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About this issue.

Maria Taylor
Energy Law Institute

Welcome to the second edition of the Energy Law Institute Review (The Review).

Over the last few months we have been developing the structure of The Review and expanding our Editorial Board. Adam Brown, from Dentons and Professor Stephen Tromans QC joined the Board in August and their input and guidance has been invaluable.

Next month, Professors Sir Bill Blair, Rosa Lastra and Sir Bernard Rix will also join our Editorial Board and we look forward to working with them on developing the Law Review further.

Three of The Review's core objectives are to:

1. Provide our Energy Law Institute community with the opportunity to publish articles
2. Bring together and document in a single publication the activities of the Institute and
3. Develop the Institute's research focusing on the live legal issues of the energy sector.

In this edition the articles all reflect the current legal issues associated with the twin challenges of Covid and Climate change.

In our opening article, James Dallas, explores the interface between the two global threats and the consequences and the prospect for climate change mitigation in the future.

In 'Carbon Pricing and Net Zero: an achievable revolution?' Adam Brown examines some of the legal and policy challenges involved in trying to use sharper and more pervasive forms of carbon pricing as the primary means to drive the economic and behavioural changes necessary to secure the achievement of climate change policy goals

Changes in behaviour was at the heart of the fifth Clifford Chance Annual Lecture given by The Rt Hon Claire O'Neill, now Managing Director Climate and Energy at the World Business Council for Sustainable Development. Previously Claire was Minister of State at the Department for Business, Energy and Industrial Strategy and President of COP 26. Claire was instrumental in shaping legislation to commit the UK to net zero C02 emissions by 2050. Her lecture highlighted the need for us all to commit to a rapid climate recovery and recognise the opportunities of moving to a low carbon economy.

Professor Stephen Tromans QC in his review of Richard Lazarus' book, 'The Rule of Five: Making Climate History at the Supreme Court' highlights how difficult and complicated it is to get environmental litigation off the ground. Stephen comments that Lazarus is well qualified to provide unique insights, with a wealth of experience gained in over 40 cases at the Supreme Court. Most sobering are the conclusions that "every litigation victory is necessarily provisional", and "progress requires not just judicial votes 5-2 but political votes by individuals globally to elect sufficiently forward thinking and inspirational leaders willing to tackle climate change".

Our 'In Conversation' discussion in this edition is between Professor Malik Dahlan and Dr.Urban Rusnák, Secretary General of the Energy Charter Secretariat. In a wide ranging conversation, Dr Rusnák talks about how the Energy Charter Treaty is responding to Climate Change and recognising the challenge of the current environment Dr Rusnak reminds students the importance of "curiosity, open-mindedness and continuity of learning for the rest of your life".

In the second half of The Review two winners of the Lord Browne Essay Prize, provide an insight into the work of the students. The Essay Prize is awarded for the best three energy dissertations submitted each year and aims to celebrate academic excellence and innovative thinking. Commenting on the winners Lord Browne remarked "All three of this year's award winners have demonstrated that rare ability to do two things at once. They have undertaken deep analysis of complex matters of law and policy, while drawing clear and – most importantly – practical conclusions".

Maria Eugenia Mattera was awarded first prize for her essay 'Addressing the Key Regulatory Challenges to Pave the Way for Energy Storage in Argentina'. Second prize went to Rosemary Hambright for her essay 'Winds of Change: A Comparative Analysis of UK and US Offshore Wind Law and Policy'. A third prize went to Maria Eugenia Bagnulo for her analysis on photovoltaic arbitration cases in Italy, Spain and the Czech Republic. For this review Bagnulo examines curtailment risk in wind and wind farms and photovoltaic energy projects in Uruguay. Our congratulations to our winners and we are delighted to publish their work.

In June, in the midst of lockdown the Energy Law LLM students held a forum via Zoom to discuss managing a career in energy law during and beyond COVID-19. The discussion was led by Silke Goldberg of Herbert Smith Freehills, Wendy Miles QC of Debevoise & Plimpton LLP, Cyril Vock of Total SA and Laura Yeates, of Clifford Chance LLP. Together, the panel provided the students with invaluable insights, reassurance and guidance on developing skills to thrive in an era of change and challenge.

The discussion prompted Pablo Sobarzo Bahamondes to reflect on his own experience, concluding "These are as a lecturer told me, strange times. But I take solace in the fact that I've enjoyed a solid year of formation and I'll come out better prepared to face this period of change".

Undoubtedly, this is a period of significant change. And for us all a 'year of formation', a chance to reflect with a view to preparing for the future.

COVID-19 and climate change.

Professor James Dallas

Professor James Dallas

In December 2019 the UN Climate Change Conference COP25 took place under the presidency of Chile. The meeting ran from 25 November to 1 December. It ended with very little progress having been achieved. There was no progress on establishing a new carbon trading system; no progress on measures to provide additional finance to developing countries beyond 2025 for adaptation; and only a relatively mealy mouthed acknowledgement that pledges under the Paris Agreement currently in place are woefully short of what is needed to keep the increase in average global temperatures to below 2° C above pre-industrial levels – let alone to achieve closer to 1.5°C, which is seen as the level really required to limit adverse consequences to an acceptable level.[1]

On 31 December the World Health Organization's China Country Office was informed of a pneumonia of unknown cause, detected in the City of Wuhan, in Hubei province, China. Ten days later the World Health Organization (WHO) issued its first guidance on the newly identified Coronavirus. By 30 January WHO had declared a Public Health Emergency of International Concern and by mid-February the disease had a name 'COVID-19'. The impact of the COVID-19 pandemic has touched every corner of the globe and had devastating consequences both for the health and wellbeing of millions of people but also for the global economy.

This article seeks to explore the interface between these two global threats and what the consequences of the collision of these cataclysms are likely to be. Section 1, looks at the timescales of the two crises. Section 2 explores some of the observable non-financial consequences. Section 3 looks at the financial demands of the two crises and their crossover. Section 4 looks at how governments can reconcile the demands of both crises, and Section 5 explores what governments have achieved to date and the prospects for climate change mitigation in the future.

Section 1: Timescales

The first thing of note is the timescales of these two disasters. They are both played out at very different tempos. The climate change challenge, at least to the extent it is anthropogenic, has been germinating since the middle of the eighteenth century when the Industrial Revolution took hold in the UK and then Continental Europe. Furthermore, the damage profile is long lived. The disruption of our global climate system is, as we know, caused by the increase in the emissions of greenhouse gases into our atmosphere. What is less well known is that many of these gases will remain there for hundreds, and in some cases thousands, of years. Even if we were to stop emitting tomorrow adverse consequences from the emissions already in our atmosphere will likely continue to be felt for hundreds of years to come. It is a problem of slow, stealthy and deadly accretion.

The timeframe for the progression of the COVID-19 problem is, by contrast, alarmingly rapid. From first identified case to a lockdown of one third of the world's population was a matter of months. The consequences for human health and wellbeing have been far reaching and swift: in 2020 an estimated 300 million jobs are at risk[2] and 1,300,576 deaths are attributed to the virus as of 13 November 2020;[3] and the global economy is expected to shrink by 7%.[4]

[1] See The Intergovernmental Panel on Climate Change (IPCC), *Global Warming of 1.5°C* (2018).

[2] See The International Labour Organization (ILO), *ILO Monitor: COVID-19 and the world of work. Third edition Updated estimates and analysis* (2020); and V. McKeever, 'The coronavirus is expected to have cost 400 million jobs in the second quarter, UN labor agency estimates' (CNBC, 2020) [online]. Available at: <https://www.cnbc.com/2020/06/30/coronavirus-expected-to-cost-400-million-jobs-in-the-second-quarter.html> accessed 10 November 2020.

[3] See The WHO, 'Coronavirus disease (COVID-19) Weekly Epidemiological Update Data as received by WHO from national authorities' (2020) <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200907-weekly-epi-update-4.pdf?sfvrsn=f5f607ee_2>.

[4] See The World Bank, 'COVID-19 to Plunge Global Economy into Worst Recession since World War II' (2020). <https://www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war-ii> accessed 11 October 2020.

At first blush, the collision of these two problems looks bound to leave climate change the casualty since the immediacy of the COVID-19 problem will inevitably trump the relatively slow burn development of the climate change problem (although it is accelerating).

So, what are the obvious consequences of COVID-19 for climate change action and are they necessarily antithetical?

Section 2: Some demonstrable implications of COVID-19 on climate change

The first obvious impact of COVID-19 has been on airtime. Cast your mind back to this time last year. One of the most widely reported speeches of 2019 was from Greta Thunberg, the Swedish climate activist, who at the age of 16 was given the opportunity to address the world and business leaders at the World Economic Forum Annual General Meeting at Davos. In April of that year Extinction Rebellion, a UK based movement whose aim is to get governments to declare a 'climate and ecological emergency', orchestrated a series of marches and demonstrations in London over an eleven-day period. It was followed by further protests in other major cities around the world, including New York, Amsterdam and Sydney. Their campaign of peaceful civil disobedience led in London to over 1,100 arrests.[5] This prominence was achieved from a group only formed in 2018, demonstrating the level of appetite for the topic. At the time of writing they claim to have 340 groups operating in 72 countries.

Throughout 2019 the heat increased and the noise grew louder. The climate change issue was capturing headlines in newspapers and magazines around the world and absorbing more airtime on radio and television than ever before. Greta Thunberg was invited to Davos again in 2020 when she told world leaders, 'I want you to act as if your house is on fire – because it is.' Then radio silence. Once COVID-19 appeared the news had a new all-consuming lead story. The significance of this is obvious. If you are to achieve the collective global action that is required to tackle climate change, with its attendant cost and inconvenient changes to lifestyle, this will only happen if there is the political will to do so. To foster political will requires pressure from voters. This requires an engaged, informed, motivated and vocal electorate; such a state cannot exist without airtime (and is even less likely to arise if the activists are confined to barracks).

The second observed consequence of COVID-19 for those in the UK (and indeed in most other countries subjected to widespread lockdown) was a marked reduction in air, sea and noise pollution as air travel ground to a halt, car and goods vehicles journeys were severely restricted and marine traffic was paralysed.

The reduction in car travel was prompted by lockdown. But after restrictions were eased the reduction has continued to a lesser degree, fuelled by a slump in economic activity but also the shift in working practices. The pandemic converted the 'working from home' experiment, which has been around and edging forward for some time, into a necessity that looks likely to outlive the pandemic.

Air travel for business and pleasure has been hit hardest. A huge amount of international business is now transacted remotely, and holidays are being taken locally – the so called 'staycation'.

The reduction in car and air travel has been mirrored by a similar reduction in travel by sea. Travel for pleasure has largely stopped and cruise liners sit idle in ports around the world. The use of oil tankers and LNG carriers has fallen reflecting the drop off in demand, and container vessels are in dock, hobbled by the lack of demand and the exhaustion of warehouse and other storage capacity. All this reduced activity has a silver lining as it has led to visible and demonstrable improvements in water and air quality, and a reduction in noise pollution. This in turn seems to have been reflected in a positive bounce in the animal and plant kingdoms.[7] As Michael McCarthy noted,[8] 'Fish returned to the canals of Venice, no longer churned up by tourist boats. In parts of northern India, the Himalayas became visible for the first time in 30 years as air pollution fell. Baby turtles made it safely to the water on Brazilian beaches empty of sunbathers, joggers and dogs.'

So, there were some demonstrable positives from the appalling situation we found ourselves in with COVID-19. First, we could witness first-hand how much damage we were doing to the environment but also how relatively quickly and dramatically our actions could begin to reverse this state of affairs. The benefits of clean air were even more potently brought home when reports of the impact of poor air quality on COVID-19 victims was made public. Secondly, we could see how we could be weaned off air travel and even car travel for a not insignificant period of time – in the UK many have neither flown anywhere nor even been to their offices, for nine months. Evidently, we can change the way we work and live without bringing about the collapse of the civilised world.

Section 3: The implications on financing climate action

The most worrying area is what impact combatting the consequences of COVID-19 will have on financing the measures to mitigate emissions and undertake adaptation. The anticipated costs of transitioning from our reliance on fossil fuels to low-carbon alternatives, together with the costs of adapting to the unavoidable consequences of emissions

[5] See R. MacIndoe, 'Extinction Rebellion protests: how London and other UK cities are being disrupted by mass 'October rebellion'' (*Inews*, 2019). < https://inews.co.uk/news/environment/extinction-rebellion-protests-london-uk-october-2019-cities-dates-disruption-today-347132> accessed 10 November 2020.

[6] See J. Sung and Y. Monschauer, 'Changes in transport behaviour during the Covid-19 crisi' (International Energy Agency (IEA) 2020). <https://www.iea.org/articles/changes-in-transport-behaviour-during-the-covid-19-crisis> accessed 11 October 2020. These authors explain that global road transport activity was almost 50% below the 2019 average by the end of March 2020 and commercial flight activity almost 75% below 2019 by mid-April 2020. Moreover, public transport has also been affected. For example, the strict lockdown imposed in the UK in March 2020 has led to a 95% decrease in underground journeys in London.

[7] See M. McCarthy, J. Mynott and P. Marren, *The Consolation of Nature: Spring in the Time of Coronavirus* (Hodder & Srougton LDT 2020).

[8] See M. McCarthy, 'Nature got us through lockdown. Here's how it can get us through the next one' (*The Guardian*, 2020). <https://www.theguardian.com/books/2020/oct/03/nature-got-us-through-lockdown-heres-how-it-can-get-us-through-the-next-one?page=with%3Aimg-3> accessed 11 October 2020.

already in the atmosphere and managing the loss and damage that cannot be avoided, provides a bill of unprecedented scale.

The IPCC's special report, Global Warming of 1.5°C, suggests that the likely cost of limiting global warming to 1.5°C 'are projected to involve the annual average investment needs in the energy system of around 2.4 trillion (USD2010) between 2016 and 2035, representing about 2.5% of the world GDP (medium confidence).'[9] The UN Environment Programme estimates that the cost of adapting to climate change is expected to grow to US$140-300 billion per annum by 2030 and US$280-500 billion by 2050.[10]

A recent study by the Brookings Institute[11] looked at four possible pathways for GHG emissions (as adopted by the IPCC) to forecast the likely cost to the US economy: from emissions peaking in 2020 and then declining through to 2100 to, at the other extreme, emissions rising continually to 2100. Different policies and technologies are required for different pathways. The estimates of the impact on GDP per capita range from 1.0-2.8% at the lower end to 6.0-14.3% at the other end (that is, the do-nothing option).

The European Union's first package of climate and energy measures agreed in 2008 set targets for 2020. These targets included reducing greenhouse gas emissions by 20% (compared with 1990), increasing the share of renewable energy to 20%, and making a 20% improvement in energy efficiency.[12] In2021 alone, out of a total budget of €168.7bn the EU budgeted to spend 21% (€37bn) on climate change measures (this was set pre Covid-19).[13]

As regards the UK, as it took the parliamentary steps in 2019[14] to reduce the UK's 2050 emissions target to net zero[15] a debate ensued about the costs to the UK economy of so doing. The UK's Committee on Climate Change,[16] estimated the cost at £50 billion per annum. Leaked memos from the UK's Department for Business, Energy and Industrial Strategy put the cost at nearer £70 billion per annum. The then Chancellor of the Exchequer, Philip Hammond, said 'On the basis of these estimates, the total cost of transitioning to a net zero economy is likely to be well in excess of £1 trillion'.[17]

On any basis the sums of money required to be mobilised to address climate change are eye watering. By way of comparison the cost to the United States, in today's money, of fighting WWII (the most expensive war ever waged) was US$4.1 trillion, and the Vietnam War cost less than US$1 trillion in today's money.[17]

Turning to the financing of the COVID-19 crisis, the financial burden of COVID-19 is twofold. First, there is the money needed to combat the health aspects of the pandemic – everything from developing vaccines to building new hospitals and laboratories, buying protective medical equipment and developing track and trace software. Secondly there is the money needed to protect businesses and individuals whose livelihoods are threatened by the impact of lockdowns and stultified trading – support required for furloughing employees, providing a social security safety net, deferring or foregoing taxation, and making loans and offering guarantees. The situation is made worse for governments because this expenditure is required when inevitably tax receipts are plunging.

In May 2020 the IMF estimated that the fiscal measures taken by governments around the world to combat the fallout from COVID-19 amounted to US$9 trillion of which US$4.4 trillion comprises direct budget support and the balance is made up of public sector loans, equity injections, guarantees and other quasi fiscal operations.[19]

McKinsey, the global management consultancy, put the figure at US$10 trillion. Whichever figure is right it represents an extraordinary sum. To put it in context, even the lower estimate is three times the sums mobilised in the recovery measures for the financial crisis of 2008.[20] Please see diagram on page 8 from McKinsey & Company "The $10 trillion rescue: How governments can deliver impact," June 5, 2020.

In Europe the EU leaders have agreed a package of measures to tackle COVID-19 including joint borrowing of 750 billion euros. McKinsey estimate that Western European countries had, by the end of May 2020, already allocated close to US$4 trillion, which, as they say, is 'almost 30 times larger than today's value of the Marshall Plan [the US support plan for the re-building of Western Europe after WWII]'.

In the UK the Office for Budget Responsibility (the UK's watchdog on government spending) estimated the cost to the UK for the financial year 20/21 would be somewhere between

[9] See The Intergovernmental Panel on Climate Change (IPCC), *Global Warming of 1.5°C* (2018).

[10] See The United Nations, *UNEP report: Cost of adapting to climate change could hit $500B per year by 2050* (2020).

[11] See Brookings Institute, *Ten facts about the economics of climate change and climate policy. A joint report from The Hamilton Project and the Stanford Institute for Economic Policy Research* (Brookings Institute 2020) <https://www.brookings.edu/research/ten-facts-about-the-economics-of-climate-change-and-climate-policy/> accessed 10 November 2020.

[12] See European Council of the European Union, *Climate change: what the EU is doing* (2019) <https://www.consilium.europa.eu/en/policies/climate-change/> accessed 10 November 2020.

[13] Climate Home News: Chloe Farand 1911.2019

[14] See The Climate Change Act 2008 (2050 Target Amendment) Order 2019 <https://www.legislation.gov.uk/uksi/2019/1056/contents/made> accessed 10 November 2020.

[15] The Climate Change Act was adopted in the UK in November 2008 representing the first global legally binding climate change mitigation target set by a country. In particular, the UK aimed to reduce its greenhouse gas emissions by 80% by 2050, in comparison with 1990 levels. In 2019, this target became a net zero target by 2050. The Climate Change Act provides a system of carbon budgeting, to help the UK meet its targets through a series of five-year carbon budgets.

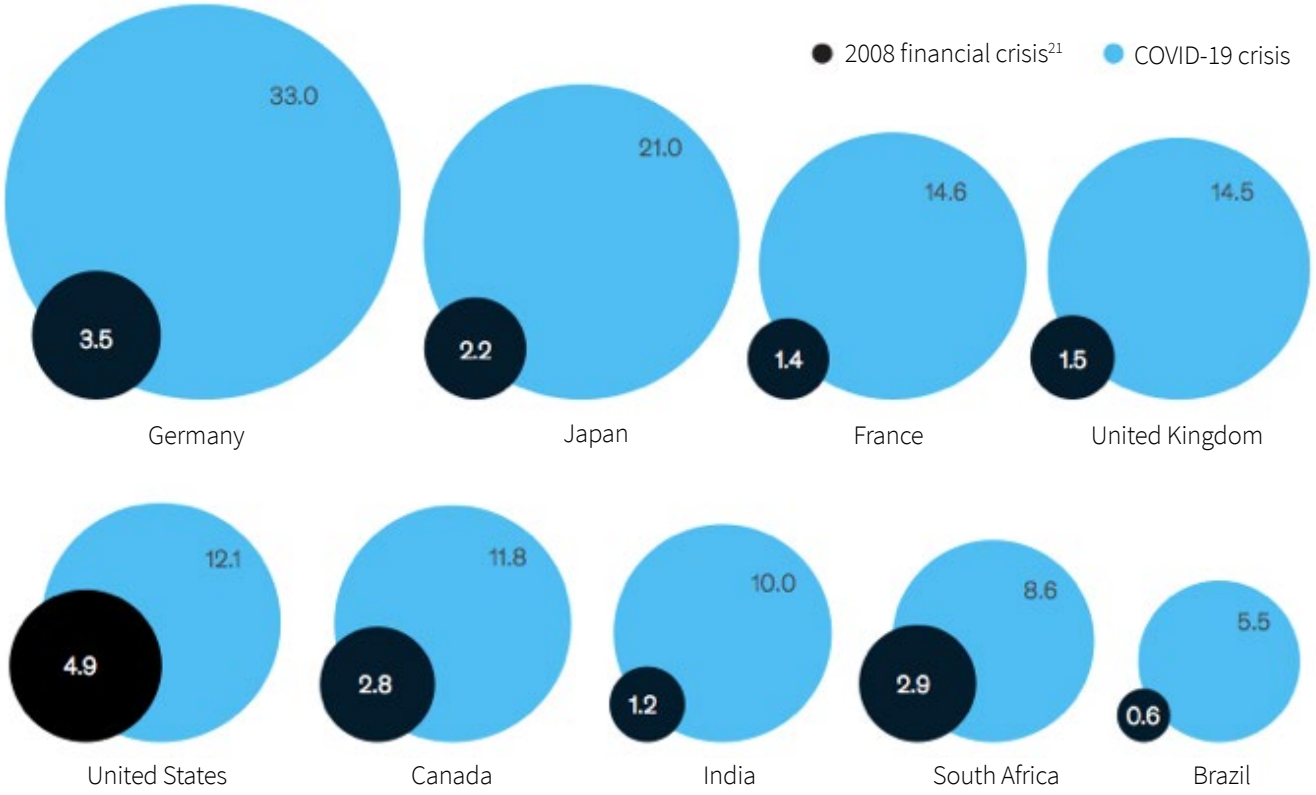
[16] The Committee on Climate Change (CCC) is a non-departmental public body that advises the UK government and parliament on the climate.

[17] See BBC, 'Climate change: Emissions target could cost UK £1tn, warns Hammond' (2019) <https://www.bbc.co.uk/news/uk-politics-48540004> accessed 10 November 2020.

[18] See S. Dagget, *Costs of Major U.S. Wars, Congressional Research Service* (2010) <https://fas.org/sgp/crs/natsec/RS22926.pdf> accessed 11 October 2020.

[19] B. Battersby, W. R. Lam and E. Ture, 'Tracking the $9 Trillion Global Fiscal Support to Fight COVID-19' (2020) <https://blogs.imf.org/2020/05/20/tracking-the-9-trillion-global-fiscal-support-to-fight-covid-19/> accessed 10 November 2020.

[20] See Z. Cassim, B. Handjiski, J. Schubert and Yassir Zouaoui, *The $10 trillion rescue: How governments can deliver impact* (McKinsey and Company 2020) p3.



Across countries, economic-stimulus responses to the COVID-19 crisis outsize those to the 2008 financial crisis

Economic-stimulus crisis response, % of GDP[22]

£263 billion and £391 billion. The decline in the UK's GDP is the largest annual decline in 300 years.[23]

At first blush, the clash of these two massive demands upon the global economy looks fatal for one or the other and the immediacy of the COVID-19 pandemic makes it more likely that climate change will be the casualty.

Section 4: Reconciling COVID-19 recovery financing with climate change

So is all this an unremitting disaster for the campaign to tackle climate change? Well I would argue whilst it is certainly painful it does not have to be terminal, not least because we now know that governments can mobilise huge amounts of capital on the scale required to address climate change. But the real key to making sure that climate change is not left as the roadside victim of COVID's hit and run on humanity lies in finding measures that serve the key objectives of both response programmes. As regards the economic goals of the response to the pandemic, the principal aim is to boost the global economy, save jobs where possible and create new jobs to replace those irredeemably lost; the IEA estimates that job losses globally from the pandemic will be in the order of 300 million.[24] The core aim of the international response to climate change as laid out in Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) is to achieve 'stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. This has been refined over time and is now expressed by the Paris Agreement, forged at COP15, in more concrete terms as '…to strengthen the global response to the threat of climate change … including by holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels.'[25]

The challenge for governments as they strive to restore their broken economies is to find measures that serve these two objectives and avoid measures antithetical to the other. This approach is reflected in the goal first promoted by the UN Secretary General, Antonio Guterres, who has urged countries to 'build back better'.[26]

In the UK, referring to the challenge, the Chairman of the UK Climate Change Committee,[27] said in their 2020 report to Parliament:

[21] Data published by International Monetary Fund in March 2009; includes discretionary measures announced for 2008-10.
Source: Global economic policies and prospects, International Monetary Fund (IMF), March 2009, imf.org; government sources; IHS Markit; IMF; press search; The state of public finances: Outlook and medium-term policies after the 2008 crisis, IMF, March 2009, imf.org

[22] 2019 GDB into account for values related to COVID-19 crisis.

[23] See BBC, 'Chancellor Sunak warns of 'tough times' for UK economy' (2020) <https://www.bbc.co.uk/news/business-52279871> accessed 10 November 2020. 2019 GDP taken into account for values related to Covid 19 crisis. [22] 2019 GDP taken into account for values related to Covid 19 crisis.

[24] IEA, *Sustainable Recovery* (IEA 2020) <https://www.iea.org/reports/sustainable-recovery> accessed 11 October 2020.

[25] Paris Agreement, art 2.

[26] UN Secretary-General António Guterres, *Video message for the day of the International Day for Biological Diversity*, (2020) <https://news.un.org/en/story/2020/05/1064752> accessed 10 November 2020.

[27] Dagget (n 17).

'The steps that the UK takes to rebuild from the COVID19 pandemic can accelerate the transition to a successful and low-carbon economy and improve our climate resilience. Choices that lock in emissions or climate risks are unacceptable.'

So how likely is it that governments will choose a path that meets both goals and what are the range of options open to them? Based on precedent, there has to be a material risk of locking in emissions, since the quickest way to put the economy back on its feet is most probably to go back to where we were. The 2008 financial crisis experienced a similar challenge. In 2008 fossil fuel consumption and greenhouse gas emissions fell dramatically as the global economy collapsed. But as the economy recovered, we quickly restored and then exceeded pre-crisis emission levels. This time we need to lock the reductions in permanently.

So, what are the sorts of things governments should be contemplating as they rebuild? One of the bodies at the forefront of calling for recovery measures to be sustainable has been the International Energy Agency (IEA). On 28 April 2020 the IEA published a special report[28] in collaboration with the International Monetary Fund, which seeks to provide the necessary information, analysis and options to enable governments to choose the appropriate course for them. It is not seeking to be prescriptive. As Fatih Birol, the Chief Executive of the IEA said 'The Sustainable Recovery Plan is not intended to tell governments what they must do. It seeks to show them what they can do. … Our Sustainable Recovery Plan shows governments they have a unique opportunity … to boost economic growth, create millions of new jobs and put global emissions into structural decline.'

The report looks at six areas: electricity, transport, industry, buildings, fuel supply and strategic opportunities in technology innovation. It looks at possible measures in each area and analyses them by reference to their cost, economic benefit and scope for job creation, and their impact on energy security and sustainability, including with respect to emissions. The analysis looks both at the short and medium term. The initial horizon of the plan is three years to 2023. The IEA believes their measures can lead to global GDP being 3.5% higher in 2023 than it otherwise would have been had the measures not been adopted. Furthermore it suggests that unlike in 2008, the emissions path would be permanently reversed, with 'annual energy related greenhouse emissions … 4.5 billion tonnes lower in 2023 than they would otherwise be'. It says that adoption of the plan 'would make 2019 the definitive peak in global emissions'. The measures range from steps to encourage electric vehicles and the removal of gas guzzlers to measures to encourage expansion and modernisation of electricity grids and the acceleration of solar and wind projects. As regards new technology the focus is on hydrogen, improvement in batteries, encouragement of small modular nuclear reactors, and carbon capture, usage and storage.

