Optimising renewables: a model for profitable decarbonisation

Written by

Ryan Cory-Wright

Published

12 March 2024

Category

Strategy & Leadership

Key topics

Climate Change, Sustainability

Decarbonisation doesn't need to be an obstacle for developing economies, and can even generate significant profits, new research from Imperial Business School, HEC Paris and Massachusetts Institute of Technology reveals.

The Moroccan government is targeting a **45 per cent reduction** in carbon emissions in line with United Nations Climate Change Conference commitments. It aims to achieve this, in part, by making its state phosphates company OCP Group fully carbon-neutral by 2040.

Accounting for around six per cent of Morocco’s GDP, OCP supplies more than half of all phosphate-based products sold in Africa, including fertilisers and products for the food and pharmaceutical industries. With around 60 per cent of the company's energy needs currently coming from non-renewable sources, decarbonising the group’s operations would be a significant step towards Morocco achieving its target.

Existing international climate change commitments specify that wealthier countries should decarbonise sooner because the process is less affordable for developing nations focused on industrialising their economies. However, our work demonstrates that decarbonisation can sometimes be profitable by eliminating the ongoing costs of purchasing fossil fuels. This offers a **strong incentive for companies and developing economies to make decarbonisation part of their growth strategy**, rather than an obstacle to it, by optimising investment in renewables.

Predicting bad weather with machine learning

Our research designs a decarbonisation plan to install a combination of solar panels and batteries throughout OCP's production system over the next few years. The plan deals with the **inherent uncertainty of solar generation**, using optimisation to account for the fact that weather predictions are often inaccurate, and using batteries to level out this variability.

> It is plausible that partial decarbonisation would be profitable in other industries and countries

Specifically, we use machine learning to plan for a reduced set of "typical days" rather than considering every day in the planning period, and then estimate the uncertainty in weather forecasts for those days. We then make the weather forecast for each of these days "fuzzy", and optimise for the worst-case weather forecast based on historical weather data. This gives OCP enough information to make operational decisions for specific periods, such as when to release or store energy in batteries, without being either unnecessarily conservative or too reliant on the past.

Our plan also considers that seasonal weather patterns are likely to change over time due to climate change, using machine learning to learn from simulated data while accounting for prediction inaccuracies. This **allows OCP to make strategic decisions over years**, such as how many solar panels and batteries to install at each of the company's sites, and when to replace them.

Profitable decarbonisation

Taken together, this information has allowed us to develop a concrete pipeline that considers historical weather data, fertiliser production targets and energy consumption data, and to generate a decarbonisation plan.

We forecast that our plan, which OCP is implementing, will be profitable for the company. However, **there is a trade-off between the level of decarbonisation and the scheme's profitability**, depending on how much is invested. Specifically, our figures show that the project's net present value increases with the amount invested up to around $750 million, and then decreases as more is invested.

> Decarbonisation can sometimes be profitable by eliminating the ongoing costs of purchasing fossil fuels

This highlights that companies implementing this type of decarbonisation plan need to decide on a level of investment that balances their interest in cutting emissions and their need to generate profit. In OCP's case, our plan is guiding the company's investment in solar panels and batteries, which is part of a wider $13 billion green initiative aimed at fully decarbonising operations by 2040.

Wider implications

Our model forecasts that partial decarbonisation – specifically using solar panels and batteries to decarbonise electrical supply – is profitable for OCP. This is partly due to Morocco's abundant solar energy supply and relatively expensive non-renewable energy prices. Therefore, although our research focuses on a phosphates company, it is plausible that partial decarbonisation would be profitable in other industries and countries with significant energy requirements.

However, our model also shows that, for OCP, a 100 per cent reduction in carbon emissions does not appear profitable. This highlights that **there are limits to the degree of decarbonisation that companies can achieve through market options alone**. To keep to the promises made in Paris in 2015, governments may need to consider regulations, subsidies, or carbon pricing schemes that further incentivise investment in renewable energy. This is particularly important in the context of COP28’s messaging around the need to accelerate climate action.

This article draws on findings from "Decarbonizing OCP" by Dimitris Bertsimas (Massachusetts Institute of Technology), Ryan Cory-Wright (Imperial College London) and Vassilis Digalakis (HEC Paris).

Written by

Ryan Cory-Wright

Published

12 March 2024

Category

Strategy & Leadership

Key topics

Climate Change, Sustainability

Main image: Man As Thep/iStock via Getty Images Plus

Share

About Ryan Cory-Wright

Assistant Professor of Analytics and Operations
Ryan Cory-Wright is an assistant professor in the Department of Analytics, Marketing & Operations and is affiliated with the I–X initiative on interdisciplinary AI and machine learning.

His research interests lie at the intersection of optimisation, machine learning, and statistics, and their applications in business analytics and renewable energy.

Read Ryan's Imperial Profile for more information and publications.

Monthly newsletter

Receive the latest insights from Imperial Business School

Sign up now

Are carbon credits worthless?

Over the past few years, the voluntary carbon market has been thriving. But is it saving the planet, or simply giving organisations the right to pollute?

Read more