has been the adoption of carbon pricing, aimed at incentivising

clean energy investment and innovation.

While placing a price on carbon enhances the competitive position of renewable energy technologies, new research has highlighted a downside, and found that high carbon prices may actually decrease the share of renewable capacity in the overall generation portfolio, creating a more competitive environment for fossil fuel generators; a situation exacerbated by the liberalisation of the electricity market.

The problem stems from the intermittency of renewable energy sources. Despite rapid technological advancement in the industry, scientists are yet to come up with a way to ensure the wind is always blowing and the sun continues to shine. To safeguard an uninterrupted supply of power to the electricity grid, renewable energy requires backup from traditional, “dirty” electricity sources - usually gas or coal fired.

In the past electric utilities were vertically integrated, which placed some degree of control over the coordinating of green versus non green capacities. Freeing up the market has changed the dynamics.

Increased competition among generators has rendered electricity a commodity that is traded on wholesale electricity markets, typically organised through a national or regional regulator which sets spot prices determined by complex bidding and dispatching rules. The regulators purchase energy in order or merit. On top of the list are sources with minimal marginal cost of supply – usually nuclear. Renewable energy sources – solar and wind power – are second in line, selling their electricity at a slightly higher price. The remaining demand is then met by gas and coal fired plants which ramp up production as back up if lack of wind or sun prevents renewable generators from meeting their quota.

## A higher carbon price

As part of our research, **Strategic Investment in renewable Energy Sources: The Effect of Supply Intermittency**, Sam Aflaki, Assistant Professor of Operations Management and Information Technology at HEC Paris and I examined the relationship between cost structure, intermittency and capacity investments in the energy market and found that increasing the carbon price had two counteracting effects on investments in renewables. On the one hand, basic economics ensured it improved their cost competitiveness. On the other hand an increase in renewable energy

investment and capacity necessitated an increase in the fossil fuel reserves required as back up for times when weather failed to generate enough renewable electricity to meet demand. Thus an increase in the carbon price led to an increase in the cost of reserves to cover intermittency. To make matters worse, often it was older, more emission-intensive technologies that were used to supply the extra power.

Given that market forces ensure this backup electricity is sold at an even higher price, fossil fuel generators will always be more profitable than renewable power stations and continue to attract investment.

In our study we found this effect was amplified by the marginal cost pricing of the open market structure mentioned above, supporting previous **research** which suggests market liberalisation leads to under-investment in renewable generation capacity.

**Alternatives to addressing uncertain supply**

Long-term electricity contracts , which offer fixed feed-in tariffs to the owners or renewable generation capacity, do ameliorate some of the disadvantages of liberalised markets. However a more effective, and efficient, approach to increasing capacity investment in renewables may be to focus investment dollars on reducing the intermittent nature of wind and solar power. One option is by improving ways to store the excess electricity available when demand is low (and cheap) and to pump it back into grid during peak periods. The most widely used form of bulk-energy storage is pumped-storage hydropower (PSH), which combines water and gravity to capture off-peak power and release it at times of high demand. Technology is also being developed to store energy in the form of heat. Another technique, being developed by Tesla, involves the use of electric cars; charging their batteries during off-peak periods and pumping the power back onto grid when demand (and prices) are high.

Other ways to even out this intermittency could include the pooling of multiple generation units, encouraging large power companies to diversify their generation sources using different technologies and geographies.

High crude oil prices and falling technology prices suggest renewable energy will play a critical role in the energy revolution that is necessary to change our current path. While many industrialised countries have introduced carbon taxes – and there is a growing support for the introduction of a global carbon price – our research suggests more study is necessary to ensure

efficient use of resources in this area.

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