However perhaps surprisingly the area, alongside solar photovoltaics, in which it is judged the biggest impact can be made in both jobs and sustainability, dollar for dollar, is the prosaic area of energy efficiency. Energy efficiency measures produce the most marked impact on emissions reductions – the report states 'historical patterns show that efficiency measures have not attracted as much attention as they deserve; the unique set of circumstances created by COVID-19 mean that this could be an opportunity for their potential to be seized.' Many of the efficiency measures (which include replacing inefficient industrial pumps, insulating existing buildings and designing more energy efficient new buildings) have 'negative abatement costs' – that is, over the long term the measures save emissions and money. Furthermore, of the nine million jobs the plan expects to create, four million are related to energy efficiency.[29]

The report is an excellent piece of work given the timeframe within which it was produced. It is a very valuable tool for policymakers around the world. So how have governments responded to the challenge it provides?

Section 5: Is the recovery going to be green?

Well the first point to note is that there is some considerable and growing support for the recovery to be green. In April 2020 Pascal Canfin, the chair of the Environment Committee of the European Parliament, launched an informal alliance of environment ministers, MEPs, and representatives of the business community, including trade unions and civil society, amongst others. Canfin said, 'There will be a before and after COVID-19 crisis. We are choosing to accelerate the ecological transition when the time comes to reinvest in the economy. The COVID-19 has not made the climate crisis go away. The public money that states and Europe will spend to reinvest in the economy must be consistent with the Green Deal.'

Despite the loss of airtime referred to earlier the public has not forgotten climate change. Ipsos MORI[30] carried out a survey of over 28,000 people in April 2020 to establish whether people were in favour of climate change actions in the recovery being prioritised. The overwhelming majority of respondents said yes – the country with the most positive responses was India, with 81% respondents saying yes, while Australia had the fewest, with 57% saying yes. So the public back a green recovery and so do many prominent politicians and business leaders.

So let us look at what governments are reported to be doing. Well some of the policy statements are positive. During a speech held at the CPC20 UK Prime Minister Mr Boris Johnson affirmed[31]: 'I can today announce that the UK government has decided to become the world leader in low cost clean power generation – cheaper than coal, cheaper than gas; and we believe that in ten years time offshore wind will be powering every home in the country, with our target rising from 30 gigawatts to 40 gigawatts.'

The facts are far less encouraging. A report by Axios,[32] an American news website, has sought to establish the share

[28] IEA (n 21).

[29] IEA (n 21).

[30] See IPSOS MORI, *Two thirds of citizens around the world agree climate change is as serious a crisis as Coronavirus* (2020) <https://www.ipsos.com/en/two-thirds-citizens-around-world-agree-climate-change-serious-crisis-coronavirus> accessed 11 October 2020.

[31] See The Conservatives, 'Boris Johnson: Read the Prime Minister's Keynote Speech in full' (2020) <https://www.conservatives.com/news/boris-johnson-read-the-prime-ministers-keynote-speech-in-full> accessed 11 October 2020.

[32] See Axios, 'The countries painting their pandemic recoveries green' (2020) <https://www.axios.com/green-comebacks-climate-change-pandemic-803b9f50-21d8-4302-86f2-8a1c0f21d79f.html> accessed 11 October 2020.

of government spending on recovery directed to 'green' measures. According to their analysis South Korea, France and Germany are way out ahead in the proportion of their spending categorised as green, with South Korea at 38%, France at 25% and Germany at 21%. Others referenced include the UK at 5%, Denmark at 3%, Canada at 2% and China at 1%. The area identified as receiving the largest proportion of this expenditure is what is termed 'carbon and climate' (which encompasses nature conservation and lowering methane emissions) at 27%. This is closely followed by electrified transport at 25%, and energy efficiency at 15%.

So the public want a green recovery and the politicians are saying the right things. Does this mean we can we avoid the perils of 2008 and wean ourselves off ever increasing consumption of fossil fuels as the global economy rebuilds? Well we are clearly more aware than we were in 2008 of the risk of backsliding. Also the cost of renewables, particularly solar and wind, is now a lot lower than in 2008. However, there remain many developing countries who are rightly insistent on securing the benefits of social and industrial development, which inevitably translates into more electrification and more energy consumption generally. For them the very low fossil fuel prices, driven by weak global demand and price wars, represent an opportunity: it is hard to ask a smoker to quit smoking when the price of cigarettes just halved.

Furthermore for some economies the mantra of 'build back better' may not be quite so compelling. For those developed countries that McKinsey term 'co-ordinated economies' there is a tendency to favour underwriting existing businesses rather than letting them go to the wall and financing the development of new businesses. In so doing they protect more jobs in the short term. But this approach carries the risk of holding on to traditional and polluting businesses when it might be better to let them fail and be replaced by greener alternatives. This path carries an additional risk – if governments do not lock in the emissions savings now, when the time comes for them to accelerate their spending on emissions reduction more money will be required and there will likely be less available.

But does the lack of success to date in mitigating emissions mean that 'building back better' needs to take on an even more radical hue? Should governments around the world be using their extensive involvement in the economy to promote green measures in everything they do? Governments (both national and local) are major procurers of goods and services. Imagine what the impact would be if all government vehicles in the UK had to be electric by 2025; all power government procured had to be from renewable sources; all government buildings were overhauled to meet the highest standards of energy efficiency and this was accompanied by a programme for new houses to solve the housing shortage, puncture the house price bubble and eradicate homelessness. What if all food purchased for schools, the armed forces and government offices was required to be domestically sourced? A purchaser of the government's scale could 'move the market'. Add in measures to stop business air travel from being tax deductible and to tax other air travel and real change may occur.

But if this is not enough, and the damage caused by job losses from closing unsustainable businesses is too hard to stomach, perhaps now is a time for governments to be really radical. The reality is that the advance of artificial intelligence is such that shortly we will be faced with technology that is capable of doing many of the jobs currently undertaken by humans more cheaply and more efficiently: consider how many of Amazon's one million employees will be needed once drones, driverless cars and similar innovations are in place. These changes will dwarf the 300-400 million jobs lost through the pandemic. Is now the time to confront the fact that a world in which full(ish) employment exists is an impossible dream and embrace the change through some form of universal income system and in so doing greatly accelerate the achievement of a low-carbon global economy.

For all this I suspect the attraction of repairing what is there rather than rebuilding anew will be far too attractive for most governments. The fast-changing landscape of the pandemic, the restrictions on personal liberty, the threats of mass redundancy and the emptying coffers do not make for an ideal backcloth for innovation and risk taking.

Amidst all of this there is perhaps one reason for optimism. In the opening paragraphs I talked about the contrasting tempos of the pandemic and the climate crisis. What I did not refer to is that the warnings for each crisis have been around for much the same time. Joshua Lederberg, the Nobel laureate scientist once said 'the biggest threat to man's continued dominance on the planet is the virus'. In 2015 Bill Gates said in a Ted talk that the greatest risk of a global catastrophe is most likely to be a highly infectious virus rather than a war.[33]

Well we have been warned about the climate crisis and we now know what happens if we do not heed the warnings of an upcoming disaster. Let us hope COVID-19 galvanises the world community into action – starting with a positive outcome to COP26.

Biography

Professor James Dallas joined Queen Mary University of London as Executive Director of the Energy Law Institute in 2014. James was also a partner at Dentons until earier this year and has more than 35 years experience in energy and infrastructure during which he has worked for a wide range of clients across the world.

James has a BA and MA from Oxford University in Jurisprudence. He trained to be a solicitor with Herbert Smith Freehills. In his early career he joined an oil exploration company involving him in upstream transactions around the world, particularly in the Middle East and Africa.

James returned to private practice in 1984 with Denton Hall (now Dentons), a firm with a leading energy practice, where he was Chairman from 1996-2009.

He was also a non-executive director of AMEC plc from October 1999 to May 2007 and was Chairman of their Remuneration Committee for six years.

[33] See B. Gates, 'TED Talk 2015: The next outbreak? We are not ready' (2015). <https://www.ted.com/talks/bill_gates_the_next_outbreak_we_re_not_ready/transcript> accessed 11 October 2020].

Carbon pricing and net zero: an achievable revolution?

Adam Brown

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In theory, a system of carbon pricing (even if adopted only by some jurisdictions) could be the most effective catalyst for the major economic and behavioural changes required in order to avoid catastrophic climate change. This article considers some of the legal and legislative policy issues that would be relevant to any attempt to establish such a system.

Climate change: the perspective of 2020

The potentially devastating environmental and social impacts of man-made greenhouse gas (GHG) emissions have been the focus of considerable political and scientific activity for the last 30 years. A lot of people, governments and businesses now understand that it is extremely desirable to keep the average increase in global temperatures to 1.5°C above pre-industrial levels, and that this means reaching a position of no net GHG emissions globally by around 2050 (net zero).[1] Some are even taking effective forms of action to address these problems.

However, at no point in the last 30 years have annual global GHG emissions fallen (apart from in the early phase of economic shut-down in response to the COVID-19 pandemic this year). Instead, the use of fossil fuels has continued to grow. GHG emissions have continued to rise.[2] Some estimate that rather than having another 30 years in which to make up for this lost time we are likely, on current trends, to exhaust the global 'carbon budget' within the next 10 years, passing the point of a 1.5°C increase in global average temperatures by 2030.[3]

The UK has had a statutory GHG emissions reduction target since 2008 (set to a version of net zero since 2019)[4] and its government is advised by a Committee on Climate Change (CCC) that produces a constant stream of excellent reports

[1] Intergovernmental Panel on Climate Change (IPCC), *Global Warming of 1.5 °C* (2018) <https://www.ipcc.ch/sr15/>.

[2] The gap between the emissions trajectories of current and announced policies and what is needed to avert unacceptable adverse impacts of climate change has been highlighted in many places, including IPCC (n 2) and UN Environment Programme, *Emissions Gap Report* 2019 (2019) <https://www.unenvironment.org/resources/emissions-gap-report-2019?_sm_au_=iMV06K0NkWbRR6TKQcLJjKQ1j7GJ1>. See also D Helm, *Net Zero: How We Stop Causing Climate Change* (2020) ch 1.

[3] As ever, many uncertainties remain, as highlighted by IPCC (n 2). See also Z Hausfather, 'Why the IPCC 1.5C report expanded the carbon budget' (*Carbon Brief*, 2018) < https://www.carbonbrief.org/analysis-why-the-ipcc-1-5c-report-expanded-the-carbon-budget>.

[4] The Climate Change Act 2008 c 27 <https://www.legislation.gov.uk/ukpga/2008/27/contents>, as amended by the Climate Change Act 2008 (2050 Target Amendment) Order 2019 (S.I. 2019/1056) <https://www.legislation.gov.uk/uksi/2019/1056/contents/made>.

about how to meet that target. Their report on the adoption of a net zero target indicates a need for the UK to make the following changes by 2050, amongst others: an overall reduction of 93 per cent on our 2017 level of GHG emissions; all electricity generated from renewables, nuclear, natural gas with carbon capture and storage (CCS) or hydrogen;[5] 90 per cent of heat coming from low-carbon sources (as opposed to 4 per cent at present); virtually all road transport running on electricity or hydrogen rather than petrol or diesel; a 50 per cent reduction in consumption of beef, lamb and dairy products; reforesting of about 5 per cent of land in the UK; and limiting the increase in UK flights to 25-40 per cent above 2005 levels (as opposed to current projections of a 60 per cent increase on those levels).[6]

Taking the UK as a specimen of a rich country, it is clear that governments, individuals and businesses need to make some radical and permanent changes, and that these are changes across the economy, not just in a self-contained 'energy industry' that can somehow be manipulated into a painless transition with no impact on people's daily lives and businesses in other sectors.

It is said that the aggregate costs of avoiding dangerous man-made climate change will be smaller than those of adapting to it, but that in itself does not make moving from 'business as usual' to a net zero world anything other than – for many – a costly and uncomfortable prospect.[7] Almost every aspect of our daily lives (at any rate, in developed economies) has a material carbon footprint that will need to be eliminated or genuinely offset in a net zero world.[8] Although we now have a better idea of how to achieve net zero, the prospect of actually doing so still seems daunting.

At one end of the scale, people need to eat less beef and cheese. At the other end of the scale, the global oil and gas industry, the majority of whose reserves belong directly or indirectly to governments, will need to shrink by a factor of at least two.[9] The growth in businesses and individuals taking voluntary steps to decarbonise is welcome, but very unlikely to be sufficient by itself. How do you ensure that change occurs on a wider scale, and more rapidly?

The economic case for (more effective) carbon pricing

Economists have a straightforward answer. Global economic activity produces too many GHG emissions because nobody pays a price that reflects the environmental and social consequences of their acts and omissions that (directly or indirectly) generate GHG emissions. Although a variety of 'carbon pricing' schemes are in place around the world, their scope is far too limited, their design often flawed, and their price level generally too low. Something broader and more aggressive is called for.[10]

The more expensive it becomes to produce and/or consume fossil fuels and products with a high carbon footprint (from hamburgers to cement), the more producers and consumers have a reason to switch to producing and consuming lower-carbon products and forms of energy.

There is a consensus that an ideal carbon pricing scheme would have the following characteristics:[11]

- Ultimately, it would cover the whole economy in one way or another – applying, at some point along the value chain, to every gCO2e that is emitted (eg in the case of a bag of traditional cement, it could be paid either by the manufacturer or by the purchaser, or a combination of both). This involves a lot of looking at the carbon footprint of everything that we buy: the carbon price in principle attaches to the GHG emissions embodied in the supply chain of each product. However, for practical reasons, it may be appropriate to start by focusing on those sectors or products that contribute the largest shares of global GHG emissions and on which, from an administrative point of view, carbon pricing can most readily be imposed.

[5] For comparison, 54.4 per cent of UK electricity generation was from low-carbon sources in 2019. See HM *Government, UK Energy in Brief 2020* (2020) p 27 <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/904503/UK_Energy_in_Brief_2020.pdf>.

[6] Committee on Climate Change (CCC), *Net Zero – The UK's contribution to stopping global warming* (2019) <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>.

[7] The proposition that, as regards climate change, mitigation of undesirable outcomes before they materialise is cheaper than adaptation to them once they have arrived, was stated in the Stern Review of the Economics of Climate Change, commissioned by the UK government and published in 2006. The CCC (n 7) found that the adoption of a 'net zero' target for UK greenhouse gas emissions in 2050 would not cost any more than the previous statutory target of an 80% reduction against 1990 levels (itself partly based on Stern's conclusions).

[8] See M Berners-Lee, There is no Planet B (2019) and M Berners-Lee, *How Bad Are Bananas? The Carbon Footprint of Everything* (2nd edn, 2020).

[9] Researchers working within the framework set by the IPCC have mapped out four indicative pathways to net zero. They all involve at least halving global consumption of fossil fuels by 2040. Notwithstanding some eye-catching recent announcements by some oil majors, that is not quite the future that most of them (let alone national oil companies or many governments with a major stake in the industry) seem to be planning for. Others argue that net zero in 2050 is compatible with fossil fuels still dominating the global energy sector at that time, but that this would depend on massive shifts in investment – for example, into new technology to reduce the carbon footprint of fossil fuel extraction, hydrocarbon supply chains and use of fossil fuels. The majority of the industry is as yet not visibly committed to such shifts. See CCC (n 7) p 90; Energy Transitions Commission, *Making Mission Possible: Delivering a Net-Zero Economy* (2020) < https://www.energy-transitions.org/publications/making-mission-possible/>; Stockholm Environment Institute, *The Production Gap Report* (2019) <http://productiongap.org/2019report/>; International Energy Agency, *The Oil and Gas Industry in Energy Transitions* (2020) < https://www.iea.org/reports/the-oil-and-gas-industry-in-energy-transitions?_sm_au_=iMV06K0NkWbRR6TKQcLJjKQ1j7GJ1>; and a number of publications by consultancy Thunder Said Energy <https://thundersaidenergy.com/>.

[10] See generally Helm (n 3).

[11] See the Report of the High-Level Commission on Carbon Prices chaired by Joseph Stiglitz and Nicholas Stern (Carbon Pricing Leadership Coalition, May 2017) < https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices>; Policy Exchange, *The Future of Carbon Pricing: Implementing an independent carbon tax with dividends in the UK* (2018) <https://policyexchange.org.uk/publication/the-future-of-carbon-pricing-implementing-an-independent-carbon-tax-with-dividends-in-the-uk/>; D Klenert, L Mattauch, E Combet, O Edenhofer, C Hepburn, R Rafaty and N Stern, 'Making Carbon Pricing Work for Citizens' (2018) 8 Nature Climate Change 669; The "Economists' Statement on Carbon Dividends" to *The Wall Street Journal* (signed by, amongst over 3,500 other US economists, 4 former Chairs of the Federal Reserve and 27 Nobel Laureate Economists) (2019) <https://clcouncil.org/economists-statement/?_sm_au_=iMV06K0NkWbRR6TKQcLJjKQ1j7GJ1>. For a different, but perhaps not entirely impartial perspective, see J McGillis, 'The Case against a Carbon Tax' (2019) (available at https://www.instituteforenergyresearch.org/wp-content/uploads/2019/04/Carbon-Tax-Policy-BriefFinalText-1.pdf).

- The price of emissions would start considerably higher than in most current carbon pricing schemes, and it would increase over time in a carefully calibrated and predictable way. The object is to reach a point where the carbon price paid represents the full social and environmental cost of each additional unit of GHG emissions.
- To ensure both equity and a measure of popular support, some or all of the proceeds of the carbon pricing regime would be paid to, or used to fund schemes for the benefit of, those on whom the burden of paying carbon prices, and the other consequences of the regime if it is successful, will fall in a way that may be considered inequitable. These might include, for example, former coal-mining communities or poorer citizens in rural areas who rely heavily on petrol or diesel cars and have no prospect of converting to an electric vehicle. Such payments and schemes are sometimes referred to generically as 'carbon dividends'.
- It would have a global reach, because the carbon-rich supply chains of today's economy are global. The development of a unified global scheme, or global rules for national schemes, is probably too much to expect in the near term. However, individual national schemes could incorporate a 'border carbon adjustment' (BCA), so as to ensure that imported goods (including fuels and energy) do not enjoy a cost advantage over those produced domestically as a result of the lack of an equivalent carbon pricing mechanism in their countries of origin.

The last point is very important, because without a BCA, countries with stringent carbon pricing will tend to export their emissions to countries with no carbon pricing, or less stringent carbon pricing and other GHG-emission-limiting regimes. End consumers in importing countries of products exported from such countries will not face the costs of the emissions to which their demand for those products has given rise, and will have no incentive to switch their demand to lower-carbon alternatives. The UK, for example, has achieved some of its (significant) reductions in GHG emissions since 1990 simply by virtue of the fact that it no longer makes as much steel as it once did, but instead imports steel from other jurisdictions, often ones where manufacturers do not face equivalent carbon constraints.[12] A BCA may encourage the exporting producers or states to raise their game in terms of climate action, provided that they get credit for doing so under importing states' BCA mechanisms.

The key qualities of an effective carbon pricing regime are well summarised in the Carbon Pricing Leadership Coalition's 'FASTER' principles – ie that a regime should be characterised by **F**airness, **A**lignment of policy and objectives, **S**tability and predictability, **T**ransparency, **E**fficiency and cost-effectiveness, and **R**eliability and environmental integrity.[13]

For many years, carbon pricing regimes that combine all the above characteristics have largely been the stuff of theory rather than practical politics. However, there are signs that this may be about to change: for example, the European Commission has promised to bring forward proposals in 2021 for an EU BCA, as part of its Green New Deal plans to make the EU carbon neutral by 2050.[14]

Pricing mechanisms: cap and trade or tax?

It is generally said that there are two ways of putting a price on carbon.

A cap and trade scheme puts a limit on the total emissions that those subject to the scheme may cause collectively, and requires that individually they must either purchase, or otherwise be allocated, the right to emit each unit of emissions for which they are held responsible under the scheme. Over time, the overall cap reduces, and a greater proportion of participants can be required to purchase rights to emit rather than being allocated them for free. This should force up the price of the right to pollute, encouraging the adoption of less polluting technology. The rights to pollute, when not allocated for free, can be auctioned and are tradable. This is intended to promote efficiency.

A carbon tax, on the other hand, requires a person who is directly responsible for GHG emissions, or who purchases goods or services in whose production GHG emissions are, or are deemed to be, embodied, to pay a certain sum by way of tax.

This is not the place to try to determine which of the two approaches is 'better' in some absolute sense – if that is even a meaningful question for the purposes of public policy. Both have their supporters among economists, and both have been notably unsuccessful in some cases. When they have been unsuccessful, those disposed to favour the approach in question point to weaknesses of design or implementation in the particular case, whilst those who favour the other approach tend to see the shortcomings of the approach that they do not favour as inherent in the approach itself.[15]

Without wishing to identify ourselves as a partisan of either approach, for most of the remainder of this paper, we focus on carbon taxes rather than cap and trade schemes. There are three reasons for this. First, it seems to us that, in principle, all the criteria for an 'ideal' carbon pricing regime set out above could be met by either a cap and trade scheme or a carbon tax; focusing on just one approach therefore has the merit of brevity. However, there appear to be good arguments (for example, in terms of maximising behaviour-changing

[12] The Climate Change Act 2008 sets its net zero target in terms of the UK's territorial emissions, rather than encompassing all the emissions for which the UK economy is responsible.

[13] See, for example, Carbon Pricing Leadership Coalition, 'What is Carbon Pricing?' <https://www.carbonpricingleadership.org/what>.

[14] European Commission, 'The Green Deal' (COM(2019) 640 final) (2019) (available at https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf). This is not the first time that the EU has contemplated such a move. For the history of earlier EU proposals in this area, see M Mehling, H van Asselt, K Das, S Droege and C Verkuijl, 'Designing Border Carbon Adjustments for Enhance Climate Action' (2019) 113 *American Journal of International Law* 433 pt IV.A <https://www.cambridge.org/core/journals/american-journal-of-international-law/article/designing-border-carbon-adjustments-for-enhanced-climate-action/BF4266550F09E5E4A7479E09C047B984?_sm_au_=iMVZv26fqNRK1J55QcLJjKQ1j7GJ1>. Proposals have also been put forward to introduce a federal carbon price with a BCA in the context of US climate policy. See for example the Congressional Action Plan for a Clean Energy Economy and a Healthy, Resilient, and Just America (July 2020) <https://climatecrisis.house.gov/report>. As with the EU proposals, this is not the first time for such proposals (see Mehling, above, pt IV.B.1).

[15] See for example Helm (n 3) pp 110–113.

impact) for imposing some level of carbon pricing directly on end consumers. In that case, it seems hard to escape the conclusion that, in practical terms, it would be considerably simpler to use a tax than a system of personal carbon allowances and tradable permits. Finally, UK experience since 2011 suggests that where there is an existing cap and trade scheme that is not delivering all the outcomes of the ideal regime, it is probably easier to supplement it with a tax than to engage in wholesale reform of the existing scheme or to layer a new one on top of it.[16]

We shall also assume, unless stated otherwise, that the hypothetical carbon taxing regime that we are discussing is a unilateral one that has all the characteristics of an ideal scheme outlined above. Where it applies to products made, or points in a product's life cycle that occur, outside the taxing jurisdiction, in circumstances where a carbon pricing regime of comparable stringency does not apply, a BCA would be applied. In such cases, the BCA would be designed to mimic, as closely as possible, the economic effect that the tax would have if the product had been made, or the relevant life cycle step had occurred, inside the taxing jurisdiction.

Why do we not have effective carbon pricing already?

Carbon pricing is not a new idea. There is a fair amount of it about. If it is (or can be) such a good thing, why have the world's policymakers not already devised the ideal carbon pricing regime and put us securely on the way to net zero? There are many reasons for this, and their relative importance no doubt varies considerably between jurisdictions. We list some of them below, grouped under four headings, but noting that most of them may be said to straddle more than one of these.

- Purely political objections. Carbon pricing looks like (and often is) a form of tax. Most politicians in most countries assume that introducing new taxes or increasing existing ones will be unpopular: it will not win them elections or make their lives easier in government. This view arguably does not take account of the potential for carbon dividends. However, it may be challenging to explain to voters how a tax with carbon dividends could successfully change their high-carbon behaviour without making them poorer (at least in the short term) or inconvenienced.
- At least partly moral objections. A scheme that increases the price of high-carbon products makes it likely that they will be consumed more by those who are relatively wealthy – ie those who are best placed to, and therefore should, make lower-carbon choices. Also, a carbon tax with a BCA is open to the objection that it imposes on developing economies the costs of reducing emissions arising from demand in developed economies that themselves faced no carbon pricing over the decades and centuries in which they industrialised.
- At least partly legal objections. A BCA could be designed in such a way as to serve to insulate producers in the importing (taxing) country from competition in other (potentially exporting) countries without equivalent regimes, thereby reducing the competitive advantages of the latter. The concern sometimes expressed is that this could make it hard to establish a BCA that did not either fall foul of, for example, World Trade Organization (WTO) rules or risk provoking some form of retaliatory trade measures from potentially exporting countries.
- At least partly practical objections. Much climate change policy has been pursued through the United Nations Framework Convention on Climate Change (UNFCCC) and other international fora. To UNFCCC negotiators, attempting to reach global agreement on carbon taxes must seem wholly unfeasible. On the other hand, from a purely national perspective, the potential difficulty of avoiding the pitfalls under the other three headings may seem a powerful argument for not imposing a carbon tax at all. For example, as in any tax regime there will be a need to avoid avoidance schemes and other abuses that would defeat the policy intent, particularly in relation to any compensation mechanisms. However, perhaps the biggest practical objection is in relation to 'rebound' effects – a simple example of which would be buying a much more fuel-efficient car in response to a carbon-tax-driven increase in the price of fuel, but then driving further in it and generating more emissions, because you can do so without increasing your overall costs.[17]

All of these potential objections, and others, could detract, in one way or another, from the effectiveness of a carbon tax regime. They need to – and can – be addressed, but meeting them has implications for the design of such regimes. In the next sections we illustrate this by looking further at some points that are either legal in nature or are particularly likely to shape legislative outcomes.

'The polluter pays'

The principle that those responsible for pollution occurring should also be responsible for meeting the resulting costs is intuitively fair, as well as being sound economics. It underpins other statutory regimes that apply to many companies that would be subject to a carbon tax, and although it has not always been at the centre of approaches to mitigate the risk of climate change, it appears to have been responsible for some notably successful interventions.[18]

Who is the polluter?

However, it is worth asking the question, who is the polluter? Suppose you buy a washing machine. The washing machine is manufactured somewhere: that factory uses energy that

[16] This is what the UK government did by introducing a 'carbon price floor' into the existing Climate Change Levy established by the Finance Act 2000 c 17 (as amended) <https://www.legislation.gov.uk/ukpga/2000/17/contents>. The relevant provisions (sch 6) are a fairly painful read, but there is a convenient explanation in HM Revenue & Customs, 'Excise Notice CCL1/6: a guide to carbon price floor' (2017) <https://www.gov.uk/government/publications/excise-notice-ccl16-a-guide-to-carbon-price-floor/excise-notice-ccl16-a-guide-to-carbon-price-floor>.

[17] Berners-Lee, Planet B (n 9) takes this example much further on pp 206–7, and generally lays considerable stress on the importance of rebound effects. See also Berners-Lee, *Bananas* (n 9) p 166 and bibliography cited in note 17 there.

[18] For example, the UK carbon price floor (n 17) is credited with having played a leading part in decarbonising UK electricity generation. See Ofgem, *State of the Energy Market 2019* (2019) p 129 (figure 5.10) <https://www.ofgem.gov.uk/system/files/docs/2019/11/20191030_state_of_energy_market_revised.pdf>.

may be high, low or zero carbon. The manufacturer uses components made, perhaps in other factories, out of raw materials such as steel and concrete, which often have a very high carbon footprint.[19] Downstream, there are wholesale and retail distribution and supply chains with their own energy use, including transport, which is likely to include some high-carbon elements (shipping, HGVs). Broadly speaking, in deciding who the polluters are in this chain who will bear the carbon tax, there are four options.

- Taxing production of raw materials embodying GHG emissions. This is the approach of going as far up the supply chain as you can. Rather than taxing the washing machine manufacturer or the supplier of steel, for example, you focus on the mining company that dug up the coal that is responsible for the steel's carbon footprint. Rather than taxing the shipping company for using bunker fuel, you tax the refinery that produced it or the upstream oil and gas company that extracted the crude oil from which it was derived. To move away from our washing machine example for a moment, you would tax the cattle farmer rather than the supermarket or the consumer. This is not necessarily the most practicable approach, but it is worth considering if only to remind ourselves that the emissions from this part of the end product lifecycle do need to be captured by the tax, even if ultimately this is done at a later point in the supply chain. The raw materials approach would focus much of the tax burden on the energy industry. It is also the approach that reaches back furthest from end consumers of final products resident in the taxing country into international commodity markets. Both these points suggest that while this approach has the advantage of a tight focus, it may also have the disadvantage of potentially losing some of the power of the tax to drive behaviour in the rest of the economy. In our view, it may place too much weight on the BCA element of the regime: raw materials are less likely to (and in some cases will never) originate in the jurisdiction of the end consumer than final products, and may well not even originate where that product is manufactured. However, the focus on raw materials, and particularly the extractive energy industries highlights some points that are important for the other options as well. If you apply the carbon tax to the production of crude oil, for example, you are potentially taxing two things: first, the CO2 that you are assuming will be released into the atmosphere when it is converted into something else (eg plastic) or a fuel derived from it is burnt; second, the GHG emissions resulting from the upstream and midstream processes (eg fossil fuel powered generation to pump from the well and power the rig and pipelines, flaring, fugitive methane emissions). In the first case, if you literally tax production rather than supply, you will have to make assumptions about future use of the raw material that may be inaccurate. Suppose, for example, you are extracting natural gas that will be supplied to a combined cycle power station or a steam methane reformer hydrogen production facility that is fitted with carbon capture and storage. The emissions consequences in that case would be very different from supplying to an open cycle, unabated gas-fired power station. As for emissions associated with the production of fossil fuels, the carbon intensity of upstream operations has been found to vary considerably both from one basin or country to another (eg by a factor of four between Saudi Arabia and Algeria) and between individual projects (eg by a factor of six between different projects in Indonesia).[20] You therefore have a choice: either try to take account of the emissions intensity of production of each barrel of oil based on the performance of the well where it was extracted, or apply an 'industry average' emissions factor, which will flatter the performance of some and penalise others. The former approach would be precise, but also complex, and possibly impracticable in the context of a carbon tax based on raw material production, where production does not take place in the taxing jurisdiction. The latter is simpler and has the advantage that there is some correlation between areas of higher and lower emissions factors and higher and lower production costs (eg Canada is near the top and Saudi Arabia near the bottom for both), meaning that efficiency is rewarded.
- Taxing inputs. Impose a tax on each person in the supply chain as and when they introduce an element that adds to the carbon footprint of the final product. This is broadly what the EU Emissions Trading System does when it measures, for example, the emissions of a steelworks or cement factory and requires it to purchase and submit an equivalent number of EU allowances (leaving aside the fact that the emitter may receive some free EU allowances). It avoids some of the difficulties associated with the previous option, and would potentially be a better framework in which to engage with others. For example, if you wanted the carbon tax to take account of the upstream and midstream emissions of the oil and gas industry, doing so at the point when an industrial end user or a retail supplier purchases fuel may make sense, since refineries, gas processing facilities and LNG terminals know where the petroleum or gas that they refine or process comes from.[21] (Whether higher rates of tax applied to inputs from different locations would make a difference to their purchasing behaviour is another question.)
- Focus on the end product. In some cases (eg industrial purchases of gas), the tax point would be the same as for the previous option, but the position will be different with others, such as consumer purchases of food, clothes, or the washing machine mentioned above. If the tax is levied on the final consumer in these cases, how is that better than the same amount of tax, covering the same range of emissions, being levied at an earlier point in the

[19] See Berners Lee, Bananas (n 9), entries for 'A bag of cement (25kg)' and 'A tonne of steel'.

[20] M Masnadi, H El-Houjeiri, D Schunack, Y Li, J Englander, A Badahdah, J-C Monfort, J Anderson, T Wallington, J Bergerson, D Gordon, J Koomey, S Przesmitzki, I Azevedo, X Bi, J Duffy, G Heath, G Keoleian, C McGlade, D Meehan, S Yeh, F You, M Wang and A Brandt, 'Global carbon intensity of crude oil production' (2018) 361 Science 851 <https://www.osti.gov/pages/servlets/purl/1485127>.

[21] How important are these emissions? According to the International Energy Agency, 'Methane Tracker 2020' <https://www.iea.org/reports/methane-tracker-2020/methane-from-oil-gas>, 'Total indirect greenhouse gas (GHG) emissions from oil and gas operations today are around 5 200 million tonnes (Mt) of carbon-dioxide equivalent (CO2-eq), 15% of total energy sector GHG emissions. Methane…is the largest single component of these indirect emissions.' For the kind of data that can be available on the petroleum sourced by refineries etc, see International Council on Clean Transportation, *Upstream Emissions of Fossil Fuel Feedstocks for Transport Fuels Consumed in the EU* (2014) <https://circabc.europa.eu/sd/a/0eef6ba6-280f-4bcd-a804-3a6bd7794d78/ICCT_Upstream-emissions-of-EU-crude_Feb2014.pdf>.

supply chain (eg on the farmer/manufacturer, wholesaler or retailer)? In one sense, it makes little difference, since whoever pays the tax, apart from the end consumer, will presumably pass the cost on down the chain. The point of imposing the tax directly on the end consumer is perhaps more psychological, emphasising their personal agency, and making it more likely that the tax (and therefore carbon) consequences of their purchasing choices are clear to them: one can imagine, for example, supermarket labelling and receipts highlighting the tax element of an item's price. However, such transparency could still be provided without the tax being levied at the point of sale to the individual consumer. It would be slightly simpler in administrative terms to levy the tax at an earlier point in the supply chain, and in the case of food retailers this would have the additional and perhaps important merit of ensuring that tax was paid on 'waste' items that are not sold to end consumers.

- Focus on national carbon footprint. A unilateral carbon tax cannot be extraterritorial (at least in the literal sense: its opponents may argue that it has an extraterritorial effect), nor should it try to be. The point of any BCA element in a carbon tax regime is to ensure that consumers in the importing economy pay, directly or indirectly, the price of the emissions that they have caused in the exporting country – which, in the absence of international demand for its products, would not be making so many of them and generating so many emissions. A BCA should therefore always be levied on the importer.

- Mixed approach. In practice, it may be desirable – particularly if a carbon tax is to be genuinely economy-wide – to adopt a mixture of the above approaches, since even the brief discussion above indicates that some may be more suited to one type of product than another. It may be noted that the closest thing that the UK currently has to a carbon tax, the Climate Change Levy (CCL), which is essentially a tax on the supply to businesses of electricity and certain fossil fuels, applies at multiple levels in the energy value chain (eg on the supply of electricity by retailers but also on the use of coal and gas by generators).[22] The trick is to avoid (or at least make sure that there is a reason for) any tax being paid twice.

Ensuring that only the polluter pays

At whatever point in the supply chain the carbon tax is applied, it should ideally reflect the actual emissions at, or leading up to, that point. However, there may be occasions when this is not possible. For example, you may want the tax to reflect the carbon intensity of electricity used to manufacture a product. In practice, you can only do this in a literally accurate sense if the manufacturer generates all its own power or is supplied with it by a private network with its own generation facility. Otherwise, the electricity a manufacturer draws from the grid will be generated from a mixture of sources and you could levy the tax based on: (i) grid-wide average carbon intensity of generation during a given period; or (ii) average carbon intensity of electricity supplied by that manufacturer's electricity supplier. Matters then become more complicated if the manufacturer is on the supplier's 'green tariff' – probably marketed as being '100% renewable electricity', but in most cases involving a mixture of 'green' and 'brown' power, with the latter being 'greened' through the purchase of 'guarantee of origin' certificates sold by renewable-generating projects separately from their electricity.

Should the tax payable on a MWh of electricity used by a manufacturer vary with any of these factors? If so, the administration of the tax, and any associated system of rebates, becomes more complicated – although arguably in the good cause of (ultimately) increasing the demand for clean power. Such complexities will also need to be addressed in the context of other countries' electricity supply arrangements if a BCA is to have the same impact as domestic application of the tax.

International law

BCAs and the WTO regime

As noted above, the compatibility of BCAs with WTO rules has often been discussed. We do not attempt here to add to that discussion, which in our view demonstrates (i) that as a matter of law, it should be possible to design a BCA that is WTO-compatible, but also (ii) that as a matter of fact, no authority that imposes a BCA can be sure of not provoking retaliatory measures from states that claim (whether or not correctly as a matter of law) that WTO rules justify their actions.

What is relevant for present purposes are the features that a BCA (and a carbon tax regime more generally) should have if it is to be WTO-compatible. In general, a BCA should be intended to achieve only legitimate environmental aims and designed in such a way as to achieve those aims rather than being a form of disguised protectionism. As far as possible, products subject to the BCA should be treated in the same way as those produced domestically. Other points to note include the following:

- The BCA should apply to imports only, not exports (to avoid classification as a subsidy under the WTO Agreement on Subsidies and Countervailing Measures).

- Although a carbon tax as a whole may be economy-wide, its BCA element should focus on sectors with high carbon cost and trade exposure (carbon leakage risk).

- Any differentiation between countries where goods subject to a BCA originate should only be on the basis of demonstrable differences in carbon content of the goods they produce.

- BCAs need to be clear about the methodology used to calculate both embedded carbon in products and any carbon constraints applying to the product (eg the existence of a carbon price in the exporting country, but at a lower level than that of the importing country).

- Recycling some of the tax by having an international dimension to its carbon dividend element has both WTO-compliance and presentational advantages.

[22] See n 17 and n 19.

- BCAs should be time-limited, or at least kept under review so that their levels can be adjusted to take account of, for example, grid carbon intensity or regulatory changes in exporting countries.
- Even if a BCA is a unilateral measure, it should not be introduced without discussion (and ideally negotiation) with the exporting countries that will be most affected by it.
- There are some procedural steps that it may be worth considering as a way of clarifying a measure's WTO compatibility (although in practice these require such high levels of agreement among WTO parties that it may be difficult to secure at present).[23]

UNFCCC common but differentiated responsibilities (CBDR)

The UNFCCC (1992) provides, at Article 3(1):

> "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof."[24]

The UNFCCC Paris Agreement (2015), after listing the objectives of climate change mitigation (including 1.5°C) and adaptation (Article 2(1)(a) and (b)) mentions the further objective of: 'Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.' (Article 2(1)(c)), before stating (Article 2(2)):

> "This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances."[25]

A repeated area of difficulty in UNFCCC negotiations has been the complaint of less developed countries that countries whose wealth has been built up over decades and centuries of unconstrained exploitation of fossil fuels now expect them to forego the opportunity to industrialise using, for example, coal, but without paying or compensating them financially for doing so. As we will see, there are both principled and pragmatic arguments in favour of reflecting CBDR principles in a BCA regime.

Some statistics may help to provide context.

- If you count the EU (plus the UK) as a single bloc, there are only 16 'countries' that individually emitted more than 1 per cent of total global fossil fuel CO2 emissions in 2019.
- Together, these countries accounted for 81.4 per cent of such emissions. Leaving out the EU+UK (8.7 per cent), five of them accounted for 58.2 per cent: China (30.3 per cent), the US (13.4 per cent), India (8.5 per cent), Russia (4.7 per cent) and Japan (3 per cent).[26]
- Many of these top emitter countries are also among the EU's top sources of imported goods.
- The EU's 11th ranking trading partner for imports of goods is Vietnam, with a value of imports into the EU that is almost exactly 10 per cent of the value of EU imports from China. China's total fossil fuel CO2 emissions are almost 40 times Vietnam's, but Vietnam's are growing faster: in power and other industrial combustion, four times faster than China's in 2005–2019.[27]

It is not difficult to find reference points for quantifying countries' 'differentiated responsibilities' when it comes to man-made GHG emissions. How might these be factored into BCAs, and used to adjust tax liabilities based simply on measurement or estimates of emissions in the supply chain?

- It is possible to estimate how much each country has contributed to global emissions since 1750. For some countries, their cumulative historic share is smaller than their share of current emissions (eg China, with a historic share of 12.7 per cent, which is about 40 per cent of its current share); for some the position is reversed (eg the US, with a historic share of 25 per cent, and Russia, with a historic share of 9 per cent, in each case almost double their current shares). It might go some way to making a BCA more palatable if the taxing country were to apply a scaling factor that took account of both the historic and current figures in

[23] The bullets in the text summarise the conclusions of the very thorough analysis in Mehling (n 15) pt VI pp 473-481. See also A Krenek, 'How to implement a WTO-compatible full border carbon adjustment as an important part of the European Green Deal' Österreichische Gesellschaft für Europapolitik (2020) <https://oegfe.at/wordpress/wp-content/uploads/2020/07/OEGfE_Policy_Brief-2020.02.pdf>; M Porterfield, 'Border Adjustments for Carbon Taxes, PPMs and the WTO' University of Pennsylvania Journal of International Law (2019) 41.1 1 <https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=1994&context=jil&_sm_au_=iMVZv26fqNRK1J55QcLJjKQ1j7GJ1>. Also relevant is an older paper, J Hillman, 'Changing Climate for Carbon Taxes: Who's Afraid of the WTO?' (2013) <https://www.climateadvisers.com/wp-content/uploads/2017/07/2013-07-Changing-Climate-for-Carbon-Taxes.pdf?_sm_au_=iMVZv26fqNRK1J55QcLJjKQ1j7GJ1>. There are, of course, points of more or less difficulty in the WTO analysis. For a somewhat more sceptical view, see R Quick, 'A Carbon Border Tax or A Climate Tariff?' (*International Economic Law and Policy Blog*, 2019) <https://ielp.worldtradelaw.net/2019/10/guest-post-a-carbon-border-tax-or-a-climate-tariff.html?_sm_au_=iMVZv26fqNRK1J55QcLJjKQ1j7GJ1>.

[24] See https://unfccc.int/resource/docs/convkp/conveng.pdf.

[25] See https://cop23.unfccc.int/sites/default/files/resource/docs/2015/cop21/eng/10a01.pdf.

[26] European Commission, JRC Science for Policy Report, *Fossil CO2 emissions of all world countries* (2020) <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC121460/kjna30358enn.pdf> p 11.

[27] European Commission, *DG Trade Statistical Guide* (2020) <http://trade.ec.europa.eu/doclib/docs/2013/may/tradoc_151348.pdf> p 55.

some way.[28] This is not necessarily straightforward, either in practice or as a matter of principle. A BCA mechanism aims, or should aim, to create a 'level playing field'. It removes only one competitive advantage that an exporting country may have, namely lower carbon pricing; others (eg lower labour costs) remain. Also, while coal-fired power may historically have been the cheapest basis for industrialisation, renewables now often have a cost advantage, at least when it comes to building new generation capacity. All other things being equal, would you treat an economy powered by 20-year-old coal-fired units the same as one that has increased its installed capacity by 50 per cent with a new coal-fired unit this year?

- The sectoral distribution of countries' emissions varies considerably. Some sectors are directly relevant to goods that they export (eg power); others less so, or perhaps not at all (eg perhaps much of transport and some agriculture). This could also be factored in, as could other measures, such as a country's emissions per capita or indeed GDP per capita (which may indicate its ability to fund mitigation and adaptation measures on its own account).

However, while there is much to be said for attempting to adjust BCAs to reflect CBDR and other, broader notions of historical or economic equity, such adjustments will not be straightforward. Inevitability, whatever criteria are chosen as the basis for them are likely to result in more favourable treatment of some countries than others, giving rise to political tension, if not the potential for WTO-incompatibility (under GATT most favoured nation rules).[29]

The potential for a carbon tax regime to reflect CBDR principles and the spirit of Article 2(2) of the Paris Agreement is not exhausted by adjustments to BCAs, however, as we shall see when we come to discuss carbon dividends below.

Investment treaties

A third potentially relevant area of international law are investment treaties. Many countries are parties to large numbers of these. A country looking to impose a carbon tax will want to consider its potential exposure under investment treaties before finalising the details of any associated BCA. A hypothetical example may help to illustrate the kind of scenarios that could arise.

Suppose Country A adopts a carbon tax with a BCA that weighs heavily on exporters to it from Country B, where the oil and gas industry has a heavy carbon footprint. Country B therefore decides to reduce the emissions of its upstream sector by requiring all operators to cease flaring, eliminate fugitive methane emissions, and power their operations with electricity of an average carbon intensity not exceeding 50gCO2/kWh (there is no existing renewable electricity generation capacity in Country B), regardless of an individual project's remaining expected operational life.

Oil companies based in Country A are major investors in the oil and gas sector in Country B. If Country A has no investment treaty with Country B, and the investors have no remedy under B's national law, possible outcomes range from reduction in B's carbon footprint funded by the investors, to premature decommissioning of upstream assets, with negative economic consequences for B. If there is an investment treaty in force between A and B, its precise terms, and the particular circumstances, may be such as to give the investors some protection, or they may not. It will depend, for example, on whether the measures can be characterised as breaching any requirement to give fair and equal treatment, or prohibition on indirect expropriation, in the treaty; whether there is a carve-out from such a prohibition (eg for environmental regulation) that is applicable to the proposed measures;[30] and, if not, whether any associated requirement to pay compensation is engaged. The analysis, and resulting political calculations, may be more complex if Countries A and B are Contracting Parties to the Energy Charter Treaty (ECT). For example, both countries may have to think about how their actions could affect investors from other Contracting Parties.[31]

In short, when setting the terms of any carbon tax with regard to its impacts on business costs, a government may need to look carefully at the BCA element of its proposed regime, and possible reactions to it, through the lens of applicable investment treaty provisions.

Sovereignty and self-determination

Another aspect of the ECT that may be relevant in the scenario discussed above is paragraph 3 of Article 18, ('Sovereignty over Energy Resources'), which asserts:

> "Each state continues to hold in particular the rights to decide the geographical areas within its Area to be made available for exploration and development of its energy resources, the optimisation of their recovery and the rate at which they may be depleted or otherwise exploited, to specify and enjoy any taxes, royalties or other financial payments payable by virtue of such exploration and exploitation, and to regulate the environmental and safety aspects of such exploration, development and reclamation within its Area, and to participate in such exploration and exploitation, inter alia, through direct participation by the government or through state enterprises."

[28] See for example H Ritchie, 'Who has contributed most to global CO2 emissions?' (*Our World in Data*, 2019) <https://ourworldindata.org/contributed-most-global-co2?_sm_au_=iMVZv26fqNRK1J55QcLJjKQ1j7GJ1>.

[29] See Mehling (n 15) pp 472-3.

[30] See, for example, the Comprehensive Economic and Trade Agreement (CETA) between the EU and Canada <https://ec.europa.eu/trade/policy/in-focus/ceta/ceta-chapter-by-chapter/index_en.htm>. There is a fairly standard prohibition on expropriation in Article 8.12, whose meaning is elaborated by Annex 8-A, the final paragraph of which states that: 'except in the rare circumstance when the impact of a measure or series of measures is so severe in light of its purpose that it appears manifestly excessive, non-discriminatory measures of a Party that are designed and applied to protect legitimate public welfare objectives, such as health, safety and the environment, do not constitute indirect expropriations.' See also Article 24.3 ('The Parties recognise the right of each Party to set its environmental priorities, to establish its levels of environmental protection, and to adopt or modify its laws and policies accordingly and in a manner consistent with the multilateral environmental agreements to which it is party and with this Agreement…').

It is far from clear what the legal effect of Article 18(3) is, or quite how it relates to other provisions of the ECT. However, in the context of BCAs, it is interesting to read it alongside Article 1(2) of the UN International Covenant on Economic, Social and Cultural Rights (CESCR):

> "All peoples may, for their own ends, freely dispose of their natural wealth and resources without prejudice to any obligations arising out of international economic co-operation, based upon the principle of mutual benefit, and international law, in no case may a people be deprived of the means of subsistence."

Article 1(2) is an aspect of the broader 'right of self-determination' set out in Article 1(1) CESCR, by virtue of which all peoples 'freely determine their political status and freely pursue their economic, social and cultural development'. It is partly qualified by Article 5(1) ('Nothing in the present Covenant may be interpreted as implying…any right to engage in any activity…aimed at the destruction of any of the rights or freedoms recognised herein…'), and re-emphasised by Article 25 ('Nothing in the present Covenant shall be interpreted as impairing the inherent right of all peoples to enjoy and utilize fully and freely their natural wealth and resources.').

These provisions have sometimes been put forward as part of a human rights-based case for international action to mitigate climate change, focusing for example on the rights of small island states, the habitability of whose territory is threatened by rising sea levels – making it impossible for their peoples to enjoy the kind of rights expressed in Article 1(2). However, in the context of a BCA, it seems possible that they could be pressed into service for different purposes.

Suppose that Country D has a fairly small economy, but it has deposits of coal, builds a new coal-fired power station and starts to develop a manufacturing sector. (For the moment, it sees its decarbonisation priorities as lying in the agricultural sector, and with the replacement of cooking over open wood fires with safer and cleaner methods.) A state-owned corporate group based in Country D sets up a factory in Country C assembling finished products from components manufactured in its factory in Country D. Country D imposes a carbon tax that is particularly focused on coal. This includes a BCA under which tax is payable on imports of goods made in countries where the power supply has a high grid carbon intensity. In addition to any arguments arising from the other relevant areas of international law noted above, could Country D claim infringement of its rights under Article 1(2), as well as under Article 18(3) ECT if it is a Contracting Party to the ECT?

The prospect of such a claim being made (let alone being legally successful) may seem somewhat far-fetched in the context of individual bilateral relations between states. However, there is clearly a tension between provisions such as Article 1(2) CESCR and Article 18(3) ECT and the use of BCA or similar mechanisms to induce countries to change aspects of their energy policies. Whether there is any general appetite to 'adapt the concept of state sovereignty to the present needs of a globalised and interdependent world' in a systematic way (or indeed, how that could be achieved) is unclear.[32] However, the issue may become more acute if a carbon tax-related measure could be said, in practice, to deprive the exporting country of all, or a significant part, of its potential export markets. Perhaps there is an additional point here for the EU to consider in framing its own BCA proposals.

Constitutional problems, democracy and governance

Federal states

The question of sovereignty can arise in relation to the domestic, as well as the international application of carbon tax measures, particularly in states with a federal constitution. At the time of writing, the Supreme Court of Canada is hearing three cases on just this point.[33]

Canada's Greenhouse Gas Pollution Pricing Act of 2018[34] introduces a federal system of carbon pricing and emission reductions targets that applies to any Canadian province or territory that does not choose to implement its own carbon pricing regime that meets the federal targets. The federal regime includes a fuel charge applicable to a range of fuels when they are, for example, delivered, used or produced, into a province or territory where it applies, and a price payable, by facilities in certain sectors whose emissions have exceeded a certain threshold, when they produce GHG emissions over a specified level. Covered facilities whose emissions fall below the threshold where the tax applies can earn credits for doing so, which they can then sell.

A number of provinces and territories to which the Act now applies – either because they have not enacted their own carbon pricing arrangements (or have repealed arrangements previously enacted), or because their own arrangements are not deemed to meet the standard set in the Act – have either challenged the Act on constitutional grounds, or intervened on the side of those who have raised challenges. Bare majorities in the Courts of Appeal in Saskatchewan and Ontario sided with the federal government. A larger majority of the Alberta Court of Appeal held the Act was unconstitutional.

At the heart of the arguments about the constitutionality of the Act are disputes about what the true subject matter of the Act is; how that relates to the provisions of the Constitution

[31] See, for example, Energy Charter Treaty <https://www.energycharter.org/fileadmin/DocumentsMedia/Legal/ECTC-en.pdf> arts 10 (Promotion, Protection and Treatment of Investments), 13 (prohibiting expropriation, with a carve-out for non-discriminatory measures in the public interest carried out under due process of law and accompanied by prompt, adequate and effective compensation) and 21 (Taxation Measures).

[32] See O Quirico and M Boumghar (eds), *Climate Change and Human Rights: An international and comparative law perspective* (2016) ch 8, s 3.

[33] *Attorney General of Saskatchewan v Attorney General of Canada* (Sask.) (Civil) (As of Right) 38663; *Attorney General of British Columbia v Attorney General of Alberta* (Alta.) (Civil) (As of Right) 39116; *Attorney General of Ontario v Attorney General of Canada* (Ont.) (Civil) (As of Right) 38781.

[34] Available at https://laws-lois.justice.gc.ca/eng/acts/G-11.55/.

Act 1867 that set out areas where provincial legislatures have exclusive competence; and whether its subject matter is a matter of national concern (in the sense that the failure of one province or territory to regulate on it has an adverse impact on others). Without delving too deeply into Canadian constitutional doctrine, an extract from the majority judgment of the Alberta Court of Appeal will give a flavour of the issues that any federal constitution or system of devolved government may have to grapple with in this area.

> '[311] The provinces have the unchallengeable jurisdiction to reduce GHG emissions. But because the provinces might actually choose to exercise their powers in the way they are constitutionally entitled to do – for example, by not imposing carbon pricing on individual consumers – the federal government claims a right to use the provinces' exercise of their constitutional powers as justification for invoking the national concern doctrine and stripping away those powers. In other words, because the federal government believes a province's failure to act would not ensure the overall efficacy of the federal government's policy choice, the jurisdiction of all the provinces should be overridden. This cannot be…
>
> [313] We must say something about the implicit criticism that Alberta is producing a disproportionate share of industrial GHG emissions. This is undeniable – but hardly unexpected. Alberta, because of its oil and gas sector, has been one of the biggest drivers of the Canadian economy for decades. Were that not so, Alberta would not have been one of the largest financial contributors to the federal coffers throughout that entire time. Thus, it is disingenuous, not to mention unfair, to imply that, because Alberta continues to generate the wealth it does, Alberta cannot be counted on to regulate its own industries and do its part in reducing GHG emissions.
>
> [314] That said, the point is this. The fact one or more provinces produce disproportionately higher GHG emissions, and thus more potential for a negative impact on other provinces on this front, does not permit the federal government to deprive the provinces of their incontrovertible jurisdiction over their natural resources or other provincial powers. Under our federal system, what one province or the federal government does – or does not do – may well adversely affect another province socially, economically or environmentally.
>
> [315] Take for instance certain trade barriers that provinces have been effective in maintaining. To the detriment of other provinces. Or the fact oil is imported into some provinces from countries whose records are not as environmentally progressive as Canada's, enabling and enriching those other countries. To the disadvantage of more responsible oil-producing provinces. Or the fact some provinces export coal to other countries whose burning of that coal has a disproportionately negative impact on the world's atmosphere. To the detriment of non-coal exporting provinces. Or the fact that if one province does not have sufficiently stringent vaccination provisions in place, that can lead, in our mobile age, to germ breakouts elsewhere. To the detriment of other provinces. Hence, the mere fact something one province does might adversely affect another economically, socially or environmentally is not itself a basis for the federal government's taking over provincial jurisdiction under the national concern doctrine.
>
> [316] The bottom line is this. How the provinces exercise their jurisdiction to regulate GHG emissions is a policy question not a legal one. That policy question includes deciding how to balance environmental priorities with other provincial priorities. No government is in favour of pollution. Citizens of each province and territory elect their provincial or territorial governments knowing the platform on which each has run. If the federal government can successfully invoke the national concern doctrine because a province fails to see a policy issue the same way it does, then the federal government could effectively upend the election in any province or territory.
>
> [317] This would undermine democracy and federalism. As the Supreme Court said in Secession Reference at para 66: 'The relationship between democracy and federalism means, for example, that in Canada there may be different and equally legitimate majorities in different provinces and territories and at the federal level. No one majority is more or less 'legitimate' than the others as an expression of democratic opinion, although, of course, the consequences will vary with the subject matter. A federal system of government enables different provinces to pursue policies responsive to the particular concerns and interests of people in that province.'[35]

The Supreme Court may find a way to answer all of these points. Some of them savour as much of political as they do of jurisprudential argument. But that is the point. A successful carbon tax needs to find a way to reconcile divergent interests. The constitutional controversy that can arise in a federal system where some of the subnational governments are more or less strongly aligned with particular interests simply highlights this, not least because in such circumstances the risks of failing to achieve that reconciliation are magnified by the prospect of a successful legal challenge. Moreover, the existence of different carbon pricing regimes in different parts of a state may be expected to complicate the application of the international rules considered above to BCAs.

Keeping the regime on track while maintaining democratic legitimacy

The Canadian litigation touches on a key problem of any attempt to establish an ideal carbon tax regime. Carbon pricing policy has a naturally technocratic flavour, but ultimately, in a democratic system, any tax requires a measure of popular consent – and the newer and more visible to people in their daily lives a tax is, the more important it is to secure that consent. Whilst it may be possible to achieve this partly by means of carbon dividends, considered in the next section, one of the things that is striking about the case of Canada is that the constitutional and policy arguments around the 2018 Act have arisen notwithstanding the fact that

[35] *Reference re Greenhouse Gas Pollution Pricing Act*, 2020 ABCA 74 <https://www.canlii.org/en/ab/abca/doc/2020/2020abca74/2020abca74.pdf#page95>.

it allows provinces and territories the freedom to decide what to do with the net proceeds of the carbon pricing regime that it establishes (see s 165).

It is not only in Canada that governments have introduced carbon pricing measures, only to repeal or relax them later, typically after a change of administration. Similarly, more than one government has set out a trajectory for carbon pricing to increase over time, only to revisit its decision in the face of lobbying or political pressure in the form of popular protest. Yet every list of qualities that a good carbon pricing regime should have that we have ever seen includes stability and predictability.

Whilst there has been much talk recently about the possibility of using 'citizen assemblies' as part of the process of developing climate change mitigation policy on the path to net zero, we doubt whether they are the answer to this particular problem. The general arguments of principle against the use of such bodies in this area apply with particular force in relation to carbon pricing: a government that is not prepared to formulate its own detailed proposals for a carbon tax, or to stand behind them on the basis of its own judgment as it engages with a legislature about them, is probably not equipped, and is unlikely in fact, to meet a net zero target.[36] The same goes for a legislature that is not prepared to approve a long-term plan and provide it with whatever form of legislative entrenchment is constitutionally permissible or practicable in its jurisdiction. That is not to say, of course, that both government and legislature should not go to very much greater lengths than they might normally be expected to do to inform the public about carbon pricing proposals, and engage seriously with them on them. They certainly should, making use of every communications technology available.

Carbon dividends

Estimates of the level of carbon pricing required to meet the full social and environmental costs of GHG emissions vary: a recent survey found many expert estimates clustering in a range between $80/tCO2 and $300/tCO2.[37] At present, carbon pricing schemes that impose an average cost of $2/tCO2 on about 22 per cent of global GHG emissions raise a total of some $45 billion.[38]

A carbon tax regime that aimed for broader coverage and a level of carbon price that was even towards the lower end of expert estimates of the full cost of pollution would raise very significant amounts of money if adequately enforced. A government which introduced such a tax would therefore have to think carefully about what to do with the proceeds from it. Depending on a wide variety of circumstances, which will vary between jurisdictions, priorities may include the following:

- Avoidance of socially regressive effects. If all you want to do is avoid a carbon tax having socially regressive effects, you could link carbon dividends to income tax liability. For example, under current UK tax rules, people earning different levels of income pay anything from zero to between 19 and 46 per cent income tax on some or all of their earnings, depending on which income band they fall into. With carbon tax too, there could be zero, standard and higher rate bands based on ability to pay as revealed by income levels. Would there even need to be an explicit 'carbon dividend'? Would it not be simpler if those on the zero rate paid no carbon tax in the first place rather than paying and then receiving a rebate at a later date? It might be simpler, but there are two reasons not to take this approach. First, although it might work in a regime where all liability for the carbon tax fell on individual taxpayers, such a regime is unlikely in practice: as noted above, there are good reasons why some elements of a carbon tax should be imposed on businesses in the supply chain. Only a system of carbon dividends can readily alleviate the impact on individual consumers of the higher prices that they pay for higher carbon goods as a result of the tax being levied before the goods that are subject to it reach the end consumer. Second, the greater complexity involved in consumers paying the tax (or having it passed on to them) and then receiving a dividend (rather than paying less or nothing in the first place) has other justifications. Even if the tax is applied on supply to the end consumer, the consumer's entitlement not to pay the tax may not be clear at the time of each purchase in many cases (eg if they are self-employed or it is otherwise not known until the end of the tax year into which income tax band they fall). Moreover, in policy terms, a 'pay as you consume' approach to the tax – even if only on a 'temporary' basis because consumers/taxpayers anticipate a subsequent repayment of the tax by way of carbon dividend – may help raise consumers' awareness of the carbon consequences of their activities, and prompt some form of behavioural change for the better, such as reduced consumption. Finally, the priority of avoiding socially regressive effects is not just about preventing new regressive effects: there may also be the opportunity to correct the regressive impacts of some existing climate-related policies.[39]
- Dodging the rebound. The risk is that in ensuring that the tax does not increase economic deprivation, you also decrease its effectiveness. The problem with any regime that involves simply recycling some or all of the cash proceeds of the tax

[36] Helm (n 3) pp 109–11.

[37] R Pindyck, 'The social cost of carbon revisited' (2019) 94 Journal of Environmental Economics and Management 140 <http://web.mit.edu/rpindyck/www/Papers/SCCRevisitedJEEM2019.pdf>. Note that carbon prices are generally thought of as increasing over time. Among the conclusions of the report of the commission chaired by Stiglitz and Stern (n 12) was: 'the explicit carbon-price level consistent with achieving the Paris temperature target is at least US$40–80/tCO2 by 2020 and US$50–100/tCO2 by 2030, provided a supportive policy environment is in place.'

[38] World Bank Group, *State and Trends of Carbon Pricing 2020* (2020) <https://openknowledge.worldbank.org/bitstream/handle/10986/33809/9781464815867.pdf?sequence=4&isAllowed=y>; I Parry, 'Putting a price on pollution' (2019) 56(4) Finance and Development 16 <https://www.imf.org/external/pubs/ft/fandd/2019/12/pdf/the-case-for-carbon-taxation-and-putting-a-price-on-pollution-parry.pdf>.

[39] For example, in the UK, the default policy approach has been to fund a range of electricity market interventions, many of them related in one way or another to climate policy (including Feed-in Tariffs, Contracts for Difference and the Capacity Market) by means of a levy on licensed electricity supplier. The costs of paying the levies are assumed to be passed on to all customers in proportion to their consumption. The effect is that consumers fund these schemes in proportion to their consumption (which from a climate policy point of view is correct), but this takes no account of their relative abilities to pay. This is problematic, particularly when many poorer customers also live in less energy efficient homes, and therefore have higher energy demands.

back to some or all taxpayers is that in one way or another they use their carbon dividend to buy themselves the right to create more pollution. But making the payment of carbon dividends conditional on lower-carbon behaviour, as well as being politically contentious (in a sense this would be the counterpart, at the level of individual property and liberties, of the 'interference with sovereign rights' problem noted earlier), could be quite inefficient if people consume more overall in order to balance consumption of higher- and lower-carbon products ('tax on a packet of two beef burgers rebated if you also buy two plant burgers or an artificial meat burger'?). Careful implementation, and systematic avoidance of unintended consequences, are crucial.

- Enabling taxpayers to make low-carbon choices. If a carbon tax is to prompt people to make different choices, it will only work if those choices are economically feasible for them. It may take more than repayment of an individual's personal carbon tax liability to achieve this. So, for example, a massive increase in fuel duty should encourage people to switch to electric vehicles, but if somebody with a low income and no savings lives in a rural area and depends on a car to get to work, they may be unable to respond to this incentive as desired. However, some or all of the proceeds of the increased fuel duty could be set aside to make generous grants or loans to people in this position, enabling them to purchase an EV. This may be better than simply paying back to someone in this position the same amount as they spend extra each year on fuel as a result of the increase in duty, and leaving it up to more affluent motorists to respond to the carbon pricing signal and drive the switch to EVs – although that would be administratively simpler. A similar approach could be applied in other areas where taking the low-carbon option has an up-front cost that deters consumers.[40] Something similar would happen with businesses liable to pay the carbon tax. If a steelworks operating with conventional high-carbon technology is priced out of the market by the tax (notwithstanding the operation of the BCA), it should either exit the market, or be supported by grants or loans to upgrade to lower-carbon technology, becoming both environmentally and financially sustainable in the longer term: it should not carry on using the old technology, being kept afloat as a result of having been paid to pollute through carbon dividends.
- Payment into a decarbonisation fund. Some of the proceeds of a carbon tax could be put into a dedicated net zero investments fund. There is no shortage of promising technologies with the potential to contribute to the mitigation of climate change that lack access to development capital. A fund could also be used to provide a development bank-type service to decarbonisation projects in other countries, perhaps particularly developing economies disadvantaged by BCA arrangements. Such projects could be anything from reforestation to reducing power or oil and gas sector emissions. This would be very much in keeping with the UNFCCC idea of CBDR, and related human rights-based concepts discussed above, but could potentially be more flexible, and have a wider impact, than existing UNFCCC mechanisms such as the Clean Development Mechanism (CDM). The fund's purposes need not be limited to climate change mitigation projects: it may also be appropriate for the proceeds of a carbon tax to be invested in adapting to climate change, or in making good climate-related loss and damage that has arisen from climate change.[41]
- Reducing the burden of other forms of taxation. Governments are never short of things to spend money on, and the list continues to grow, for the most part. However, even if the total tax burden remains constant or shrinks, there may be reasons to raise more or less of it from different sources or by different methods. Such considerations are beyond our scope here.

Big oil and big data

If the oil and gas sector does not shrink, we will not achieve net zero. Over time, those active in the sector face two alternatives: diversification, or sticking with what they know but doing it more efficiently than others. Efficiency is also necessary to counteract decline, by some measures, in the sector's energy return on investment;[42] to contend with the possible fallout from climate change litigation;[43] and to avoid being priced out of the market by lower-carbon alternatives that are cheaper and more effective substitutes for what it offers than are currently available. Moreover, if the industry saves costs, it will become less risky, and it will be more able to invest in areas where its expertise can give it a longer-term future like carbon capture and storage.

Data and digitalisation lie at the heart of industry efforts to improve efficiency.

- Oil companies and others in the sector have a keen interest in the potential to harness distributed ledger technology (DLT) and smart contracts because they have the potential to save them huge amounts of money.[44] Using DLT and smart contracts could reduce the costs and cost overruns of building new infrastructure – some would argue by up to 50%. Physical oil and petroleum product trading can also be

[40] For example, in the case of domestic heating, you could accelerate the switch to heat pumps by taxing natural gas supplied to domestic customers more heavily, and seek to stagger the increases so as to match the pace of the infrastructure changes required to enable the electricity grid to cope with the significant increases in peak time load that would come with mass electrification of heating. Some of the tax proceeds would fund more generous grants or loans to consumers to make the up-front cost of heat pumps more palatable.

[41] On the importance of addressing climate-related loss and damage, see CSO Equity Review, 'Can Climate Change Fuelled Loss and Damage Ever be Fair?' (2019) <http://civilsocietyreview.org/report2019/?_sm_au_=iMV06K0NkWbRR6TKQcLJjKQ1j7GJ1>.

[42] P Brockway, A Owen, L Brand-Correa, L Hardt, 'Estimation of global final stage energy-return-on-investment for fossil fuels with comparison to renewable energy sources' (2019) 4 Nature Energy 612.

[43] D Drugmand, 'Fossil Fuel Companies Begin to Acknowledge Climate Litigation Threatens Their Bottom Line' (2019) <https://www.climateliabilitynews.org/2019/12/23/climate-litigation-threat-financial-filings/>.

[44] For a general survey of distributed ledger technology and its potential applications in the energy sector, see Dentons, *Blockchain in the Energy Sector* (2018) <https://www.dentons.com/en/insights/guides-reports-and-whitepapers/2018/october/1/global-energy-game-changers-block-chain-in-the-energy-sector>.

made much more efficient by replacing the old paper-based trade finance system with a distributed ledger.[45]

- By exploiting existing sub-surface data, upstream players can make the exploration process less hit-and-miss by identifying good prospects and likely dry holes before drilling. The UK Oil and Gas Authority has released 130 terabytes of data about the North Sea; they think that making good use of this data could reduce exploration costs by 20%.[46]
- There is potential to make upstream facilities operate more efficiently by making better use of all the data they gather. Wood Mackenzie estimate that US shale producers could reduce operating expenses by 10% and add $25 billion of value by putting mature wells on smart production management systems.[47]

What does any of this have to do with carbon taxes? First, it illustrates the potential for the fossil fuel industry to use technology to respond to pressure on costs. Many of the cost-saving innovations of recent years began as responses to periods of 'lower for longer' global oil prices. Responding to a severe fall in commodity prices is not that different from responding to an increase in carbon tax. Second, the extent to which an entire industry of such size and global scale can become so deeply digitalised is suggestive of the role that technology could play in implementing a carbon tax.

It is now not too far-fetched to imagine raw materials having their emissions associated with their extraction and manufactured materials and components having their carbon footprints tagged to them as they enter the supply chain, enabling carbon taxes to be applied in a very precise way, particularly in the context of BCAs. For legislative purposes, you might decide that the average emissions associated with the production of a tonne of cement in Country X are 0.5tCO2, and set the BCA accordingly. An importer purchasing cement from a producer in Country X that can show its emissions are only 0.4tCO2 should be entitled to a rebate on the BCA, just as a domestic producer can reduce its carbon tax liability by improving the emissions performance of its processes so as to record a smaller amount of emissions per tonne produced (assuming that the tax is levied on manufacturers on the basis of actual emissions). This is not only fair, it provides an incentive to decarbonise.

To deliver the best results, an ideal carbon tax such as we have been discussing needs to be very granular. That means handling a lot of data, and mining that data for insights – for example, about how particular applications of the tax affect the behaviour of particular groups or economic sectors. It will need to store a vast amount of data, particularly if the tax operates in a way that needs to take account of the economic activity of individuals (and potentially also their status under other tax regimes, as noted above). Suppose somebody receives a carbon dividend in error. Suppose you want to allow people to borrow against their future carbon dividends to invest in making their homes more energy efficient. You may want to track supply chain emissions, as noted above. If you fund a reforestation project with the tax proceeds, you want to keep track of each tree – just as, in monitoring the carbon footprints of agricultural products, you will want to take account of how much or how little fertiliser (which can have a very high carbon footprint) and diesel the farmer has used.

Very soon, you may be looking at information flows that are too numerous and diverse to be managed by a central counterparty. This points to a system that can facilitate large numbers of transactions automatically, within set parameters – in other words, smart contracts.[48] That system must be very secure and capable of encouraging parties who do not have direct contact with each other to trust each other. Above all, you need a system that records, in immutable form, every transaction that is made within it. This sounds like a job for some kind of DLT.[49] It goes without saying that a key part of establishing such a system would be not only to ensure its legal compliance with data privacy rules, but to win popular support by convincing taxpayers both that their data would be secure, and that they would be receiving a benefit in return for giving the system control over it.[50]

No jurisdiction in the world has yet implemented the ideal version of a carbon tax. But if and when they do, it should arguably be a data-rich, deeply digitalised, regime that can be integrated with smartphones and the internet of things, and be capable of: tracking individual products through the supply chain; distinguishing between hydrocarbons from different sources on the basis of the emissions intensity of the processes by which they have been extracted, transported and refined; and managing in a seamless and user-friendly way huge amounts of data and the countless interfaces between the carbon tax system and everyday life and commercial activity.[51]

[45] See Dentons (n 45); Gazprom, 'Gazprom Neft and S7 Airlines become the first companies in Russia to move to blockchain technology in aviation refuelling' (2018) <https://www.gazprom-neft.com/press-center/news/gazprom-neft-and-s7-airlines-become-the-first-companies-in-russia-to-move-to-blockchain-technology-i/>.

[46] See Oil and Gas Authority, 'The Oil and Gas Authority launches one of the largest ever public data releases' (2019) <https://www.ogauthority.co.uk/news-publications/news/2019/the-oil-and-gas-authority-launches-one-of-the-largest-ever-public-data-releases/>.

[47] See Woodmac, 'How digitalisation transformed the US Lower 48' (2018) <https://www.woodmac.com/press-releases/digitalisation-in-us-lower-48/>.

[48] For a summary description and legal analysis of smart contracts, see LawTech Delivery Panel, *Legal statement on cryptoassets and smart contracts* (2019), particularly pp 31–34 <https://technation.io/news/uk-takes-significant-step-in-legal-certainty-for-smart-contracts-and-cryptocurrencies/>.

[49] It is important, given the hype around DLT, not to jump to the conclusion that DLT, rather than other forms of database technology, is the ideal solution to any complex digitalisation problem (see Dentons (n 45)). It is sometimes objected that DLT is inherently wasteful of energy: however, this is a criticism based on the fact that the original application of DLT, as the operating system for the cryptocurrency Bitcoin, relies on brute computing power in a way that is not inevitable and is not found in some more recent versions of DLT technology, since there are other, less energy intensive ways of achieving the necessary element of consensus than the 'proof of work' approach. See J Sedlmeir, H Buhl, G Fridgen and others, 'The Energy Consumption of Blockchain Technology: Beyond Myth' (2020) Business and Information Systems Engineering <https://link.springer.com/article/10.1007/s12599-020-00656-x>.

[50] For example, if adopting lower-carbon behaviours were to reduce the taxpayer's liability for carbon (or other) taxes, there would be an incentive to provide access to the data that showed that the conditions for such a reduction had been met in a given case.

[51] There may be few governments that would be capable of building such a system without contracting it out to one of the global Tech Giants – which may give rise to further political concerns.

Not a silver bullet – but well worth trying

Not even a perfect carbon tax can solve all the problems of man-made climate change. There will still be plenty of tough policy judgments to make, and other areas of regulation required. However, as well as creating a useful pot of money to fund other interventions, a carbon tax along the lines we have been discussing can make three distinctive contributions:

- It would provide a very effective framework for incentivising capitalism to do the things that it does best (like finding cheaper and therefore more profitable ways to satisfy demand), whilst controlling some of its natural drawbacks (not pricing in externalities like CO2 emissions).
- It could be deployed in such a way as to engage consumers and offer them powerful incentives to change their behaviour – overcoming the inertia of those who would like to 'do their bit' but are unable or unwilling to act on their good intentions – and provide a hard cash answer to those whose initial reaction may be 'why should I care?'.
- Rightly calibrated, it could promote equity both domestically and at an international level, easing, even if pursued on a unilateral basis, some of the tensions between countries that have hampered efforts to coordinate global action on climate change.

As we have seen, there are a lot of issues to grapple with in building such a system: legal, practical, even philosophical (when it comes to interference with property rights and individual liberty). But it seems worth trying. Although there may be strong arguments against increasing tax burdens in the context of COVID-19 and its economic aftermath, a time when people have already had to make all sorts of adjustments to their normal habits and when there is a feeling that government should take radical actions to 'build back better' may not be a bad moment to introduce a new kind of carbon tax.

This article originated in an invitation to present on the role of digitalisation in resolving the perceived conflict between carbon neutrality and economic interests.[52] Think of the journey towards net zero as leading from the summit of one mountain (the high-carbon economy) to the adjacent peak of a decarbonised, net zero economy. The risk is that we have to go all the way down the first mountain and up the second, off-road, in a vehicle with square wheels – an itinerary that is likely to result in a number of casualties. The hope is that policy instruments like a carbon tax can give us round wheels and a smoothly winding road – possibly even providing a bridge between the mountains so we do not have to go all the way down and up – to bring us to our destination more quickly, and in one piece.

At the time of writing, the UK, uncertain of whether it will be able to link the new emissions trading system for which it has prepared legislation in the context of its departure from the EU to the EU Emissions Trading System (ETS), is keeping open the option of bringing a new carbon emissions tax (CET) into force.[53] The CET appears to aim only to cover the same ground as the EU ETS, but – whether the UK ETS or the CET is chosen – there would be room to do more in other areas. As the UK government aspires to maintain a position of leadership on climate issues in the (COVID-extended) period of its presidency of UNFCC COP 26, it is to be hoped that there may be some fresh UK policy thinking on this subject.

Biography

Adam Brown has worked on energy regulation at Dentons since 2013. He focuses particularly on the interaction between regulatory frameworks and the new technologies and business models required to drive energy transition and move to a net zero economy. Alongside carbon pricing, his other current interests include floating offshore wind, business models for scaling up renewable energy and low carbon hydrogen production, carbon capture and storage, distributed ledger technology, and energy as a service. A former UK government legal and policy official, Adam has helped to design regulation and draft legislation in the energy sector and other areas, including environmental protection, infrastructure planning and competition law, at both UK and EU level.

[52] The author is extremely grateful to the World Energy Council (Austria) and the Organisation for Security and Co-operation in Europe for the chance to speak on the subject of 'carbon neutrality versus economic interests' at the 2nd Vienna Energy Strategy Dialogue in November 2019 (which was themed around 'The Impact of Big Data in Energy, Security and Society'). This article has in part grown out of preparation for that presentation.

[53] HM Government, *Carbon Emissions Tax* (2020) <https://www.gov.uk/government/consultations/carbon-emissions-tax>; the Greenhouse Gas Emissions Trading Scheme Order 2020 (draft statutory instrument: not yet made as at 23 September 2020) <https://www.legislation.gov.uk/ukdsi/2020/9780348209761/contents>; HM Government and others, *The future of UK carbon pricing* (2020) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/889037/Government_Response_to_Consultation_on_Future_of_UK_Carbon_Pricing.pdf>.

The fifth Clifford Chance Annual Lecture.

Delivered by The Right Honourable Claire O'Neill and introduced by James Pay

Claire O'Neill

James Pay

The Annual Lecture is one of the key dates in the Energy Law calendar for energy law academics, practitioners and policy-makers in the UK and internationally. This year the lecture was given by Claire O'Neill, Managing Director Climate and Energy at the World Business Council for Sustainable Development.

Introduction by James Pay, Global Head of renewables Clifford Chance LLP

"Welcome everyone here to Clifford Chance this evening. Clifford Chance is absolutely delighted to be able to continue our association with the Institute. This is a very important event for us, and we really value the participation of everyone from the Institute and everyone who has come here this evening. But we have particular pleasure in inviting the Right Honourable Claire O'Neill to be our special guest speaker this evening. Being the Head of our Global Renewables practice, the subject for this evening, the climate change challenges that lie ahead of us, are particularly close to my heart and take up an awful lot of my time. Claire's interest in this particular issue is deep and long standing. She was MP for Devizes from 2010 until the last election, when she stood down, and in that time, she was minister of various departments including Minister for Rail, Minister for Climate Change, and Cabinet Minister for Energy and Clean Growth. In those capacities, she had an instrumental role in shaping legislation to commit the UK to net-zero CO2 emissions by 2050.

She also played a key role in launching the Power Past Coal Alliance, and I note that the UK is committed to no more unabated coal power generation by 2025. She had a key role in negotiations around the level of subsidies in the offshore wind sector, which has delivered the benefits of lower costs to the consumer. And of course, she was responsible for formulating the UK's bid in relation to hosting COP26. Claire remains focused on incentives and investments that are needed to decarbonise the hardest to reach sectors in the global economy. To do so will undoubtedly require a combination of intergovernmental policies, perhaps particularly around carbon trading, something that COP25 noticeably failed to deliver. It will also require changes in behaviour by each of us in the years ahead, and some of those will be pretty

fundamental. I understand Claire is currently writing a book, which I think is provisionally entitled *Cracking the Keeling Curve: Who Leads the Low Carbon Fightback?* Hopefully, Claire will tell us about the arguments that she's going to promote in that book, but for now, without further ado, let me welcome Claire to the Annual CCLS Energy Law Institute Clifford Chance Lecture."

Claire O'Neill lecture

"Thank you for this fantastic opportunity to be here at this wonderful annual lecture. It's really great to actually lift my gaze from the political world and to be here after what has been a very interesting day, rounding off a couple of interesting weeks. I'm sure in the 12-step programme for recovering politicians, it is absolutely forbidden to pay close attention to the reshuffle, but I'm going to have to tell my recovery buddy that I'm afraid I broke that rule today. I did spend a fair amount of time watching what was happening, partly because I did want to see who was going to be my successor. Alok Sharma will be a good man in the job and I've offered him every assistance; anything I can do to help make this really important event a massive success.

What was compelling for me today was actually what was not featured – a plan for climate action, rather than a plan to stay in power.

I think that, in a nutshell, encapsulates the challenge that we face currently with this monumental task of climate recovery. We have been very focused on the role of governments taking this leadership position, being part of these international negotiations, really setting the pace. And we look to governments to come together to solve the problem and to be the first movers in action. But governments, I'm here to tell you, will only look first to what they need to do to survive, and then perhaps raise their eyes to the broader, global challenges. I think that means for those of us, or those of you who are in the corporate or financial or service sectors role, who say 'well, we will act after governments legislate' are actually missing a really vital point, which is: it's not either legislation or action, it's both legislation and action that have to come together. I call it 'everybody in'. This is not a sort of 'who goes first' polite circle, it is all of us working together – not arguing about who goes first, not arguing for a need for us all to advance in lockstep, which is what you hear from particular industry sectors, but being courageous enough to break out of this circle, to actually change the shape, and to set your own tough, binding targets and then figure out how to get there. So what I hope to do in this short set of remarks tonight is to persuade this audience to think really hard about what role you and your organisations can play; what targets you can set and would agree to be bound by, and how we come together to face this challenge of climate recovery.

The first bit of context – I'm going to introduce you to a couple of important Ks tonight. First, the Karmen line. The Karmen line marks the boundary of our planet's atmosphere, upon which all the gases on which our lives depend essentially peter out into space. It's only 60 miles up. So if I drove home to Cambridge tonight, in an electric vehicle of course as you'd expect, if instead of driving up the M1 I just went straight up, before I got home I'd be done with the atmosphere. It is incredible to think that we've been conducting an uncontrolled chemical experiment on this tissue-thin layer of gases since the start of the industrial revolution, and that the impacts of that experiment are now both being felt and are accelerating.

That brings me to my second K: the Keeling Curve. The Keeling Curve is the daily plot of atmospheric carbon dioxide levels in parts per million taken from the top of Mauna Loa volcano in Hawaii. As of this Monday, the reading stood at 450.35ppm – the highest level ever known in human history. And that curve has been plotted since about 1958 but of course we now have excellent ice core data that can take our view into history much further back, up to 3 million years further back. Ice cores indicate that the last time CO2 levels were this high, sea levels were 20 metres higher than today and beech trees were growing on the South Pole. That is at today's CO2 levels, not at the levels we are expecting before we get to grips with our net zero ambition. I know you will have heard the predictions of economic and societal damage that will happen if we don't act quickly, but of course what we don't know is some of these feedback effects that are in there.

People talk a lot about the science, you know, follow the science and we're all predicting gloom and doom. But if anyone is remotely interested in what David Attenborough says and does, just listen to what he says might happen in Antarctica if the Thwaites Glacier, which holds most of the fresh water on that continent, should melt, and understand why we're spending £50 million pounds on a joint research project with the US, trying to understand those glacial dynamics. This is not long-tail impacts that might happen over the next 200 years, this is impacts that could happen within five years and materially change the way that we live our lives. And of course only two years ago we had the very stark warning in the form of the IPCC report that set out quite clearly, in a very well meta-analysed, peer-reviewed way, what would happen at 1.5°C versus 2°C warming, and basically told us if we wanted to hold to a 1.5°C world, we needed to get to net zero emissions by 2050, and if we wanted to hold to a 2°C world, we maybe had 10 or 20 years of wiggle room.

These are not new warnings and concerns, although the scientific base on which we are talking about them has radically improved. It was these threats, if you like, these impacts that first brought the world together at the Rio Earth Summit in 1992 to thrash out the basis of what was hoped to be a global framework and a global action plan. Since then we've had 23 years of annual global climate summits before the Paris Agreement in 2015 finally created, for the first time since Rio, a universally supported global framework. But in order to achieve unanimity, of course, you will know as lawyers, you often have to compromise to the lowest common denominator. And it is the case that the 'obligations' put on the world in order to sign up to Paris were the softest possible targets.

And so, five years on, we are hosting another summit, the 2020 Conference of the Parties (COP26). People have been saying this process is fundamentally flawed. These government-to-government negotiations are really not achieving much. And if you looked at the data you might think that was true. Since Rio, almost 50% of cumulative greenhouse gas emissions have occurred. So, since we started talking about this in a global format, almost half of what has been emitted has actually happened. So when people talk about the historical relevance

of the industrial revolution, we think about us as being a part of this, because we were a coal-burning economy, but actually the real growth rate has happened in the last 25 to 30 years as the world has seen this massive uplift in economic growth. In the last decade, the annual rate of increase was 60% higher than it was in the 1990s. Whilst Paris was a brilliant diplomatic triumph, an enormous, enormous, achievement, the condition to sign up to Paris was very soft. It was essentially a nationally determined contribution, saying to countries, 'You tell us how you're going to get there, and these will not be mandatory, there is no legal framework upon which we can hold you to these challenges.' Countries have delivered – some countries have delivered a lot, some countries not so much. But if you add up these nationally determined contributions, they put us on track for a 2.8–3.2°C world. And despite the strong evidence now of net zero as the landing zone, only 65 countries out of 197, plus the EU, have net zero ambitions, and only 14 of those have translated them into what you might call a whole of economy set of policies.

Now, I was very pleased in the UK to be the minister that brought forward the net zero legislation for the UK economy. We were the first industrialised major economy to make the commitment that we will be net zero by 2050 in law. I mean followed, it is fair to say, by France 24 hours later, but history of course only remembers the winners!

So, it's not surprising that some actually say 'we're a little bit better off because of this international diplomacy', the evidence is hard to find. Now, I actually don't subscribe to that view. I think it's worth remembering that the Earth Summit that started all of this was the product of two years' worth of diplomatic work drafting treaties intended to safeguard the Earth's biodiversity and climate; the first time those two really important things had been put together. And it was very much informed by the structure and success of the Montreal Protocol, which you will know did successfully create a global consensus and action plan for the phase-out of ozone-damaging CFCs. But the Rio summit floundered on the basic divide over who should go first, and who should pay what. And this is a thing called the Common but Differentiated Responsibilities Principle, which has bedevilled every event since then.

There were other successes. International processes were created that encouraged investment in climate science. Indeed the IPCC reports, which have informed every climate summit, were a product of the first Rio summit. Governments began thinking about adaptation, always a problem. We talk a lot about mitigation, but what about adaptation? What's required? For the first time that was dobbed in as a major global problem and there were initially attempts made to stop tropical deforestation and start thinking about carbon markets.

And while the Paris Agreement, by its own terms, did not impose enforceable limits on member countries' actual emissions, it did make possible what I think is a really powerful new tool in the climate recovery armoury – and this is perhaps why many of you are here – which is a legal action against governments with claims that can now be framed against that context of Paris. For the first time it gave lawyers the benchmark to test, to test against what was actually being delivered. And that framework is increasingly being used in climate change lawsuits. I checked today, you will probably know more than me, but I understand there are now lawsuits brought against governments in at least 28 countries around the world, and increasingly against high-emitting companies too. But we're not going to legislate our way out of this, although there are some that say 'This is what delivered the turning point for big tobacco.' So, having some landmark decisions may well move, particularly some of the highest-emitting companies, forward faster.

But what else do we need to do? I wanted to bring it back to today. This is the so-called super year of climate action, this year. 2020 is the year when the Paris Agreement is supposed to be brought to life, it's when countries are being asked to set out their next phase of their non-binding ambition. We have a biodiversity global conference going on as well, and this is the year where the Sustainable Development Goals are to be refreshed for the first time.

So, what is the outlook? Well, in a world with multilateralism fraying around the edges, and with populist governments on the rise, global frameworks are not exactly the flavour of the month. And the decades of negotiations that I referenced around the various frameworks have essentially just repeated again and again like a sort of global Groundhog Day. Many of the same arguments. Who goes first? How much do developing countries cut versus developed countries? Who pays? Who pays, both in the sense of is it consumers, taxpayers, or shareholders, and who actually pays in terms of flows of international development finance? What's the target? Net zero is a really helpful policy target. It was so much easier in government once we had the net zero target because everything had to be put through the framework of 'Can emissions get to zero, or can you credibly offset those emissions?'

Many countries find net zero a problem. They want to express their targets in terms of carbon intensity. They argue that they have a development right to achieve at least the energy standards, or energy consumption, that the Western world did and that's how they want to express their way forward. I mentioned adaptation. Interestingly the Prime Minister of the Maldives conducted a cabinet meeting in a Perspex cube with three feet of water outside, basically demonstrating very starkly what will happen to many of the small island states should we fail to deal with the climate change problem. But of course, the question is: what are you going to do to help us adapt to this existential challenge in many cases? What about the workers? What does a just transition, words you will hear very often, what does that look like?

I sat in the Madrid conference centre in the negotiations. Often you're steered away from the negotiations as a minister, but as the president I said I could sit in. I was ashamed, you know, I was ashamed that the world had come together, and we had half a million climate strikers outside and so much of the plenary of the conversation is steeped in ritual. So, in one hour session we were talking about markets, carbon markets. We spent a third of that session arguing about whether the meeting we were in should be termed an 'informal' or an informal 'informal'.

Every year when we discuss global finance one of the world's richest oil-producing countries stands up and says that it

should be compensated for all this 'green crap', effectively, that the world is doing, that is destroying its economy. This is not what the climate protesters or the world who are watching expects to see. And that was why I was determined to deliver a very different sort of COP, one that I hope will continue to be delivered. Because there is something on the rise that I think starts to change this very negative zero-sum game that is being negotiated. And that is that the conversation should not just be about the cost of decarbonisation, it should be about the opportunity from moving to that low-carbon economy. The opportunity to spur on economic growth, the opportunity to create jobs. One estimate says that India could have five times as many people working in its solar industry by 2040 than there are working today in the fossil fuel generation industry.

The opportunity is to transform communities. Has anyone been to Grimsby recently? You must go to Grimsby immediately and you will see the future, because Grimsby and Great Yarmouth and Lowestoft and Hull are being utterly transformed by the UK finally figuring out how to produce offshore wind energy at a cost below that of fossil fuel energy. It is utterly transformational for those towns. And essentially what we should be looking for is investment all the way up the east coast, because we could fill our boots, and most of Europe's boots, with offshore wind energy from the North Sea. It's a wonderful, wonderful asset.

The opportunity to provide products and services to consumers who increasingly rank sustainability as one of their top priorities, although it's not yet clear how much they will pay for it. Indeed, in Davos, Kristalina Georgieva, who is the new managing director of the IMF, said that low-carbon growth could be the silver growth bullet that the world is looking for. And the good news is, you know, we don't just have to persuade governments of this. The private sector, always with a nose for opportunity – and it's fair to say, I think, a rapidly changing appetite for climate risk exposure amongst its lenders and investors – I think is leading the charge currently on decarbonisation.

BP, for example, has set out a plan. They don't know how to get there, but what they've set out is the plan and the governance structure and some of the capital they'll need. They could be a little more ambitious. UK companies like Sainsbury's, who I was with a couple of weeks ago, again have set out net zero plans by 2040 and have said, 'We know how to get 40% of the way there, but what we're going to do is spend 10% of our Capex and have this governance structure and we will get there.' Microsoft have said that they will not just be carbon neutral but will be carbon negative by 2030 and want to offset every molecule of CO2 that they have ever emitted since formation. There are bold, ambitious and transparent decarbonisation plans in every single sector and the good news is that that boldness, I think, is pulling up ambition in local governments, in cities and states and in national governments too.

So, the challenge will be how we bring together this ambition and dock it into the annual climate jamboree, the only time the world comes together to focus on this enormous challenge. If we do it right, we won't just be talking to ourselves in little break out rooms all around the conferences, we'll actually be working out how we cross borders – policy borders, joint technology innovation, shared capital funding. For example, how do we phase out coal? The reason Germany has committed to phase out coal by 2038 and joined the Powering Past Coal Alliance is they have done a massive great economic bung to East Germany. And we're going to have to find similar ways of paying for this transition in Poland, in South Africa, in Indonesia, in coal-rich countries around the world.

So COP26 should not just be a sort of, you know, zero-sum game of negotiations, it should be the one, big, exciting annual moment for climate recovery plans with everyone involved: governments, cities, states, corporates, the financial services sector, citizens, families and individuals; negotiations that are framed by the opportunities available and that work out how we blend together the solutions that we need. It is not like the CFC negotiations were, where it was a relatively easy set of solutions; it is far more complicated. But I fervently believe that with everybody in, we can start this process of climate recovery and can in the process move from a narrative that at times can feel despairing to one of hope and opportunity and employment and transition. And we can seize those growth opportunities from the biggest transition, the biggest economic transition, we will ever see.

So, I started my remarks tonight with a call for governments to set out their plans for climate action, and hopefully have shown that for rapid progress, we will all need to be thinking about those plans and working together. We can come together and challenge ourselves and challenge each other and commit to rapid climate recovery. So, my final question to you tonight, before you ask questions of me, is please leave here and think about what is your plan? Thank you."

Biography

The Right Honourable Claire O'Neill is a British businesswoman and former Conservative Party politician who is the managing director for climate and energy at the World Business Council for Sustainable Development. She was Member of Parliament (MP) for Devizes from 2010 to 2019, and served as Minister of State for Energy and Clean Growth from 2017 to 2019 with right to attend Cabinet after January 2018.

Book review.

Professor Stephen Tromans QC reviews *The rule of five: Making climate history at the Supreme Court* by Richard J. Lazarus

Professor Stephen Tromans QC

Both the title of this book, published this year, and its subject matter are particularly poignant at the time of writing this review. We have become all too familiar with the 'Rule of Six' and prior to his hospitalisation for COVID-19 (having plainly not observed any 'Rule of Six'), President Trump has ignited controversy with his nomination of Judge Amy Coney Barrett to the Supreme Court – a procedure now itself thrown into doubt by the President's diagnosis and that of two Republican members of the Judiciary Committee of the Senate, according to the New York Times of 2 October 2020.

The title of course refers to the majority for decisions of the nine-judge US Supreme Court and the book chronicles, in engrossing detail, the events that led to the 5–4 majority decision of the Court on 2 April 2007 in the most important case on environmental law yet decided by that Court, *Massachusetts v United States Environmental Protection Agency*. The book is fascinating and important at a number of levels. I discuss three.

First, it provides a unique insight into the workings of the US Supreme Court. Professor Lazarus teaches courses on environmental law and Supreme Court decision-making at Harvard University. Before that he acted in over 40 cases in the Supreme Court, and advanced oral argument in 14. He is therefore able to bring a wealth of detail and experience, which makes the book a treasure house for lawyers interested in the complex dynamics of Supreme Court litigation, the pitfalls of presentation of time-constrained oral argument to the Court, and the decision-making processes of the Justices. Compared with the UK Supreme Court, where there is so much more stress on oral argument, presented at some length, the US system makes the maximum of thirty minutes allotted to each advocate a high stakes exercise – each minute and each sentence has to count. It is worth saying, however, that presenting argument to the UK Supreme Court is equally nail-biting: it is quite possible to lose a case in a two minute exchange. Both courts are characterised by judicial questioning, which can be both helpful and destructive. In the Massachusetts case, Jim Milkey, presenting the case for the plaintiffs, faced 23 questions from sceptical and hostile Justice Antonin Scalia, each one a potentially lethal hand grenade. No less exciting is the account of the later decision-making conference of the Justices, resulting in the 5–4 majority in favour of the plaintiffs. Irrespective of the environmental subject matter of the case, the book is worth reading from that perspective alone.

Second, the book provides a salutary account of the difficulties of getting complex and controversial environmental litigation off the ground. The case was initiated by Joe Mendelson, a public interest attorney with a very small, shoestring environmental organisation. Aggrieved by the failure of the Clinton Administration to take effective action against emission of greenhouse gases from vehicles and power stations, he petitioned the US EPA to regulate carbon dioxide emissions from new cars and trucks under section 202 of the Clean Air Act, on the basis that climate change could 'reasonably be anticipated to endanger public health or welfare'. This was a step initially opposed by the giant environmental NGOs, Sierra Club and Natural Resources Defense Council, on the basis that a failure or political fallout would drastically set back their cause. They did eventually come on board, as did a number of states, including Massachusetts, with some 30 parties in all challenging EPA's denial of Mendelson's petition: the 'Carbon Dioxide Warriors' as they styled themselves. The account of the dynamics within

the US EPA is itself enlightening. Support of the big NGOs and states was a mixed blessing, leading to huge and brutal conflict over how the case should be presented on paper, who should deliver the oral argument, and how such argument should be presented strategically. It is really amazing in some respects that the case got off the ground at all.

Third, for students of environmental politics, the book is important too. When President Clinton was elected in 1992, his past record on environmental matters as Governor of Arkansas was abysmal on matters such as toxic waste, deforestation, agricultural pollution and chemicals regulation. Clinton chose Al Gore as his running mate to a large extent to boost his own environmental credentials, Gore having just written the 'definitive' book on climate change, *Earth in the Balance*. However, Gore's personal ambitions to become president in 2000 meant that he was unwilling to grasp the political nettle of climate change, fearful that strong views on the matter might harm him politically. Hopes were pinned on Carol Browner, Gore's protégée and Clinton's appointee as EPA Administrator, dubbed by Time magazine as 'the queen of clean air'. However, the victory of George W Bush in 2000 led to her successor, Christine Todd Whitman, being thwarted in her efforts to regulate carbon dioxide by machinations led by Vice President Dick Cheney, who persuaded Bush to sign a letter (without consulting either the EPA or Department of Justice) stating that carbon dioxide was not a 'pollutant' and that there was no power to regulate it as such under the Clean Air Act. This created the battle line that was fought over in Massachusetts v EPA.

Ultimately, while Supreme Courts can interpret the law, as they did in this case, power resides with the elected government. A decade after the Supreme Court decision, the election of President Donald Trump in 2016 presented a threat to environmental protection law, which, as Lazarus says (p. 286), is 'without modern historical parallel'. A massive deregulatory agenda followed, with anti-regulation and pro-coal and oil appointments to senior administrative posts, such as EPA Administrator and Energy Secretary. A wholesale cull of the previous administration's orders took place and the US notified withdrawal from the Paris Agreement on Climate Change. Appointments of right-leaning judges have been made to courts at all levels. All is possibly not yet lost, but things certainly would have looked bleak if Trump were re-elected.

Richard Lazarus's final assessment of the legacy of the case is that while the sort of transformative change that was sought by those bringing a case can begin in a courthouse, 'it never ends there' – 'every litigation victory is necessarily provisional'. Progress requires not just judicial votes 5–4, but political votes by individuals globally, to elect sufficiently forward-thinking and inspirational leaders willing to tackle climate change. The public's record on electing such leaders does not at present, unfortunately, inspire confidence.

Making climate history at the Supreme Court written by Richard J. Lazarus. The Belknap Press of Harvard University Press, Cambridge, Massachusetts and London, England, 2020.

Biography

Professor Stephen Tromans QC is a barrister specialising in energy and environmental law. He has worked in the field of nuclear energy since the early 1990s and is the author of the leading UK textbook on the subject. He is a member of the Government's advisory Committee on Radioactive Waste Management.

In conversation.

Professor Malik Dahlan talks to Dr Urban Rusnák

Professor Malik Dahlan

Dr Urban Rusnák

MD: You have had a varied, fascinating career during times of considerable change and challenges including – a diplomat during the Velvet Revolution and an ambassador to the Ukraine during the first Russia–Ukraine gas dispute, to name a couple. How have your past experiences helped inform your current work with the Energy Charter Treaty (ECT)?

UR: Indeed, in my professional career, I went through multiple positions and countries. I should correct you a bit, during the Velvet Revolution in Czecho-Slovakia I was still in my final year of the Moscow Oil & Gas Institute. I spent five years in the Soviet Union studying oil and gas geology. After a short stint as a researcher, I joined the Czecho-Slovak federal foreign service, as it turned out only seven months before the split of my country. During the first posting abroad, to the Slovak Embassy in Turkey, I was researching oil and gas geopolitics and wrote my doctoral thesis on Caspian pipelines. My earth sciences and energy background always provided a different angle to the problems of law and international politics. My personal life experiences from various countries with sometimes very different political systems also help to build and maintain relations with ECT contracting parties.

MD: The ECT has become an established multilateral investment treaty that has endured considerable change in the energy sector over its 25-year history. What would you attribute the success to?.

UR: In my view, the main reason for the ECT's success and to a certain extent the source of current problems is its self-implementation in investor-state disputes. While Contracting Parties focused their efforts for many years on negotiations and discussions on additional protocols or improvement of coverage, the investment protection part of the Treaty was used by investors as designed. And precisely when this success of the Treaty in the protection of energy investment hit some crucial states, their governments started to contemplate the usefulness of the Treaty. Russia and Italy decided to leave the Treaty; some others are promoting its modernization to strengthen the right to regulate and to address shortcomings. On top of this, there is a changing paradigm of climate emergency. To my surprise, those renewable investors who used the Energy Charter Treaty to protect their solar and wind farms in the past decade are absent from the public debate.

MD: And the next 25 years? Given the immense challenge of climate change, how will the ECT remain relevant? What steps is it taking to address the political and economic challenges of climate change?

UR I see the role of the ECT as a legal regime, enabling the controlled transition from the greenhouse gas emitting energy to the low-carbon, zero-carbon and carbon-negative energy systems. In such a process, the ECT can provide the necessary legal tools for balancing the legitimate rights of governments to regulate and the equally legitimate rights of private foreign investors to be treated fairly. The technological advancements that will make carbon-containing fuel more expensive to use may speed up the process faster than expected. So any phasing out of fossil fuels by regulatory means should be planned and implemented gradually, in consultation with the relevant stakeholders. In 2017, the Energy Charter Conference endorsed some best practices in regulatory reform that could minimize potential conflicts with foreign investors (CCDEC 2017 04).

MD: A core part of the ECT provisions stresses the concept of sovereignty over natural resources. Do you see changes being made to these provisions as the use of fossil fuels becomes increasingly undesirable?

UR: I don't see how the sovereignty over the natural resources could be shaken by the ECT modernization. Emphasizing the right of governments to regulate, which is already covered by the ECT, some negotiating proposals are seeking to

strengthen the sovereignty of the Host State in implementing public policy objectives. There are opinions that the UNFCCC Paris Agreement provides the obligation to limit fossil fuel investment protection. However, the Paris Agreement contains no commitment related to investments at all. Furthermore, it explicitly recognizes '… the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances'. In my view, the concept of sovereignty over natural resources was if anything, strengthened recently. Having said that, it is evident that some countries or groups of countries may decide to phase out fossil fuels faster than others. This, in principle, would not contradict the Treaty.

MD: You have pioneered changes to modernize the ECT and increase transparency and yet I am sure the modernization programme is a continuous and incremental one. Can you outline your vision for the modernization programme over the next 3–5 years.

UR: I believe that we are at the critical juncture of the modernization process. Demand for the ECT modernization dates back to 2009. The rapidly growing number of registered investor-state dispute settlement cases in the second decade of this century, peaking in 2015 was clearly indicating such a need. In my opinion, the Treaty modernization has been overdue for a decade. Today, there is a high risk that if Contracting Parties fail to agree on changes necessary for the satisfactory outcome of negotiations the ECT may cease to exist. However, due to the 20 year-long sunset clause in Article 47 of the Treaty, Contracting Parties may wish to avoid such an outcome. I expect that in 3–5 years the issue on the table will be the ratification of the instrument modernizing the Treaty, a kind of ECT 2.0

MD: You have lectured and are an author of numerous articles and are obviously very at home in the world of academia. What advice would you give to our LLM students on developing their careers?

UR: Academic knowledge per se is (just) a springboard to the real world. You never know where you will land next. Therefore the most important takeaways from university are curiosity, openmindedness and continuity of learning for the rest of your life.

Biography

Dr. Urban Rusnák became Secretary General of the Energy Charter Secretariat in January 2012. As of 1 January 2017 he has been re-elected for the second 5 year term. Dr.Rusnák is Slovak by nationality. He graduated from the Moscow Institute of Oil and Gas in 1990 with an M.Sc. and received his Ph.D. from the Ankara University Institute of Social Sciences in 1998. Dr. Rusnák also holds an Honoris Causa doctorate from the Kiev Slavonic University since 2009.

Prior to his appointment at the Energy Charter Secretariat, Dr.Rusnák worked at the Ministry of Foreign Affairs of the Slovak Republic and was the Leader of the Project for Slovakia's External Energy Security. Before that, he was Extraordinary and Plenipotentiary Ambassador of the Slovak Republic to Ukraine (2005-2009), Head of the MFA Political Analysis Division (2003-2005), Deputy Head of Mission at the Embassy of the Slovak Republic in Turkey (1994-1998). He also held the position of Executive Director of the International Visegrád Fund in Bratislava (2000-2003) and Director of the Slovak Institute for International Studies (1999-2000).

Since becoming Secretary General, Dr Rusnák has focussed his efforts on the modernisation and expansion of the International Energy Charter Process, and on the updating of the institutional arrangements for the Conference. A chairmanship of the Energy Charter Conference by member states as introduced in 2014. The first important step in the modernisation efforts has been the adoption of the International Energy Charter in May 2015. This political declaration which addresses the energy challenges of the twenty first century has been shared by almost 100 signatories creating ever growing International Energy Charter worldwide family. As of December 2019 negotiations on the Energy Charter Treaty Modernisation are going on.

Professor Malik R Dahlan holds the Chair of International Law and Public Policy at Queen Mary University of London.

He was the Professor of International Law, Trade and Policy at CCLS until 2018. His academic career, distinguished by its breadth disciplines and his wealth of experience and expertise, is known for being at the cutting edge of the intersection of law and policy. Before joining the Queen Mary faculty, Professor Dahlan practiced regulatory law for fifteen years across many sectors including energy, defence, trade, government affairs, rule of law among others. His experience in renewable energy extends beyond legal practice into investment and entrepreneurship, as he owned the Gulf's first private renewable energy company and was the international chair of the largest renewable energy private equity fund in the world.

At CCLS, Professor Dahlan sits on the Advisory Council. He leads the Trade Initiative and sits on the Sovereign Wealth Funds (SWFs) Working Group. He teaches Renewable Energy Law and Energy Geopolitics; and supervises LLM and PhD dissertations on trade, energy and ethics, investment, Investor-State Disputes (ISDS), and dispute resolution.

Energy storage in Argentina - key regulatory challenges.

María Eugenia Mattera

María Eugenia Mattera

'Critically, achieving a low-carbon economy is less technology dependent than it is dependent on new, well-designed energy law'
(Hodas, 2016, p.198)

Introduction

The traditional designs of electricity markets are facing radical changes (Helm and Hepburn, 2019). International awareness of the catastrophic effects of climate change[1] has driven policymakers to incentivise the deployment of low-carbon electricity generation. As a result, the past two decades have witnessed a massive deployment of renewable energy ('RE'),[2] both in developed and developing countries, and this trend is likely to continue and intensify[3] in the future (Vaughan, 2019). Whilst this is going in the right direction towards decarbonising the electricity sector, RE's intermittency poses regulatory and technical challenges (Winfield et al., 2018) that necessarily have to be addressed to maximise RE's potential (Ton et al., 2008). Evidence suggests that these technical constraints can be appropriately managed with the deployment of new emerging technologies (Denholm and Hand, 2011; Díaz-González et al., 2016). These technologies are able to store energy to later reconvert it for electricity generation and can provide flexibility to the system. Energy storage is not only important in the integration of intermittent RE, it enhances energy sustainability, affordability and security, the cornerstones of the energy trilemma.

Certainly, the emergence of RE, energy storage, smart grids, digitalisation, decentralisation, consumer empowerment, and the electrification of the power systems (Helm, 2017) are all factors that shape the new paradigm (Fox-Penner, 2010). Even though technology costs are identified as one of the main barriers for large-scale storage deployment, they are declining at a rapid rate making energy storage economically

[1] The Intergovernmental Panel on Climate Change shows in its 2018 Special Report the severe impacts of global warming of 2°C above pre-industrial levels.

[2] According to IRENA (2018), the total installed RE capacity has reached 2,179,099 MW in 2017 and is likely to continue as technology costs decrease.

[3] Indeed, Goodall (2016) argues that RE, especially solar photovoltaic, will satisfy economically all the world's electricity demand.

viable (Bhatnagar et al., 2013). But, for this new paradigm to emerge, technology shocks (Helm, 2002) are not enough. In fact, there is increasing concern among stakeholders that legal uncertainty is a major barrier for storage deployment (Deal et al., 2010). As these disruptive technologies challenge the basic principles upon which most electricity systems were designed (namely, the traditional division of the electricity industry into segments, unbundling rules, and energy pricing mechanisms), there is an urgent call for regulation to appropriately address these issues. Therefore, clear and innovative regulatory designs are required to provide the right incentives for its deployment. As pointed out by the OECD and the International Energy Agency (IEA) (2009), 'policy and regulatory frameworks … will determine whether investment and consumption decisions are … low carbon'.

More recently, policymakers in the United States (US) and Great Britain (Britain)[4] have perceived this regulatory lacuna and started to issue new rules and initiate consultations to level the playing field for energy storage. Hence, the main purpose of this paper is to develop an understanding of the regulatory treatment of these critical issues by policymakers in the US and Britain to ultimately propose regulatory guidelines to pave the way for the deployment of energy storage in Argentina. As Argentina has to review its electricity legal framework, it can profit from the regulatory experience from these countries, as the US has taken the lead in the development of energy storage (Ruz and Pollitt, 2016), and Britain has initiated for the past four years formal procedures to incentivise its deployment. Moreover, Argentina shares with the US the federal structure of government that certainly has an impact on the electricity framework, and it shares with Britain the basic principles of electricity framework (at least in Argentina's original design, prior to the alteration of the legal framework, as explained in Chapter IV). Certainly, storage deployment has a relevant role to play in Argentina in order to overcome severe grid constraints and maximise RE's potential.

This paper provides an important opportunity to advance the understanding of the key regulatory challenges of these emerging technologies and how they can eventually be overcome to contribute to the deployment of storage. Furthermore, it is a starting point to initiate the debate in Argentina as no previous study has addressed it before. The work is mainly focused on the regulations issued by the US at the federal level, though some references will be made to rules adopted by the State of California given its leading role in storage deployment. In the case of Britain, even though many measures to remove regulatory barriers to storage are either under consultation or pending parliamentary approval, it is useful to discern the different alternatives under consideration. Reference will also be made when applicable to European Union (EU) law for comparative purposes as it is still applicable to Britain. As this paper is unable to encompass the entire spectrum of applications for energy storage, behind-the-meter energy storage regulation is not included in its scope.

The overall structure of the paper takes the form of five chapters, including this introductory chapter. Chapter II begins by laying out a brief description of the existing technologies and the countless services they can provide to the system to highlight the benefits of promoting energy storage. Chapter III focuses on energy storage's key regulatory concerns and critically analyses how the relevant jurisdictions have addressed them. Chapter IV provides an overview of Argentina's electricity system and suggests guidelines for a future regulation, in light of the relevant landmark rules issued by the aforementioned jurisdictions. Finally, Chapter V draws conclusions on the essential role of regulation, identifies the principles that should guide future regulation in Argentina and suggests areas for further research.

Energy storage as a 'game changer'

Unlike coal, oil or gas, electricity frameworks were designed upon the assertion that electricity could not, in principle, be stored. Therefore, one of the fundamental characteristics of power systems is the need to continuously balance, on a second-by-second basis, supply and demand to ensure security of supply (Van der Veen and Hakvoort, 2016). The exception is given by pumped hydro storage (PHS), a technology that has been used for nearly a century and represents approximately 96% of the global total installed storage capacity (IRENA, 2017). This balancing task is performed by system operators, also known as balancing authorities, who are in charge of monitoring and adjusting the generation capacity to the changing demand to stabilise the system's frequency (Fox-Penner, 2010). An imbalance of supply and demand can be catastrophic: it can lead to blackouts, significant loss of industry production and potential loss of life (Naish et al., 2008). This is why the emergence of different technologies that can transform electrical energy into another storable form of energy to reconvert it to generate electricity when needed (Meyer, 2014) is regarded as a 'game changer' (Di Castelnuovo and Vazquez, 2018, p.3) for the electricity systems given all the benefits it can provide in terms of efficiency, decarbonisation, reliability and affordability. It is said that while transmission lines carry electricity through space, energy storage carries it 'through time'(Meeus and Glachant, 2018). Hence, it is argued that the relevance of these technological advances is that electrical energy becomes a commodity similar to coal, oil and gas (Naish et al., 2008).

Before examining the central regulatory challenges of energy storage, the technologies and the numerous services they can provide to the electricity system are described in the next subsection.

Technologies and classification

In broad terms, electric energy storage assets are characterised 'as a set of technologies capable of storing previously generated electric energy and releasing that energy at a later time' (Deal et al., 2010, p.2). They are commonly categorised depending on the form of energy they use: (i) mechanical, (ii) electrochemical, (iii) chemical, (iv) high temperature thermal and (v) electromagnetic energy storage. Mechanical includes PHS,[5] compressed air

[4] Reference is made to Britain instead of the United Kingdom as Ofgem's jurisdiction does not extend over Northern Ireland.

[5] PHS store energy by using low-cost electricity to pump water from a lower reservoir to an upper/higher reservoir. The water is released to flow back down to the lower reservoir while turning turbines to generate electricity, similar to conventional hydropower plants.

(CAES)[6] and flywheels[7] (Renewable Energy Association, 2015). Electrochemical are conventional batteries (ie lead acid, nickel and lithium based batteries),[8] high temperature batteries (ie sodium sulphur), and flow batteries. Chemical includes hydrogen and synthetic natural gas. Electromagnetic include supercapacitors and superconducting magnetic storage (Naish et al., 2008). These technologies can deliver different services to the electricity system according to their efficiency, life cycle and energy density (which can vary significantly) (Alizadeh et al., 2016). For instance, PHS and CAES are best suited to providing bulk services whilst batteries can have a greater performance to provide ancillary services (Meyer, 2014). Their stage of commerciality also varies and one of the most promising technologies is lithium-ion batteries because of the rapid drop in costs due to research and development for electric vehicles.[9] Energy storage is also categorised depending on where the facility is installed. Storage facilities can be standalone, co-located with generation facilities or behind-the-meter (Hassan and Dalton, 2018). As stated in the Introduction, this paper focuses on the first two as most of the regulatory issues arise from their participation in the system by importing and/or exporting electricity from the grid.

Services energy storage can provide

There is a consensus among the different stakeholders regarding the different services energy storage can provide to electricity systems. The different services can be categorised as follows:[10]

Bulk services and renewable integration

Firstly, energy storage deployment is especially relevant for countries with a high penetration of RE. Usually, when the share of RE in the electricity mix exceeds 20–25%, as in California and Britain, the imbalance between intermittent generation and changes in demand results in the 'duck curve' (Sioshansi, 2016). One solution to this phenomenon it to curtail RE to prevent congestion and perturbation of the grid (European Commission, 2013a). But this is a major drawback for the environment and has a financial impact on RE as grid operators need to resort to other sources of generation, presumably peaking power plants. In fact, studies carried out by the British system operator, the National Grid, evidence that the capacity benefit of the grid decreases as the share of RE resources increases, which calls for a growth of installed conventional generation (Naish et al., 2008). By acting as electric supply capacity (baseload), storage reduces reliance on inefficient power reserves or new gas-fired peaker plants (Meyer, 2014). In other words, these technologies store the surplus RE generation to reconvert it for later use when needed or when there is transmission capacity available (Schmitt and Sanford, 2018). As a result, the system benefits from a reduction in CO2 emissions and in costs as inefficient plants are displaced or there is no need to install new power plants. This ultimately contributes to energy security by enabling a higher and more manageable penetration of RE (Naish et al., 2008). Hence, RE's central disadvantage, intermittency, is significantly mitigated, allowing greater flexibility and efficiency for RE operation (Naish et al., 2008).

Secondly, energy storage devices allow energy time-shift, also known as arbitrage. This involves purchasing electricity when prices are low and selling back to the wholesale market or consumers when high, profiting from the difference in the value of the electricity. It has been anticipated that this benefit will tend to decrease as the number of storage devices incorporated into the grid increases and prices are stabilised (Crossley, 2013). Whilst from the storage operators' perspective this would imply a commercial loss of revenue and a potential deterrent for storage deployment in the long term, the advantage relies on the stabilisation and possible average reduction of prices (Kyriakopoulos and Arabatzis, 2016) realising the principle of efficiency, a cornerstone of electricity systems.[11]

Ancillary services

Thirdly, one of the most relevant services storage can provide is ancillary services. Though these vary according to the applicable regulatory framework, their main function is to provide stability and reliability to the grid. Indeed, some storage technologies are considered better placed than generators (who have historically provided these services) given their fast ramp rate (Meyer, 2014). Ancillary services can include regulation, frequency response, spinning reserve, supplemental reserve, fast reactive current injections, inertia, short-circuit current, and black start capacity, among others (Bhatnagar et al., 2013).

Transmission and distribution infrastructure services

Finally, in the transmission segment, a small amount of storage can diminish congestion of the lines by providing incremental capacity (Akhil et al., 2015). This not only enhances the capacity and lifetime (Akhil et al., 2015) of the existing infrastructure, but most importantly defers transmission upgrades (Dworkin, 2011), which are capital-intensive and possibly involve serious environmental, planning and social concerns. At the distribution level, storage not only implies upgrade deferral but also voltage support. This is an essential advantage for ageing infrastructures, like Argentina's, where regulatory measures and economic crises have severely affected the capacity of the grid, as explained in Chapter IV.

Benefits of storage deployment

Studies show that the introduction of storage devices in an electricity system creates a great number of technical and economic benefits (Eyer and Corey, 2010). Firstly, it allows better integration and management of intermittent RE and baseload renewables (Eyer and Corey, 2010), it increases its capacity factors, and reduces curtailment and the need to resort to conventional generation and peaker

[6] CAES store energy either in an underground structure or an above-ground system, by running electric motors to compress air and then releasing it through a turbine to generate energy. The pressurised air allows the turbines to generate electricity using significantly less natural gas.

[7] Flywheels are charged by accelerating the inertial masses also known as the rotors. The energy is stored as the rotational kinetic energy of the flywheel. To discharge the kinetic energy it is extracted by a generator, which decelerates the rotation.

[8] Li-ion battery pack costs have fallen 80% in the last 10 years (Abrar et al., 2017).

[9] Argentina is part of the lithium-triangle.

[10] The classification of the US Department of Energy and the Electric Power Research Institute from the Electricity Storage Handbook is followed (Akhil et al., 2015).

[11] Section 5 of Act 1989, section 42 of the Argentine Constitution and section 41 of the Electricity Act.

plants (Stein, 2014). Hence, its deployment contributes to resource diversification, security of supply efficiency and decarbonisation of the system (European Commission, 2013a). Secondly, it allows better management of both the transmission and distribution grids by increasing their stability and reliability (Deal et al., 2010), and deferring expansion of capital-intensive infrastructure. Finally, it lowers the cost of dispatch (Borden and Schill, 2013) and contributes in general to the stabilisation of the energy market (Naish et al., 2008).

In terms of economic benefits, evidence suggests that the introduction of storage resources can have cost benefits (Sidhu et al., 2018). In fact, the dissolved British Energy and Climate Change Committee estimated that the removal of regulatory barriers for energy storage may imply annual savings to consumers as high as £7 billion (HC, 2016). Although these numbers cannot be extrapolated to all electricity systems as different pricing variables apply, it is expected that storage will significantly reduce the system's cost (Department of Energy Resources, 2016). There is currently no evidence about the potential savings for consumers in Argentina.

With respect to sitting and permitting, storage resources evidence additional advantages over conventional resources. Indeed, as they can usually be located closer to demand centres (with the exception of PHS and CAES, which face substantial geographical limitations) there are lower electricity losses during transmission and they can be deployed in a significantly shorter period of time than peaker plants (Ruz and Pollitt, 2016).

Main regulatory issues

The role of regulation in electricity markets

Regulation is intrinsically guided by public policy and is considered an essential tool for the functioning of energy markets (Helm, 2004). Although the rationale behind privatisations in the 1990s was that market forces would be enough to create competitive prices (Helm, 2004), and that the role of the regulator should be limited to control natural monopolies, experience shows the need for a robust legal framework and a deep regulatory intervention to tackle market failures. One of these perceived failures is that energy policy, regulation and market design are not adequate to address environmental concerns (Helm, 2004). Consequently, there has been a profound shift in policy to properly address this issue by taking advantage of new emerging technologies to transition towards low-carbon systems. A clear example of this phenomenon is the massive deployment of RE that has been experienced worldwide for the past two decades. Possibly, these low-carbon technologies would not have emerged without strong regulatory designs such as feed-in-tariffs and renewable portfolio standards, especially under today's scenario where most countries have failed to internalise the social cost of fossil fuels in electricity pricing (Meier et al., 2015).

As Helm argues, 'paradigm shifts in policy typically require a change in the context and a change in ideas in response' (2005, p.1). The deployment of RE, though positive, is not enough to tackle climate change. As explained in the Introduction, these generation facilities require smarter and more flexible electricity systems and the market seems ready to provide them (Ofgem and BEIS, 2016). However, for this to occur and to profit from all the benefits storage technologies can deliver to the system, investors demand for clear rules. As regulatory risks increase the cost of capital (Helm, 2005), for these new technologies to efficiently develop, policymakers need to properly address and remove the existing regulatory barriers. In fact, it has been recognised as crystal clear that 'the general proposition that uncertainty about regulatory requirements affects market value is so intuitively obvious as to require no expert support' (Anatoli v Dep., 2001). To sum up, regulation is a necessary tool to remove the barriers storage technologies are facing and has to be used wisely to mitigate policy errors that can delay the realisation of the new paradigm.

As anticipated, storage technologies face many regulatory barriers that hinder its competitiveness against traditional players, regardless of the special features of the jurisdiction involved. The next section provides a description and critical analysis on how the relevant countries or states have addressed those concerns to identify the best practices and eventually suggest guidelines to replicate them in a future regulatory framework for Argentina.

Asset class

Historically,[12] the provision of electricity was administered by the state or state-owned enterprises. Due to a loss of legitimacy of the system of state monopolies (inefficient management, high prices and corruption, among other reasons) (Talus, 2013) a trend started in some developed countries like Britain (followed by Argentina in the 1990s) to privatise essential services, including the electricity sector. The rationale behind this process was that competition should be encouraged in the segments of the industry where it was feasible, whilst regulation should target the monopolistic segments given their relevance as essential facilities. The principle was described as 'competition when possible, regulation when necessary'(Foster, 1992). Hence, the aim of regulation was to prevent abuse of dominant position and discrimination among market participants and secure access to the essential facility: the grid. To that end, the industry was divided into three clearly defined segments: (i) generation, (ii) transmission, and (iii) distribution, each governed by their own rules and with their own cost-recovery mechanisms. Thereby, while generation is subject to market-based rates to recover costs, distribution and transmission operators are only entitled to regulated rates approved by the regulator, in other words, the utility-rate-based cost recovery (Schmitt and Sanford, 2018).

The critical issue arises from storage technologies not strictly fitting in any of the traditional categories of the electricity industry segments (Meeus and Glachant, 2018). As storage can (i) behave as a generation asset by exporting electricity into the grid, balancing or providing ancillary services (European Commission, 2013a), (ii) act as load by importing electricity from the grid, (iii) provide transmission services such as congestion management or investment deferral (Schmitt

[12] Flywheels are charged by accelerating the inertial masses also known as the rotors. The energy is stored as the rotational kinetic energy of the flywheel. To discharge the kinetic energy it is extracted by a generator, which decelerates the rotation.

and Sanford, 2018), or (iv) provide distribution services like voltage control, capacity support (European Commission, 2013a) or investment deferral, the existing legal structures fail to adequately address these unique characteristics. In fact, the underlying concern is that the emergence of these disruptive technologies are starting to question the existing regulatory designs and raising the need for a wider reform of the electricity systems (Crossley, 2013; Helm, 2017).

There is a consensus among policymakers (HC, 2016), stakeholders (EUROBAT, 2016) and scholars (Bhatnagar et al., 2013; Crossley, 2013; Stein, 2014) that the lack of a legal definition and classification of storage is a central barrier for its deployment. In fact, the International Energy Agency (IEA) has especially called for a clarification of the regulatory position of storage in the electricity value chain (2017). Thereby, classifying storage is possibly one of the main hurdles policymakers face as the relevance of the class asset is not purely theoretical. Under the existing regulatory frameworks, the definition of the legal status of these assets has major legal implications given the limitations electricity market participants face to act in both liberalised and monopolistic sectors of the industry. In particular, this strict division of segments impedes storage operators from collecting revenues under multiple classifications, challenging its economic viability (Bhatnagar et al., 2013). That is to say, even if the same storage operator could physically participate in the electricity markets and provide transmission congestion relief or deferral, from a regulatory perspective, it would be forbidden from collecting regulated and deregulated rates (Bhatnagar et al., 2013). Therefore, this uncertain regulatory treatment impacts on revenue streams, which is a basic consideration prior to the execution of any investment.

US

California is one of the leading jurisdictions in the deployment of energy storage. The state was a pioneer to introduce a legal definition of storage by means of Assembly Bill 2514 passed in 2010. It defines an energy storage system as 'a commercially available technology that is capable of absorbing energy, storing it for a period of time, and thereafter dispatching the energy'[13] The definition states that an energy storage system should be cost-effective and comply with at least one of the benefits that characterises these technologies. The definition avoids classifying storage under any of the traditional segments and seems broad enough so as to allow any storage facility to be included in its scope. In fact, California's Independent System Operator (CAISO) has categorised storage as a non-generating resource to allow its participation in the frequency regulation market (Wilson and Hughes, 2014). This neutral approach is presumably an intentional choice in order to allow the technologies to adapt to different functionalities. The definition is adequate as it stresses the importance of the commercial viability and cost-effectiveness of the technology. One question that needs to be asked, however, is whether it would have been preferable to include a high-level definition in the Bill and then provide in lower-hierarchy regulations the specifications the resources need to comply with. Such an approach would likely have facilitated future amendments as technology evolves.

A similar neutral approach has been followed by the Federal Energy Regulatory Commission (FERC), that is, the competent authority at the US federal level to regulate the interstate transmission of electricity and wholesale sales of electricity in interstate commerce.[14] By means of Order 841, FERC included a definition of electric storage resource as 'a resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid'.[15] Regarding the scope, FERC expressly clarified that the definition included storage at both the distribution and transmission level and excluded behind-the-meter storage that does not inject electric energy onto the grid.[16] Furthermore, the regulator stressed that the definition 'is intended to cover electric storage resources capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid',[17] which refers to both the physical and contractual possibility to do so. Finally, the Order clarified that regional transmission operators (RTOs) and independent system operators (ISOs) could propose a broader definition. A serious weakness of this definition seems to be the physical requirement for the resource to both import and export electricity from the grid. Although it seems logical that behind-the-meter storage destined for self-consumption is excluded, this requirement presumably leaves co-location storage not connected to the grid out of the scope and, therefore, unable to participate in the market. Hence, the storage facility must be connected to the grid to participate in the market, which can be anti-economic in certain circumstances as the resource could use the generating facility's connection instead. It is desirable that FERC provides further clarification on whether co-located storage will be considered integrated to the generating facility.

As regards classification, FERC has expressly recognised in their Policy Statement (2017) that storage resources can fit in any of the existing classes. In fact, the regulator stressed there was no need for a new classification as the hurdle can be solved with the creation of new accounts within the existing classifications (Bhatnagar et al., 2013). Therefore, it has opted to address the classification of energy storage assets on a case-by-case basis (Schmitt and Sanford, 2018), according to the project's intended use and capabilities (Meyer, 2014). However, it must be highlighted that under certain orders (ie Order 792) FERC has treated storage as generation, which evidences the regulatory uncertainty that characterises these technologies.

Two relevant cases show FERC's position regarding the requirements to be met for storage to be categorised as transmission and, therefore, allowing cost-recovery mechanisms to take place. In *Nevada Hydro*, the company requested[18] to treat its project as a transmission asset on the grounds of the Energy Policy Act, which fosters the development of 'advanced transmission technologies' (Forrester et al., 2017). The project consisted of a PHS

[13] Section 2.

[14] Energy storage also raises jurisdictional issues in the US, although FERC has claimed its competency for being wholesale and not retail transactions. See Stein (2014) and Order 841.

[15] Section 35.38(b) of the commission's regulations.

[16] Order 841, paragraph 32.

[17] Order 841, paragraph 29.

[18] The company has filed a complaint that is under FERC's consideration.

facility and a transmission corridor. FERC rejected the storage operator's request to include the costs in the transmission rates on the basis that such treatment would be discriminatory towards other PHS operators who only collected their revenues from the wholesale markets (Stein, 2014). What is more, the regulator emphasised that the request to place the resource under the ISO's control was rejected given that its costs would not be appropriately recovered by the transmission access charge (FERC, 2017). It is relevant to the case that CAISO claimed that its independence would be compromised by deciding when the resource would operate and the amount of energy to generate. By contrast, in *Western Grid Development LLC*, FERC categorised a proposed sodium sulphur battery storage project as a wholesale transmission and approved it for transmission rate recovery and increased rate. The regulator took into consideration that the electricity to be injected to the grid was to maintain its reliability rather than participate in any wholesale electricity market (Stein, 2014), that additional revenues from price differentials would be credited to consumers and that Western Grid would not retain revenues outside of the transmission access charge (Bhatnagar et al., 2013). A major difference with the *Nevada* case was that the independence of CAISO was ensured as it would not be in charge of buying power for charging nor physically operating the asset. Therefore, the main difference between *Nevada* and *Western Grid* was that, in the former, there was a higher risk for the ISO to act as a market participant putting its independence at stake (FERC, 2017). The underlying rationale of these two cases seem to indicate that if the operator proves that the asset will only execute regulated services, it can be categorised as transmission and, therefore, apply for cost recovery (Sioshansi et al., 2012).

Britain

The British Office of Gas and Electricity Markets (Ofgem) and Department of Business, Energy and Industrial Strategy (BEIS) (2016) identified the lack of definition as one of the main barriers for storage deployment and, after reviewing comments and suggestions from the interested parties, agreed to follow the definition of electricity storage proposed by the Electricity Storage Network: 'the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy' (Ofgem, 2017a). The authorities initially specified a condition that storage could not have self-consumption as primary function, but they then replaced this condition with information requirements, presumably towards the same aim.

The authorities considered three different regulatory approaches to categorise storage: (a) continue to treat storage as generation, (b) define it as a subset of generation in a modified generation licence (i) without amending the primary legislation or (ii) amending the primary legislation, or (c) defining storage in primary legislation as a new activity with a separate storage licence regime (Ofgem and BEIS, 2016). Whilst some stakeholders pressed for the creation of a new asset with its own regulatory regime, the authorities chose the path described in b(ii), classifying storage as a subset of generation, reviewing the generation licence accordingly[19] and amending the Electricity Act 1989 (Act 1989) to include storage in the primary legislation when parliamentary time allows. As a result, and contrarily to FERC's approach, Britain has opted to categorise storage as a subset of generation 'for the time being'(OFGEM, 2017a, p.5). The expressed rationale for this choice was that storage can provide the same function to the grid as conventional generation. Furthermore, it was considered that this approach would provide regulatory certainty by means of including the definition in the primary legislation, be congruent with storage developers that have already been granted a generation licence, reduce the implementation period and avoid the duplication of regulations (Ofgem, 2017a). Although these are all valid and reasonable arguments, one question that needs to be asked, is whether the regulator would categorise storage as a transmission asset or service where there is strong evidence that the resource will mainly defer transmission capacity expansion. Interestingly, the consultation acknowledges that storage resources can provide different services to the system (Ofgem, 2017c), but fails to propose a cost-recovery mechanism under those circumstances. The authorities have vaguely anticipated that the value of storage in terms of network cost recovery is dependent upon further analysis so that, at one extreme, it does act as a barrier and, at the other, does not imply a subsidy (Ofgem and BEIS, 2016). It is advisable that future consultations address this issue in order not to disregard one of the main services storage can deliver. Finally, EU Directive 944/19 (the Directive) defines storage as 'deferring the final use of electricity to a moment later than when it was generated, or the conversion of electrical energy into a form of energy which can be stored, the storing of such energy, and the subsequent reconversion of such energy into electrical energy or use as another energy carrier'.[20]

A third path: a new asset

The definition of storage adopted by FERC and California and the proposed definition of Ofgem and BEIS reflects one of the main features of storage technologies: their ability to transform electricity into another form of energy, keep such energy for a certain period of time, and then reconvert it to electricity when needed (Crossley, 2013). As electricity is transformed into another form of energy, this implies that the storage facility is certainly 'generating' electricity and not just injecting the same electricity initially taken from the grid or associated project (Stein, 2014). This is presumably the main reason why Ofgem has taken the position to categorise storage as generation. However, many arguments have been raised against such classification. To begin with, the conversion process neither increases the net capacity of electricity onto the grid nor keeps the same level imported (Stein, 2014). Secondly, these technologies question the traditional feature of generators to deliver power one-way, given that storage operates two-ways (Schmitt and Sanford, 2018). Moreover, when the resource only provides services to the grid it resembles a reliability resource more than it resembles a generator (Stein, 2014). Fourthly, although the same treatment as generation could be appropriate for certain technologies such as PHS or large-scale facilities, it has been argued that it

[19] The generation licence is under review at the time of writing (Ofgem, 2019). Ofgem approved in May 2020 a modification to the Grid Code (GC0096) to incorporate storage as a generation asset.

[20] Article 2 (59).

might not be the case for small-scale assets (Ruz and Pollitt, 2016). Finally, developers argue that classifying storage as generation overlooks all the different services it can deliver to the system (EUROBAT, 2016).

Therefore, developers (EUROBAT, 2016) and scholars (Anuta et al., 2014; Crossley, 2013; Ruz and Pollitt, 2016) propose a third path: create a new class asset for grid-level storage that reflects the capabilities of these technologies. A strength of this alternative, it has been argued, is that overregulation by reference to a different asset is avoided and there would be a reduction in bureaucracy in terms of regulatory compliance (Crossley, 2013). As an example, in Britain, holders of storage licences will be bound to comply with many of the regulations generators have to comply with plus certain conditions solely applicable to storage resources (Ofgem, 2017a). This might create an unnecessary administrative burden for storage operators that hinders deployment. Although there are strong arguments against storage being categorised simply as generation, creating a new asset does not seem to solve the underlying regulatory concern that storage gives rise to.

As discussed above, the division of the electricity industry into segments aims to foster competition in those activities where the market can operate and to control natural monopolies. The possibility for storage operators to provide services under multiple classifications faces the same barriers originally considered by policymakers: the potential distortion of the market by cross-subsidisation and information-sharing if a market participant is to collect revenues from the regulated and deregulated sector (Sioshansi et al., 2012). Furthermore, the creation of a new asset can lead to duplication of regulations (Ofgem, 2017a), and an increase transactional costs, both for the regulator and potential investors. Finally, it has been stated that new regulations could lead to confusion in the classification of resources into appropriate categories and become a barrier to the deployment of new technologies (Bhatnagar et al., 2013). To sum up, it seems that regulation should focus on mechanisms to fully value the services storage can provide to the system as a whole (if applicable, to the regulated and deregulated segments) and, at the same time, ensure competition is not distorted, rather than in engaging in the theoretical dilemma of the classification of storage.

Ownership

As anticipated, the classification of storage is intrinsically linked with ownership restrictions under the current regulatory designs. In fact, the regulatory frameworks of Britain, Argentina and most of the US (Meyer, 2014) set forth cross-ownership restrictions between transmission and generation and supply. The grounds for this limitation is to avoid potential conflicts of interest (Winfield et al., 2018) and discrimination as the operator of the essential facility might take advantage of its position to favour its own generation (Talus, 2013). Therefore, if storage is categorised as generation, ownership and operatorship limitations may apply to grid operators; whilst if considered transmission, these facilities would not be able to participate in the electricity markets (Schmitt and Sanford, 2018).

US

FERC's Orders 888 and 2000 encouraged the creation of wholesale markets and independent grid operators, known as ISOs or RTOs, which are in charge of operating the grid and administering wholesale markets (Meyer, 2014). To ensure non-discriminatory open access to transmission facilities, the orders required the utilities to file non-discriminatory open access transmission rates and functionally unbundle generation and transmission by establishing separate rates for generation, transmission and ancillary services. The regulator stressed that functional unbundling between distribution and transmission was not necessary towards such an aim. According to the aforementioned orders, RTOs and ISOs must operate the grid independently from market participants to avoid distortions. In fact, as explained earlier, in *Nevada Hydro*, FERC rejected the company's request because CAISO's independence would be compromised if it were to operate the asset and participate in the market.

The Federal Power Act expressly provides that the states have jurisdiction over distribution, intrastate transmission and generation.[21] Being a federal country, as Argentina is, brings about additional hurdles for storage ownership and jurisdictional issues that should be carefully considered by policymakers when designing an adequate framework for storage. In fact, Commissioner McNamee dissented on FERC's jurisdiction to regulate storage connected at the distribution level in Order 841. However, the US Court of Appeals for the District of Columbia Circuit confirmed FERC's jurisdiction to issue such a landmark order.[22] In the case of Argentina, there are strong arguments in favour of the federal jurisdiction, as explained in Chapter IV.

In the case of California, the Public Utilities Commission's (CPUC) Decisions 13-10-040 and 14-10-045 provided that storage can be owned by investor owned utilities (IOU) and can deliver generation, transmission and distribution services. The only limitation is that utilities are not allowed to own more than 50% of the proposed projects, with the aim of fostering private investment (Ugarte et al., 2015). It is possible that there is a positive correlation between California's success in the deployment of storage and allowing distribution utilities' ownership over the asset. Indeed, utilities have access to the relevant information and technical know-how to maximise storage's benefits. However, further studies should assess the long-term effects of distribution utilities' ownership on the market because, although it may be positive for storage deployment, it could lead to market distortion.

Britain

In addition to the unbundling requirements set forth in Act 1989 and the Directive (as its predecessor), as of 1 April

[21] Section 201(b)(1).

[22] *National Association of Regulatory Utility Commissioners v FERC (2020)* No 19-1142 (DC Cir). 'Order No. 841 solely targets the manner in which an ESR may participate in wholesale markets. This action is intentionally designed to increase wholesale competition, thereby reducing wholesale rates. Keeping the gates open to all types of ESRs – regardless of their interconnection points in the electric energy systems – ensures that technological advances in energy storage are fully realized in the marketplace, and efficient energy storage leads to greater competition, thereby reducing wholesale rates.'

2019, the amended distribution licence expressly prohibits independent distribution network operators (IDNOs) and distribution network operators (DNOs) from performing generation activities, including storage, regardless of whether storage is licence-exempted[23]. Although the transmission licence has not been amended accordingly, the regulator clarified that within the transmission activity the stress is laid on the activity performed by the economic group rather than the licences held. Hence, it is irrelevant for unbundling purposes whether the generation asset is licence-exempted (Ofgem, 2017b). This clarification is coherent with the fact that ownership restrictions between generation and transmission are the backbone of the segmentation of the industry.[24]

There are several declared grounds for this ownership restriction. Firstly, it aims at safeguarding efficient investment in the network and diminishing any potential conflict of interest as DNOs have competitive advantages over third parties. Secondly, the regulator argues that network operators should act as 'neutral market facilitators' to avoid deterring new market entrants (OFGEM, 2018a, p.6). As a result, DNOs and IDNOs have to legally unbundle if they are to operate storage assets. In other words, the distribution and generation business must be separated from an organisational, legal and decision-making point of view, ensuring no confidential information-sharing (Ofgem, 2018a). An alternative business model would be that an independent third party operates and makes decisions for the asset (Ofgem, 2018b), though an increase of transaction costs would be a major drawback (Ruz and Pollitt, 2016). Finally, DNOs are only allowed to own on-site generation for operating purposes provided that no generation is exported to the grid (Ofgem, 2018a), which seems to be a rational solution as there is no risk of market distortion.

Along with the new distribution licence, Ofgem published a Prohibition on Generation Guidance (POGG) including three exceptions to the general ownership prohibition. The first one applies to assets that are part of an island-based electricity system. The second one refers to small-scale applications necessary to ensure continuity of supply and the safe and reliable operation of the network and are considered to be 'within the normal business activity of the licensee'[25]. In essence, these are non-exporting electricity and emergency devices. The third consists of a case-by-case decision if certain requirements are met. The DNO must prove: (i) that reasonable measures have been addressed to obtain a market-based solution (public and neutrally designed public procurement process), (ii) the cost-effectiveness and efficiency of being operated by the licensee and (iii) that measures are taken to reduce the risk of discrimination and market distortion (Ofgem, 2018b). A similar approach has been adopted by the Directive by prohibiting both transmission system operators (TSOs) and DSOs from owning and operating storage assets but for integrated network components.[26] However, the exceptions seem to be stricter than Ofgem's approach as the network operator has to submit proof that third parties could not 'deliver those services at a reasonable cost and in a timely manner',[27] among other requirements. In brief, while under British law the DNO must prove that owning and operating the asset by itself is more cost-effective; under EU law the lack of a 'reasonable' market-based solution must be demonstrated. Furthermore, while EU law provides that the exception is applicable to both TSOs and DNOs and subjects operators' ownership of the asset to the commitment not to sell or buy electricity, Britain only refers to DNOs and requires 'enduring arrangements … which ensure the risks of discrimination or distortion are managed effectively'.[28] The EU's legal solution seems more sophisticated than Britain's as, at one extreme, it recognises that those exceptional circumstances could also be applicable at the transmission level and, at the other, ensures no market distortion by impeding the operator to execute market transactions.

It is argued that ownership restrictions for TSOs and DNOs can act as a deterrent for the deployment of energy storage as the operators are better positioned to exploit the benefits these devices can provide, as they have the scale (Meeus and Glachant, 2018), technical expertise and financial clout required for large-scale projects (Hatcher and Williams, 2016). Admittedly, grid operators are strongly incentivised to resort to cost-effective and efficient solutions to comply with their duties of maintaining, operating and expanding the grid. Such motivation, although laudable, does not seem enough to put at stake the basic principles of the liberalised electricity systems and obligations assumed by the operators not to distort competition[29], not to discriminate among market participants[30] and avoid cross-subsidisation.[31] Ownership restrictions for DNOs and TSOs seem to be justified in light of those general principles and the exceptions provide an adequate balance when there are no market-based solutions available.

Pricing and regulatory barriers

Reasonably, the widespread deployment of storage is dependent on realising a reasonable return on investment. However, this basic premise is jeopardised by two main issues. Firstly, existing regulations restrict access to multiple revenue streams. Storage can deliver numerous services at the same time and is capable of switching from one service to another almost instantaneously (Schmitt and Sanford, 2018). Paradoxically, this blessing and curse is at the heart of the aforementioned dichotomy of collecting market-based and cost-recovery revenues. Secondly, even when considering storage as a generation asset, there is a lack of appropriate market value for storage's multiple applications (Akhil et al., 2015; Meyer, 2014; Ruz and Pollitt, 2016) because market-based pricing and many regulatory requirements were

[23] The Electricity (Class Exemptions from the Requirement for a Licence) Order 2001, includes a class exemption for small scale generators producing no more than 10 MWs of electrical power from any one generating station or 50 MWs in the case of a generating station with a declared net capacity of less than 100 MWs.

[24] Nonetheless, the European Commission has published certain criteria to determine the circumstances under which the same economic group can have interests in both generation and transmission assets (2013).

[25] Category B.

[26] Sections 36, 38 and 54.

[27] Section 36.4.a.

[28] Criterion 3 POGG.

[29] Act 1989, section 1B.

[30] Condition 19 of the distribution license and C7, D5, E19 of the transmission license.

[31] Chapter 2, section 4.9 of the distribution license and B5 of the transmission license.

FERC has addressed the issue of access to regulated and deregulated revenues with an innovative approach. In fact, the regulator allows, as a matter of general principle, a storage operator to recover its costs through both a cost-based rate recovery and a market-based rate service provided that certain conditions included in the Policy Statement are met. Firstly, double recovery must be avoided and this can be done by appropriate market revenue crediting to rate payers, offsetting the market revenue to reduce the amount of the cost-based rate or any other reasonable proposed mechanism towards the same aim. Secondly, it vaguely requires avoiding the impact on competition in the wholesale market but recognising at the same time that many vertically integrated utilities collect both types of revenues. This clarification might reflect that a potential impact on competition is expected. Indeed, the lack of clear guidance on how this issue will be addressed was highlighted by the dissenting commissioner, as the policy statement fails to address how market distortion will be mitigated. Finally, to safeguard the RTO/ISO's independence, the control of the resource (mainly charging and discharging) should be under the storage owner or operator when providing market-based rate services and priority should be given to the provision of services to the grid (FERC, 2017). The possibility of allowing the recovery of both cost-based and market-based rates could be a major step to removing economic and financing barriers for storage technologies as the fixed-revenue stream from cost-based rate recovery might facilitate financing. However, its application is yet to be tested.

In Britain, despite Ofgem's recognition of the multiple services storage can provide to the system, from ongoing consultations it seems that the regulator will focus on removing regulatory barriers for storage to participate in the different markets, but without allowing cost recovery through rates. This could be a major drawback in terms of valuing the full spectrum of services storage can provide to the grid as explained earlier. Nonetheless, the successful performance of storage resources in the 2016 T-4 Auction and the existing pipelines of ready-to-build battery storage projects in the UK[32] reveal that the financial model might work under this structure. Moreover, it is possible that given the special characteristics in terms of length and density of the British grid, storage resources may be more relevant to providing services rather than deferring grid expansions.

Regarding the value of storage in market-based structures, certainly the value of each service is dependent on the regulatory design of the electricity market (Naish et al., 2008). However, there are common barriers that must be removed to level the playing field for storage. Firstly, regulations would need to be technology neutral and foster adequate price signals to appropriately remunerate the most efficient solutions for the systems, both in terms of cost and grid management (Forrester et al., 2017). Furthermore, the removal of price distortions such as subsidies or accounting for the social cost of fossil fuels in electricity pricing is key. In fact, IEA (2014) claims that in many jurisdictions, including Argentina, generators provide services to the grid without compensation, which leads to price distortions. In the same vein, Sioshansi (2012) argues that simulation software used by utilities fails to quantify and capture the multiple value streams provided to the grid. Hence, there is a call for regulation to appropriately value reliability, power quality, energy security and efficiency gains to make storage competitive with other technologies (IEA, 2014). Among the most relevant measures, Meyer argues that the structuring of ancillary service markets is essential to allow storage to participate in capacity mechanisms and have access to long-term contracts to secure repayment (2014).[33] The proposed amendments to the Capacity Market Rules seem to go in this direction. Moreover, as society as a whole will benefit from storage deployment due to a reduction in CO2 and avoidance of new infrastructure (Eyer and Corey, 2010), it seems paramount to find mechanisms to remunerate these benefits.

The charts below outline the most relevant steps taken by FERC and California and the measures under Ofgem's consideration and pending approval from the British Parliament to remove regulatory barriers and level the playing field for storage.

FERC:

Rule	Description	Benefit
Order 890 2007	Preventing Discrimination and Preference in Transmission Service	• Requires considering non-generation units as service providers for the grid and having them fully participating in the market
Order 755 2011	Frequency Regulation Compensation	• Recognises the enhanced value of fast ramp • Requires: (1) a capacity payment and (2) a performance payment[34]
Order 1000 2011	Transmission Planning and Cost Allocation	• Non-transmission alternatives, such as storage, need to be given comparable consideration

[32] 1.3 GW at the time of writing.

[33] In the Energy Storage Summit held in London on February 25 2019 developers expected that the most relevant revenue stream would be wholesale trading (42%), followed by ancillary services (23%), balancing services (11%) and new revenue mechanisms (11%).

[34] Its implementation in PJM RTO significantly reduced the regulation requirement and the average cost of frequency regulation. See Forrester et al. (2017).

FERC (continued):

Order 784 2013	Third-Party Provision of Ancillary Services for storage	• Regarded as a key step for storage deployment • Allows storage to provide ancillary services • Creates new electric plant accounts specific to storage in the existing classifications and costs are allocated across the accounts according to the function performed • Requires transmission providers to consider speed and accuracy when contracting frequency regulation
Order 792 2013	Interconnection Agreements and Procedures	• Reduces regulatory uncertainty regarding interconnection to the grid • Reduces administrative costs for small resources (20 MW)
Order 841 2018	Electric Storage Participation in Markets Operated by RTOs/ISOs	• Calls for new participation models for storage to allow them to provide all capacity, energy, and ancillary services that it is technically capable of providing • Ensures that storage can be dispatched and set the wholesale market clearing price as wholesale seller and buyer • Operators need to account for the physical and operational characteristics of electric storage resources through bidding parameters • Avoids double charging
Order 845 2018	Interconnection Procedures and Agreements	• Reduces interconnection barriers for storage over 20 MW

California:

Measure	Description	Benefit
2000-2018	Studies were performed to understand the benefits of storage and incentives were approved for particular projects	• Allowed to establish a value proposition for storage
Assembly Bills 2514 and 2868	Sets storage targets of 1,825 MW for IOU	• Scaled up storage deployment by giving the right signals • Adopts a neutral and cost-effective criterion • Excludes PHS to stimulate new technologies • Long-term contract (up to 10 years) • Allows the collection of 'Resource Adequacy' benefit, includes grid services
CAISO	Modified rules to allow the participation of non-generation resources	• Allows storage to provide regulation service by reducing: (i) the minimum rated capacity to provide certain ancillary services and (ii) the minimum continuous energy requirement (from hours to minutes)
CPUC Decision 18-01-003 (2018)	Decision on Multiple-Use Application Issues	• Allows recovery of incremental value streams across the different segments
Compliance with Order 841	Access charge	• Exempts storage from access charge

Measures under Ofgem's consideration or pending parliamentary approval:

Issue	Measure	Benefit
Clarifying co-location with Renewable Obligation (RO) and FIT schemes	Assessment on a case-by-case basis In principle, generators' obligations do not change and the declared net capacity will not be affected ROCs may be claimed for the RE electricity used to charge the storage device	• De-risks investments that co-locate storage alongside renewables
Planning	Retains the 50 MW threshold for standalone storage and clarifies that for co-located storage the threshold may be considered individually Ongoing consultation to carve out electricity storage, except PHS, from the national regime and to be approved by the relevant Local Planning Authority in England	• Reduces uncertainty and costs for co-location • Ease planning permission
Capacity market[35]	National Grid announced that future auctions will have the same de-rating factors as in the 2017 T-1 and T-4 auctions (where storage was less successful due to the use of the Equivalent Firm Capacity methodology that gives storage shorter duration) DSR to access long-term contracts (up to 15 years) Reduces the minimum capacity threshold from 2 MW to 1 MW New reporting and verification mechanisms that place a carbon emissions limit	• Main drawback for storage • Short contracts and de-rating factor reduces its competitiveness but it will be reviewed in the updated Rules of the Capacity Market • Contributes to financing • Levels the playing field • Preferential treatment to low carbon emission units
Balancing Service consultation	Simplification of products and standardisation of contracts Improve access to information Increase transparency	• The amendments are expected to be positive for storage operators as flexibility and fast ramp will be acknowledged
Contracts for difference	Requires, in principle, storage assets to be registered in a separate BM Unit to ensure that CFD payments cannot be made on electricity imported from the grid.	• Clarifies treatment
Targeted Charging Review - Code Review - Electricity Network Access and Forward-Looking Charging[36]	Gives storage the same treatment as generators for the use of the grid and charging (eliminates residual charges). Differentiates between controllable and non-controllable Electricity Storage Equipment and excludes the latter from the requirements for Electricity Storage.	• Reduction of charges • Clarifies the technical requirements facilitating the providers of ancillary services to connect to the NETS • Increases competition in the provision of ancillary services
Final Consumption Levies	Exempted when importing electricity from the grid (unless for self-consumption)	• Avoids double charging[37]

[35] Following the Tempus Decision, the UK government ran a consultation to review the capacity market rules. BEIS's position was published in May 2020 and it is anticipated that the 2020 Regulations will make the necessary amendments to the Electricity Capacity Regulations 2014 and the Electricity Capacity (No. 1) Regulations 2019 to be considered by both Houses of Parliament.

[36] This decision was adopted on 20 May 2020 and implemented from 20 June 2020.

[37] This decision was adopted in May 2020, and effective from 1 April 2021, which amends the Connection and Use of System Code and excludes storage facilities from Balancing Use of System charges (BSUoS) when importing electricity from the grid.

Measures under Ofgem's consideration or pending parliamentary approval (continued):

Climate Change Levy	Electricity received and stored by the resource can be supplied free from the Levy, provided that certain conditions are met	• Reduction in costs
Compliance with (Grid and Distribution Codes, BSC, CUSC)	Sets forth general guidance for storage compliance when applicable	• Reduces regulatory uncertainty

designed for conventional generators (Schmitt and Sanford, 2018). Hence, these conditions act as entry barriers for storage to compete on equal terms.

The charts above evidence the numerous measures under consideration or taken by the relevant jurisdictions to level the playing field for storage, in terms of access to the grid, planning, taxation, technical requirements to participate in the different markets, revenue streams and co-existence with other regulatory mechanisms. It shows that the removal of barriers for energy storage requires careful planning.

Proposed regulatory guidelines for Argentina

Having discussed the main regulatory challenges of storage technologies and how they have been addressed by the US and Britain, the final section of this paper suggests regulatory guidelines to be considered by policymakers in Argentina. Prior to examining those challenges in detail, the following subsection succinctly describes the Argentine electricity legal framework.

Overview of the electricity sector

The legal framework of the electricity sector is composed of Act 15,336, Act 24,065 (the 'Electricity Act', which privatised the industry), regulatory Decree 1,398/92, The Procedures (a set of rules that regulate the functioning of the sector) and the transmission and distribution concession agreements, which include general duties of the operators of the network (Durand, 2005). Like the US federal design, the National Congress is the competent authority to regulate the wholesale electricity market (WEM) and interstate electricity transmission, while distribution is regulated, in principle,[38] by the provinces.

Until 1991, the electricity sector was controlled by state-owned companies. However, inefficient management and inadequate capital spending led to an extensive privatisation that restructured the industry, providing for: (i) vertical and horizontal disintegration, (ii) the award of concession agreements to private-owned distribution and transmission utilities, (iii) liberalisation of the generation segment, (iv) creation of the WEM, (v) introduction of open access rules for transmission and distribution networks, (vi) creation of an independent regulator (ENRE) following the British model and (vii) an independent administration and dispatch of the system (CAMMESA) (Durand, 2005). Therefore, the Electricity Act divided the sector into the three traditional segments. Whilst the generation sector is regulated as a competitive market, the transmission and distribution[39] sectors are regulated as monopolies. Hence, generators are entitled to collect prices while utilities receive rates previously approved by the regulator that are reviewed every five years.

As is the case in US and Britain, the centrepiece of the unbundling regime is the activity of transmission (Eliaschev, 2006a). According to the Electricity Act, transmission utilities must refrain from buying or selling electricity and these companies cannot be directly or indirectly controlled by generators, distributors or large users.[40] By contrast, the same economic group may hold control over a distribution utility and generation assets, provided that there is operational and legal unbundling.[41] Under federal jurisdiction, this is complemented by strict reporting obligations. Regarding distribution, the regulatory scheme varies from privatisation models to state-owned companies that provide distribution and generation services.

Under the original design of the Electricity Act, generators could execute power purchase agreements (PPAs) in the term market or sell electricity at the spot market where prices were established hourly on the basis of economic production cost. In the latter, generators were entitled to collect the spot price plus fixed capacity payments. Transmission and distribution utilities passed through the seasonal price (a regulated price set on a semi-annual basis and designed to mitigate the volatility of spot prices) and collected the approved rates. Under the concession agreements, whilst transmission companies are not subject to executing expansions of the transmission capacity (FIEL, 1999), the distribution utilities must satisfy all the demand over their exclusive area, execute the committed investments and expand the capacity under a criteria of reasonableness.[42]

The decade that followed the privatisation was characterised by substantial investment in the generation capacity (Pollitt, 2008) which ensured security of supply at a competitive cost (Durand, 2005). The regulatory design was regarded as novel and successful (Fonrouge, 2004). But, in 2002, as a consequence of a severe social, economic and political crisis, an Emergency Act[43] authorised the renegotiation of the concession agreements, which resulted in rates being frozen and converted into Argentine pesos. The renegotiation, which seemed to be finished almost 14 years later,[44] expectedly led

[38] The exceptions are Edenor and Edesur, which operate in the province of Buenos Aires and the Autonomous City of Buenos Aires. However, these were to be transferred to those jurisdictions.

[39] Not all provinces privatised the distribution sector.

[40] Sections 30 and 31.

[41] Sections 30-32 of the Electricity Act and regulatory Decree.

[42] Section 25 (b), (f), (h) of Edenor's concession agreement and Chapter 5.4, Sub-Annex I.

[43] Act 25,561.

[44] A new renegotiation (or extraordinary review) of the revised rates was instructed by article 5 of Emergency Act 27,541.

to numerous claims. Furthermore, for more than a decade that followed the Emergency Act, the sector was characterised by an intensive governmental intervention (Millán, 2007) that drastically altered the functioning of the market, putting security of supply at stake. In fact, the execution of corporate PPAs was suspended (today corporate PPAs are, in principle, only available for RE[45]), the freeze of rates led to underinvestment in the grid, and the artificial low prices of electricity (and gas, as the sector was also intervened) created an unbalance between demand and supply (Pollitt, 2008). Regarding pricing, although the dispatch is still carried out according to an economic criterion, the spot price is no longer applicable and generators are entitled to collect regulated prices for the available capacity and energy generated. Even though these regulated prices were being gradually updated with the aim of returning to the principles set forth in the Electricity Act,[46] they still fail to reflect the economic cost of generation. In fact, in the latest update,[47] the spot price was reduced even further rather than being updated due to the exchange rate fluctuations experienced by Argentina in 2019 and 2020 and on the basis of distributive justice and sustainability reasons. To sum up, as the electricity legal framework has been drastically altered, a regulatory review is absolutely necessary to restore the economic functioning of the market.

The government that took office in 2015 adopted several urgent measures to normalise the sector:[48] (i) gradual reduction of subsidies, (ii) renegotiation of rates, (iii) execution of public procurement processes for conventional generation and extension of the transmission capacity, and (iv) implementation of a robust framework to promote RE deployment (Program RenovAr and MATER regime for corporate PPAs) and distributed generation. Indeed, the country has witnessed a massive deployment of RE in a very short period of time (the installed capacity has increased from 223 MW prior to 2015 to 3,270 MW,[49] and a commercial operation of 2,300 MW is expected in the coming years) and this trend is likely to continue to meet the legal consumption target of 20% by 2025. Although the portion of intermittent RE generation is not yet significant to generate grid constraints, different factors suggest that the deployment of RE will almost certainly continue in the future, especially if co-located with storage assets. Firstly, the country has excellent capacity factors, especially for wind (between 40 and 55%). Secondly, the availability of vast unpopulated areas reduces sitting constraints. Thirdly, it is expected that technology costs will continue to decrease, without the need to resort to the subsidies that are currently in place. Hence, the co-location of storage facilities along with intermittent generation can be a feasible solution towards the decarbonisation of the sector as its major disadvantage will be significantly reduced. Naturally, this assertion will depend on access to finance at reasonable costs.

In addition to the prospects of RE deployment, Argentina's geographical characteristics also play a major role in storage deployment. In particular, the north part of the country is very rich in solar resource, the best wind resources are located in the south whilst the major consumption areas are located in the centre (mainly the province of Buenos Aires). As the distance between north and south is approximately 3,500 km, long transmission lines are required to connect generation with the main consumption centres. Although measures have already been taken to increase the existing infrastructure, presumably storage can play a major role to alleviate grid constraints and reduce the need for expansions. Finally, regarding storage, Argentina has two PHS facilities with a total installed capacity of 964MW in the provinces of Córdoba and Mendoza. The regulatory treatment is that of a generation asset and they are allowed to provide ancillary services to the grid.

First step: effective consultation

The starting point prior to the issuance of any regulation should involve inviting all existing and potential players of the electricity market to express their views. This consultation period will probably contribute to a higher-quality regulation and provide the regulator with the necessary information to foresee future inconveniences that could arise from its implementation. Consultation processes have usually been followed by Ofgem and FERC allowing the relevant stakeholders to have a say in the future regulation. In fact, developers identified that active cooperation between all actors created a positive environment for the early storage deployment in California (EUROBAT, 2016). In the case of Argentina, these procedures were followed in some energy-related subjects (RenovAr's PPA and bidding conditions, MATER regime), even when there was no express legal requirement to do so. It is advisable that this mechanism is enhanced prior to issuing a regulation for storage. To that end, the vague principles of Decree 1172/2003 regarding regulation development could be complemented with the consultation criteria set forth by the British Code of Practice, especially in aspects related to timing, duration and accessibility of the consultation. Foremost, the consultation should be executed at an early stage so that it can effectively influence the outcome of the regulation.

Asset class

To begin with, a technology-neutral (EUROBAT, 2016) legal definition of energy storage should be introduced in the revised Electricity Act. There is a consensus that regulation should not favour any specific technology for two main reasons: to avoid state capture by interested groups (Helm, 2005; Posner, 1974) and to reduce barriers for future innovation. In addition, it is advisable that the chosen definition resembles that of countries where storage is being deployed to clear the way for foreign investment. In fact, although investors perform exhaustive regulatory due

[45] With the exception of very specific regimes such as the 'Energy Plus Program' implemented under Resolution 1281/2006 of the former Energy Secretariat, which instructed Large Users to enter into PPAs with generators to satisfy their incremental demand. This scheme aimed to incentivise the development and financing of new generation facilities which has been stagnated due to the market intervention.

[46] Resolutions 19/2017 of the Electric Energy Secretariat and 1/19 of the Renewable Resources and Wholesale Market Secretariat.

[47] Resolution 31/20 of the Energy Secretariat.

[48] Given the interdependence of the gas and electricity sectors, it is relevant to highlight that the former government took several measures to incentivise the development of shale gas. Given the drop in the barrel price, these investments have significantly dropped.

[49] See CAMMESA (2020).

diligence prior to executing any investment, adopting a well-known definition and regulatory framework would certainly reduce uncertainties and attract more investments. Regarding the definition itself, the EU and Ofgem's proposed definitions seem to be more adequate and updated than FERC's as they correctly reflect the process of transforming electricity to another form of energy and the subsequent reconversion to electricity. The EU's definition goes beyond this and seems to leave the door open for future technologies that would allow the storage of electricity itself. Finally, even if California's approach of a commercially available and cost-effective technology is positive as storage should be chosen when its deployment is cost-effective compared to other solutions, such conditions should be included in lower-hierarchy regulations, like The Procedures or bidding conditions. Cost-effectiveness should be a *sine qua non* requirement when the storage operator requires a cost-recovery mechanism to ensure rates are just and reasonable. By contrast, when the asset's purpose is to participate in the market, the market rules will require such effectiveness. With regard to the scope, FERC's position not to include storage behind-the-meter that is only used for self-consumption seems the right path as it should deserve a differentiated regulatory treatment aligned with the Energy Distributed Act[51] or demand-side response. Thereby, a proposed definition for storage would be 'a resource capable of deferring the final use of electricity to a moment later than when it was generated or converting electrical energy into a form of energy that can be stored, the storing of that energy, and the subsequent reconversion of that energy'.

Regarding the legal classification, as is the case in many other jurisdictions, Argentina has classified the existing storage assets (PHS) as generation. Possibly the grounds for this choice is that the main service they provide is acting as bulk capacity and arbitrage between low and high prices. However, as energy storage can provide countless benefits, especially to a long and low-density infrastructure like Argentina's, FERC's solution to categorise storage on a case-by-case basis seems more appropriate. Therefore, in this preliminary stage of development, the adoption of a flexible approach seems better to allow the asset to be categorised in accordance with the main service it will provide to the system. This would allow the operator of the facility to estimate beforehand the main source of revenue it will be entitled to collect, regulated or market-based. Indeed, the introduction of storage assets in specific locations of the system could have major benefits in terms of grid expansion deferral, making the investment economically viable by only collecting a utility-rate-based cost recovery, instead of participating in the WEM, whilst under a different scenario the operator might choose to only participate in the market-based services to repay its investment. This allows the storage operator to estimate the future revenue of the project beforehand (regulated or deregulated depending on the service) to assess its economic viability. This regulatory approach seems flexible enough to encompass the different services, local characteristics and locations where the asset is to be installed and recognises that in certain circumstances regulated rates can be more suitable for the repayment of the investment. As Helm (2017) argues, avoiding overregulation is crucial to reduce energy costs. Furthermore, this can be a prudent starting point until the Argentine regulators and stakeholders in general have a wider understanding on the associated benefits of incorporating storage into the system. What is more, this case-by-case approach is also positive as it allows regulators to gain experience with individual projects rather than an entire industry (Stein, 2014).

The classification under one or other category should be subject to the competent authority's approval as is the case in the US. If the facility was to recover costs under rates, the ENRE should intervene when the asset is to be located in the transmission grid and the provinces when located in the distribution grid, according to their respective competences. In addition, public hearings should be held if required by the applicable legal framework to adjust rates accordingly. By contrast, the Energy Secretariat would be the competent authority when the asset will participate in the WEM.[52] It is possible that this prior approval would add an additional element of uncertainty and discretion that will eventually hinder investment in storage technology. This drawback can be mitigated by including strict time limits for the authorisation to be issued, under penalty of tacit authorisation. Furthermore, to reduce discretion and dissimilar regulatory treatment voided by the Constitution,[53] it seems paramount that general guidelines outlining the circumstances under which such cost recovery would be allowed are published, as FERC did in the Policy Statement. Given that the preference should be for market-based mechanisms in light of section 42 of the Constitution, such authorisation should be interpreted restrictively. But most importantly, it is crucial that the competent authorities strictly follow those guidelines and properly substantiate their decisions. Indeed, the differentiated treatment should be expressly justified according to the services provided by the resource in question.

Ownership

As explained earlier, under the Electricity Act cross-ownership restrictions apply between the different segments of the industry. Despite those clear rules, the Competition Authority has *de facto* repealed them and allowed mergers and acquisitions of groups with participating interests in transmission and generation (Eliaschev, 2006a). As a preliminary step, the reviewed electricity framework should strengthen those restrictions and, most importantly, the competent authorities should give full effect to them to ensure the adequate functioning of the market.

Furthermore, under the current regulatory design, distribution utilities and generation facilities can belong to the same group because distribution utilities are only entitled to collect an approved rate and the regulated seasonal price that is passed to the generators through CAMMESA. As a result, there is no risk of distorting the market and discriminating in favour of the operator's generation assets. However, should DNOs be allowed to own storage assets and participate in the WEM, there is a clear risk of discrimination and cross-subsidisation

[51] Act 27,424.

[52] Annex 17.1, The Procedures.

[53] Section 16.

as indicated by Ofgem and the European Commission. Hence, the federal regulator has different policy choices to prevent this from happening. It should be clarified that although the general principle is that distribution is subject to provincial jurisdiction, the Federal Congress's jurisdiction to impose these restrictions could be justified under the constitutional interstate commerce clause (section 75.13) given that the participation of DNOs in the WEM could threaten its functioning. In fact, the Supreme Court has consistently ruled that all market participants that perform activities in the WEM are subject to the federal rules as the provision of electricity is included in the interstate commerce clause.[54]

A first alternative could be a market-based solution as suggested by Helm, who explains that all the system operator's obligations could be tendered and the most efficient solutions should be carried out (Helm, 2017). The role of the operator would be coordinating and auctioning, a 'neutral market facilitator' in the words of Ofgem. An application of such proposition could be the grid operator calling for a technology-neutral public procurement process when an infrastructure need is identified along with all the relevant technical information. The most cost-efficient solution should be awarded the work and recovered through cost-recovery mechanisms. If the operator expects to participate in the WEM, measures as those in place by FERC should be taken. In the first place, preference should be made to the grid's need. To avoid cross-subsidisation and competition distortion, FERC's solution could be applied by requiring the operator of the asset to credit consumers with the market revenues to ensure compliance with one of the guiding principles of the Electricity Act: ensure just and reasonable rates.[55]

A hybrid solution could be that proposed by Sioshansi (2012) and applied in the US to natural gas. The owner of the resource auctions the storage capacity to different parties, each one utilising it for a different service, market-based or regulated, separating the value streams and parties. The author argues that the financial viability could be compromised as the owner would require long-term contracts prior to the execution of the investment whilst the regulated interested party would need the regulator's approval beforehand. It seems that this drawback could eventually be overcome by executing long-term agreements with the interested parties and seeking regulatory approval for the regulated cost recovery as a condition precedent for the agreements. To adequately balance all the interests at stake, the authorities' approval could be conditional on achieving a certain level of performance. The parties involved could seek in turn performance guarantees from the developers to mitigate their risks.

A third choice that has been suggested (Stanfield et al., 2017) is to allow utility ownership of the assets sharing control with a third party that operates the asset in the market. The utility would only be allowed to recover investment costs through rates while the operator can do so by revenues in the market. The main advantage of this alternative is that financial costs would be shared by the utility and third party, possibly contributing to the deployment of storage technologies as the financial situation of utilities has been seriously affected after the freeze of rates. As in the first alternative, preference should be given to the services provided to the grid.

Finally, DNOs could be allowed to own storage facilities within the same group provided that additional regulations to ensure complete independence and operational ring-fencing are included. Indeed, the Electricity Act, contrary to the Directive, fails to include requirements to ensure independent decision making and information sharing between the two sectors given the explained lack of risk of market distortion. But, if the DNOs' holdings were to own storage assets, regulations such as those in place under the EU legal framework could be issued in terms of separate accounting, the designation of compliance officers, the execution of compliance programmes and cool-off periods for the people responsible for the day-to-day management.[56]

Taking into consideration the alternatives proposed there are strong constitutional and legal principles to tip the balance in favour of market-based structures. Firstly, there is an unequivocal constitutional mandate that advocates for freedom to conduct a business.[57] This implies that third parties should be allowed and encouraged to deploy storage assets in the exercise of such basic freedom, instead of utility operators taking advantage of their monopolistic position to operate storage assets. Secondly, policymakers are called by the Constitution to ensure and foster competition and control natural monopolies from market distortions.[58] In the same vein, the Electricity Act includes as essential aims of the electricity sector: the adequate protection of users, the promotion of competition, the encouragement of private investment in the generation, transmission and distribution sectors with the aim of fostering competition whenever possible, and the legal prohibition on abuse of dominance. In fact, the concession agreements provide that the exclusive area of control could be left without effect provided technology innovations allow new business structures where the service can be provided under a market structure.[60] Therefore, there is a clear constitutional and legal preference for market-based structures rather than monopolies. Undoubtedly, public procurement processes may entail higher administrative costs and longer execution timelines, but, as the process is standardised, these will presumably decrease. Hence, it can be concluded that there are strong arguments to prohibit TSOs and DNOs from owning and operating storage assets in Argentina. Notwithstanding, it seems to be a prudent policy choice to include strict exceptions to such a general restriction when efficiency grounds justify it and non-participation in the market by the operator is assured. As anticipated, the EU limits the exceptions to lack of market-based solutions whereas Britain requires demonstration that ownership by the operator is more cost-effective. The former seems a better approach in light of the general principles applicable as third-party ownership should be preferred if

[54] Fallos 305:1847; 322:2624; *EDEN SA v Provincia de Buenos Aires*.

[55] Section 2(d).

[56] Section 35 of the Directive.

[57] Section 14.

[58] Section 42.

[59] Sections 2(a),(b),(f) and 19.

[60] Clause 3.

provided at a reasonable cost. Network operators should only be allowed to own storage facilities under strict circumstances: (i) when it is a necessary and cost-effective solution to the obligation under the concession agreement to expand the grid or provide the service adequately, (ii) when prior approval of its convenience has been granted by the competent authority, and (iii) when measures are in place to ensure that the operator will not participate in the purchase or sell of electricity related to the facility. Regarding the latter, similar measures in place under the Argentine regulatory framework for gas could be implemented that require the gas transport or distribution companies who store gas to have separate accounts and be subject to the monitoring of the regulatory authority.[61]

Pricing

The measures taken or under consideration by the relevant jurisdictions analysed herein evidence that several steps need to be taken by policymakers in Argentina to pave the way for energy storage deployment. Firstly, the creation of different sub-markets is regarded as essential to enable storage to collect different revenue streams (Winfield et al., 2018). This has to be accompanied by the design of participation models that level the playing field for storage. Apart from adopting a technology-neutral approach, the market categories and parameters should signal the ramp response, location and duration of the service (Meyer, 2014), so that the market can determine which resource adds the most value to the system and remunerate them accordingly (Ugarte et al., 2015). Complementary regulations aimed at reducing administrative costs for planning, ensuring access to the grid, charging of proportional network costs, clarifying treatment under existing regulations and ensuring environmental requirements are met should also be implemented.

In fact, the creation of ancillary service markets seems to be a key prerequisite to foster storage deployment (EUROBAT, 2016). Under Argentina's current legal framework, only certain services are remunerated to generators (ie primary frequency response and supplemental reserve), but such remunerations fail to reflect the actual value provided to the system. Paradoxically, the price that generators are entitled to collect for the delivered electricity fails to reflect the economic cost, breaking a basic principle of the Electricity Act.[62] Therefore, the creation of ancillary service markets, which was considered under a proposal to review the existing regulatory framework (Krakowiak, 2019), seems a key step to smooth the way for energy storage deployment. In the same vein, as one of the traditional revenues of storage technologies is arbitrage, the restoration of the spot price to reflect the effective cost of electricity generation seems paramount. In fact, today the energy consumed by residential and commercial users fails to reflect such cost, which most certainly hinders one of storage's main sources of revenue. Storage assets should also be allowed to participate in capacity markets, as the tender instructed under Resolution SEE No. 21/2016, as having a long-term contract that secures long-term revenue streams would ease the bankability of the project (Meyer, 2014).

Finally, even though further technical studies have to be executed, it seems that storage can play a relevant role for the Argentine network. This reinforcement and expansion of the network that could be avoided by using storage needs to be adequately valued and remunerated. Under the Argentine concession agreement, the operator is subject to maintain and operate the transmission capacity but not to expand it. Hence, The Procedures include three alternatives to expand the capacity:[63] (i) construction, operation and maintenance agreements between the user and transmission utility; (ii) bilateral agreements for minor expansions and (iii) public procurement processes. Under the latter, the executor proposes a maximum annual royalty to be collected for a maximum payback period of 15 years, subject to ENRE's approval. Although this expansion mechanism has not been exactly successful (FIEL, 1999) it could be applied by analogy when the deployment of storage is equivalent to a transmission expansion deferral. This will possibly ease financing as the storage operator would have an approved revenue stream for a long period of time. Furthermore, it has the advantage that it fits into the existing regulatory framework without the need to resort to new regulatory mechanisms. What seems crucial, however, is that regardless of the chosen policy, resorting to schemes that undermine the legal principles on which the electricity sector relies, like that of the specific charges created under Act 26,095 (Eliaschev, 2006b), should be strictly avoided. Respect for the principle of Rule of Law is a basic prerequisite for the correct functioning of the market.

In the case of distribution grid reinforcement, regardless of whether the works are included in the committed investments or have to be borne by the distribution operator under the concession agreement, the cost could be recovered through the approved rate and passed through to the storage owner. By contrast, if the expansion of the capacity was not already included in the approved rates, the beneficiaries of such expansions should bear the cost through rates. As suggested in the subsection above, the asset would be owned, operated and maintained by a third party who provides the service according to the utility's need. From a financial perspective, this third party bears financial and technology risks while the utility controls compliance with the agreement and pays a fee that is passed through to consumers (Akhil et al., 2015). Similarly to the expansion of the transmission capacity, the storage operator would be entitled to collect a rate over a predefined period of time that would enable financing. Even though this mechanism of cost-based recovery could be designed to ensure a future revenue for the repayment period, additional safeguards would presumably be required by investors given Argentina's history of freeze rates. RenovAr's design could be replicated and eventually a guarantee from the World Bank could be required to secure the investment. In fact, the World Bank has already announced financing to foster storage deployment (World Bank, 2018).

To sum up, a future legal framework for storage needs to strike the right balance between a flexible scheme that appropriately values all the services provided to the system as a whole in terms of decarbonisation, reliability, investment deferral or

[61] Article 34 of Act 24,076 and its Regulatory Decree No. 1738/92.

[62] Sections 35 and 36.

[63] Sections 2.2, 2.3 2.4. There are also national and provincial funds destined to the expansion of the transmission capacity.

avoidance and, at the same time, avoid double recovery that may affect the adequate functioning of the market. When cost recovery is done through rates, the principle of just and reasonable[64] should be the overarching principle to solve any conflict.

Incentives

Even though the measures highlighted in the section above might seem enough to create a market, project financing is a major barrier for storage deployment given its high capital costs (Miller and Carriveau, 2018). In fact, Ruz and Pollit (2016) have identified that the lack of long-term contracts both in Europe and California is a major obstacle to access financing. This is especially relevant in a country like Argentina, which has a track record of significant sectorial interventions (proven by the alteration of the whole electricity system over the last 15 years) and, therefore, has higher financing costs than those of the region.

Hence, for storage development to become a reality, additional safeguards need to be in place for investors. In fact, the successful deployment of RE was due to the robust scheme in place that ensured long-term PPAs (20 years) and an adjusted bidding price in US dollars, backed by a treasury fund (FODER) and counter-guaranteed by the World Bank.[65]

There are several measures available to incentivise storage deployment. The execution of long-term PPAs appears to be crucial for financing (Bhatnagar et al., 2013). In fact, this structure has been widely used in the US for storage co-located with a generation facility (Miller and Carriveau, 2018). In Argentina, as explained earlier, storage assets that are categorised as transmission could be entitled to collect the regulated cost recovery for a determinate period of time and this would possibly ease financing. The issue arises when storage's primary function resembles that of generators. In that case, storage could participate in capacity markets and compete with conventional generators under schemes such as Resolution SEE No. 21/2016. This requires adjusting the technical requirements to effectively level the playing field for storage. Another alternative is resorting to the established auction mechanism for RE. Although Act 27,191 relieves RE generators from committing power capacity,[66] future rounds of program RenovAr could allow higher prices to be awarded for independent power producers (IPPs) that include storage in their bids. Under this scheme, the IPP would receive a price for both the available capacity and energy generated and could eventually include in their financial model an estimation of the potential revenues to be collected in the different sub-markets, as any other conventional generator. These payments should be complemented with strict non-compliance penalties to avoid discriminatory treatment against conventional generators. Furthermore, policymakers should evaluate the convenience of allowing co-location with existing RE plants and execute PPAs for the available capacity.

For standalone projects, the financial structure seems to be more challenging as the asset will presumably deliver several services simultaneously or switch instantaneously from one to another. Therefore, provided that the sub-markets are created, different agreements, related according to the timing and technical capabilities of the resource, would have to be designed. The term of those agreements should be reasonable enough to allow the repayment of the investment. In fact, the 2016 T-4 Auction in Britain, which was very popular for storage, awarded a contract with a four-year term (Hassan and Dalton, 2018), and the proposed amendment to the Capacity Market in Britain allows storage to enter into contracts with terms of up to fifteen-years. The consultation process would play a relevant role to understand the developers' needs with regard to contract terms and conditions to ease financing.

Another incentive could be to include a procurement target, as done by California, which proved to be successful to bring storage into discussion. The inclusion of a target in Argentina seems a reasonable regulatory choice as it is consistent with the structure in place for the promotion of RE.[67] Indeed, a study performed by BEIS (2018) shows that effective regimes are characterised by high levels of consistency between the instruments used and institutional structures. To define the target, CAMMESA should identify the fragile areas of the grid where energy storage can be optimised by means of a technical study and the competent authorities should set the targets accordingly. One question that needs to be asked, however, is who should be bound to comply with the target. If the answer is the network operators, as is the case in California, the major drawback is that their financial situation is critical as a result of the freeze of rates, which has been reinstated under the Emergency Act 27,541 and lower hierarchy regulations.[68] Hence, the storage developer may not have a credible counterparty in the respective agreement, which may hinder financing. An alternative path would be to follow Act 27, 191's design, where all electricity users have to comply with the target, allowing large users to opt out from CAMMESA's joint purchase mechanism and comply individually with the consumption target[69]. Residential users would comply through DNOs, which would be represented by CAMMESA. This approach, although consistent with RenovAr's structure, has the major drawback that CAMMESA has to remain as an ISO and that means it cannot be a counterparty of PPAs. This is a major issue to be addressed by policymakers, but it will ultimately depend on the time of its instrumentation.

Finally, fiscal incentives have proved to be an essential tool for projects with high up-front costs (Miller and Carriveau, 2018). A similar scheme to that available for RE projects could be designed for storage. Indeed, fiscal incentives available for RE

[64] Sections 2b and 40 of the Electricity Act.

[65] See Navia et al. (2016) for a summary of RenovAr.

[66] Section 19, Act 27,191.

[67] Act 26,190.

[68] After more than 15 years of freeze rates, the former administration formally concluded the Integral Tariff Review to gradually apply the new rates agreed with the transmission and distribution concessionaires. The Emergency Act 27,541, passed in December 2019 under the current administration, authorised the National Executive Branch and provinces who adhered to either restart the renegotiation of the Integral Tariff Review or conduct an extraordinary revision to reduce the impact of such rate increase for residential, industrial and commercial consumers (Article 5).

[69] In order to comply with the consumption target, the Argentine RES framework allows large users (those who exceed certain consumption thresholds defined in the electricity framework) to comply be means of: (i) CAMMESA's joint purchase mechanism or Program RenovAr; (ii) self-generation or co-generation or (iii) by contracting its share of RES in the MATER regime.

could be extended for co-located storage facilities, considering the RE facility and the resource as a unique project for the purpose of qualifying for the incentives. The main issue will be whether co-location with existing RE facilities will also benefit from the incentives. This is a major issue in the US with stakeholders pressing for Congress to clarify that the investment tax credit is applicable to all energy storage technologies (ESA, 2018). Presumably, the existence of fiscal incentives or other measures that lower the cost of capital are key for storage deployment.

Overall, there are many regulatory steps to be addressed to foster energy storage deployment. Key factors to be considered by policymakers in Argentina are the categorisation of storage assets in the regulatory framework, defining the market participants that will be entitled to own and operate the assets, and the design of appropriate value streams for their financial viability. Investors may also demand additional safeguards as storage assets are capital intensive. To that end, innovative structures as that of RenovAr will be key for storage deployment's success.

Conclusion

The purpose of this paper was to propose guidelines for a future regulation to pave the way for the development of energy storage in Argentina. To that end, the landmark rules issued by two developed countries with sophisticated electricity sectors, the US and Britain, were analysed from a critical viewpoint to enhance our understanding of the treatment of the main regulatory barriers and to ultimately extract the best practices for storage deployment in Argentina in light of its legal framework.

Storage resources are regarded as the 'holy grail' towards the accomplishment of the energy transition (Trabish, 2010). The current state of progress suggests that storage's deployment is feasible if the appropriate regulatory incentives are in place. Thereby, regulation has a crucial role to remove barriers and allow this new player to enter the scene.

The need to review Argentina's electricity framework is clear-cut. The US and Britain's experience evidence that an adequate regulatory framework cannot happen overnight. Careful planning and cooperation with all the relevant stakeholders are essential steps towards an appropriate and robust legal design to put the necessary incentives in place for storage deployment. By contrast, lack of regulation or policy errors will possibly hinder these innovative solutions, and, as a result, delay the realisation of the new paradigm to the detriment climate change mitigation.

The following conclusions can be drawn from the present study. First, the promotion of storage in Argentina is going in the right direction towards accomplishing the basic constitutional and legal principles of the electricity sector: the efficiency of public utilities and safeguarding security of supply in a sustainable manner.[70] Furthermore, to address the key regulatory challenges storage poses, a flexible approach for its classification seems the right path given the novelty of these new technologies. In terms of storage ownership, the future regulation should be based on preference for market-based solutions as there is a clear constitutional and legal choice for competitive solutions rather than monopolistic structures. Moreover, adequate pricing of storage is a crucial step for its financial viability. To that end, removal of technical requirements designed for conventional generators is necessary to level the playing field for storage as is the creation of sub-markets to ensure different revenue streams. Finally, given Argentina's history of significant interventions in the electricity sector, additional safeguards for investors should be designed to secure repayment of the investments, as for RE deployment.

The current study has examined storage from a legal perspective. Hence, further technical research should be conducted to assess the concrete benefits and savings that storage deployment can have on the Argentine electricity sector. The execution of pilot projects, like those carried out by the US and Britain, could be a suitable path towards this aim. However, the cost-effectiveness of storage compared to other solutions is not only dependent on further research but also on the cost of gas. Finally, further studies need to examine more closely the links between storage ownership by DNOs and the potential effects on markets.

Biography

María Eugenia Mattera is an Argentinian-qualified lawyer, with seven years' experience in top-tier law firms, specialised in regulation and Energy infrastructure projects, mainly renewables. She holds an LL.M. in Energy & Natural Resources from Queen Mary University of London and a Specialisation in Administrative-Economic Law from Pontifical Catholic University of Argentina. She is currently working in the Legal and Compliance Department of a Solar IPP, based in London.

[70] Section 41 and 42 of the Constitution and 40 Electricity Act.

Regulation of curtailment risk in wind and photovoltaic energy projects in Uruguay.

Maria Eugenia Bagnulo Cedrez

Maria Eugenia Bagnulo Cedrez

Introduction

When renewable generators invest in a wind farm or a photovoltaic project in Uruguay, they should consider a range of risks that could appear throughout the life of the project. Curtailment is one of such risks. This is defined as a typically involuntary decrease in the output of a generator from what it could otherwise produce given available resources (for instance wind or sunlight).[1] What happens if energy developers deliver a costly project, which starts to produce energy, but subsequently the system operator restricts the grid for commercial or operative reasons? This would result in the generators being forced to dispatch less energy than the energy they are able to produce. The revenue of a photovoltaic or wind farm project is associated with the quantity of energy produced by the power plant during a certain period of time.[2] Thus, the existence of an operational or commercial restriction on the grid could have a direct financial impact on such projects. Curtailment in Uruguay increased considerably in the last ten years as a consequence of the significant development of renewable energy projects resulted in energy production soaring beyond energy demand.[3] The growth in energy generation was not accompanied by the deployment of transmission and distribution lines. As electricity must be 'consumed' as soon as it is produced because it cannot be stored easily,[4] curtailment became a reality rather than a risk. Consequently, different voices started to appear, expressing their concerns about the necessity of a legal framework to address the matter: firstly, generators of renewable energy, who requested a guarantee that their projects will not be restricted arbitrarily, as well as compensation in case such restrictions occur;[5] secondly, the state power utility, which is the off-taker in the Power Purchase Agreements ("PPAs") and received the generators' claim regarding curtailment;[6] thirdly, the lenders, who lend the money to build the projects (under the format of project finance) and need to ensure that there will be enough cash flow to repay the debt service;[7] and finally, the Executive Power attending those concerns, which enacted a decree - Decree 59/015[8] - to determine how the curtailment risk must be allocated between the different actors. However, far from ending the discussion, the decree installed further debates.

Since no research on the regulation of curtailment risk in wind farms and photovoltaic energy projects in Uruguay has been conducted to date, this paper seeks to fill this gap and contribute to the literature. Recommendations emanating from this chapter could be a useful resource for the policymakers implementing regulatory measures.

This paper is divided into three sections. The first section sets the context by introducing an overview of curtailment from a theoretical perspective. It includes a definition of curtailment; a cause analysis; a review of diverse mechanisms implemented by states to mitigate curtailment; and practices

[1] Lori Bird et al. 'Wind and solar energy curtailment' (National Renewable Energy Laboratory)

[2] Ibid.

[3] 'UTE paid US$59 million for wind energy not used' (El Observador) <www.elobservador.com.uy/nota/ute-pago-unos-us-59-millones-por-energia-eolica-que-no-utilizo-201814500> accessed 15 February 2019.

[4] Van der Veen RAC and Hakvoort RA, 'The Electricity Balancing Market' (2016) 43 Utilities Policy 186.

[5] 'UTE will pay for all wind energy even if it does not use it' El Pais <https://negocios.elpais.com.uy/noticias/ute-pagara-toda-energia-eolica-use.html> accessed 10 February 2019.

[6] El Observador (n 3).

[7] 'Important features of bankable PPAs' (OPIC) <www.opic.gov/sites/default/files/files/10%20Elements%20of%20a%20Bankable%20PPA.pdf> accessed 20 February 2019).

[8] Decree No.59/015 of 25 February 2015.

in terms of compensation when it occurs (1). The second section critically analyses the legal framework concerning curtailment in Uruguay, with particular reference to the provisions of Decree 59/015. The Nationally Determined Contributions ("NDC´s") of Uruguay in the Paris Agreement and an overview of the national energy policy are also considered. Besides, it reviews how the USA and China - jurisdictions with similar levels of curtailment to Uruguay - have legally addressed curtailment risk and compares this to the Uruguayan approach (2). The third section includes conclusions and recommendations for policymakers that demand for serious reconsideration of the matter in the country (3).

Context and overview of curtailment risk from a theoretical perspective

Concept and causes

Curtailment occurs when the power grid operator issues an instruction to restrict the power output of a generator to maintain grid stability and system safety or to balance the offer and demand of electricity at a given time.[9] The causes of curtailment could be due to grid constraints or commercial reasons.[10] The former is directly associated with a technical aspect: the grid capacity, which is not designed to support unlimited injection of energy. Thus, when the quantity of energy available exceeds the grid capacity, curtailment necessarily enters into the scene.[11] The latter is due to the dichotomy between offer of and demand for energy. When energy supply exceeds demand and there are no available methods to store or export it to neighbouring countries, curtailment is used as the main tool to conserve energy balance.[12] In this scenario, the system operator, which takes curtailment decision, is obliged to accept less wind or solar energy than is available. Increasing the interconnection between the grid and renewable power plants is key to the successful deployment of renewable technologies.[13] Therefore, when high levels of renewable energy generation are planned by a country, implementation of infrastructural changes on the grid and regulations should also be considered.

Importance and mechanisms of mitigation

In the case of renewable energy projects, business success depends on the ability to produce electricity whenever there is sufficient sunlight or wind to power facilities. As wind and photovoltaic projects have important capital costs but no fuel costs (variable costs), maximizing the output of energy increases capability to recover capital costs.[14] Different methods could be implemented by diverse stakeholders to reduce the impact of curtailment, such as regulatory, technical and contractual measures.[15] Regulatory measures[16] tend to coordinate the generation of energy by developing systems to schedule energy production by location and forecast of resources.[17] Technical measures aim to strengthen transmission capacity either through installation of new transmission lines or by investing in the modernization of existing grids. In addition, the reinforcement of the network interconnection between countries is also an option,[18] as excess electricity in one state could be the solution for lack of electricity in another.[19] Alternatively, curtailment could be reduced by developing techniques to store energy[20] and promoting the use of electric vehicles,[21] as happens in China.[22] Curtailment risk is in some circumstances contractually addressed by the off-taker (the utility) and the renewable energy generator in the PPA, generally under the form of 'take-or-pay' contracts.[23] In these contracts, the parties agree that the utility must pay for any energy that is produced or could have been produced if it had not been curtailed, generally establishing a fixed quantum of curtailment (in number of hours per year) without obligation of compensation, and a provision of compensation beyond the limit of curtailment fixed in the agreement. The big challenge of this modality is calculating and verifying the 'available' energy that was not 'delivered.[24] Another possibility is the creation of a 'curtailment market' in which bidders might allocate their energy pricing into two different components: a monthly fixed price in US dollars for MW/h of energy actually produced and a price in US dollars for MW/h of energy (offered) to be curtailed by the grid operator. The fixed charge provides bidders with the ability to identify a guaranteed cash flow stream for their project. This mechanism leaves the curtailment pricing subject to the market through a competitive bidding process. Rather than compelling the utility and energy consumers to assume the whole risk, this process creates a sharing of curtailment risks leading to a fair and transparent way to monetize it.[25]

Controversial aspects of curtailment

The most controversial aspects from a global perspective

[9] Anjali Viswamohanan et al., 'Rethinking Renewable Energy Power Purchase Agreements' [2018] CEEW journal; L Kane and G Ault, 'A Review and Analysis of Renewable Energy-Curtailment' (2014) 72 Energy Policy 67; L Bird et al., 'Wind and Solar Energy Curtailment: A Review of International-Experience' (2016) 65 Renewable and Sustainable Energy Reviews 577.

[10] H Schermeyer, C Vergara and W Fichtner, 'Renewable Energy-Curtailment: A Case Study' (2018) 112 Energy Policy 427.

[11] Anjali (n 9).

[12] Bird (n 1).

[13] Dworking et al., ´Energy Transmission and Storage´ in Michael Gerrard (ed.), *The Law of Clean Energy* (Chicago, American Bar Association, Section of Environment, Energy, and Resources, 2011).

[14] Bird (n 1).

[15] Anjali (n 9).

[16] Resolution N° 281-E/2017, Ministry of Energy and Mining of Argentina, arts 7,8.

[17] Anjali (n 9).

[18] 'Wind Europe views on curtailment' (Wind Europe) <https://windeurope.org/wp-content/uploads/files/policy/position-papers/WindEurope-Priority-Dispatch-and-Curtailment.pdf> accessed 20 March 2019).

[19] Bird (n 9).

[20] N Zhang et al.,'Reducing Curtailment of Wind Electricity in China' (2016) 184 Applied Energy 987; I Kuzle et al. (eds), 2014 IEEE International Energy Conference (ENERGYCON 2014), Dubrovnik, Croatia, May 2014 (IEEE 2014) 572; Bird (n 9).

[21] N Zhang et al.,'Reducing Curtailment of Wind Electricity in China' (2016) 184 Applied Energy 987; I Kuzle et al. (eds), 2014 IEEE International Energy Conference (ENERGYCON 2014), Dubrovnik, Croatia, May 2014 (IEEE 2014) 572; Bird (n 9).

[22] Bird (n 19); Zhang (n 20).

[23] OPIC (n 7).

[24] Anjali (n 9).

[25] Sterling et al, 'Proactive solutions to curtailment-risk' <http://www.firstsolar.com/-/media/First-Solar/Documents/Grid-Evolution/Proactive-Solutions-to-Curtailment-Risk.ashx?la=en> accessed 27 March 2019.

are: whether compensation should be paid to renewable generators for the energy curtailed; the allocation of the risk; the criteria followed for the curtailment decision; and the methods used to compensate.[26] Most of the literature and legislation reviewed suggest that the energy curtailed should be compensated by the party best able to control and manage the curtailment.[27] In most of the electricity markets the grid operator takes the curtailment decision.[28] However, it is not often the grid operator that assumes the curtailment risk; it is instead frequently allocated, as it occurs in Uruguay, to the off-taker. The methods most commonly implemented by diverse jurisdictions regarding curtailment decisions are last first out,[29] pro-rata,[30] shedding rota,[31] technical-best,[32] greatest carbon benefit,[33] generator size,[34] and curtailment markets.[35] The mechanisms used to determine the amount of compensation vary by type of curtailment. Generators are most commonly compensated at the market value price of the electricity curtailed, but this compensation does not normally include revenue lost from green certificates or other types of support mechanisms. In some jurisdictions, generators are compensated only for a percentage of the energy lost, which usually varies from 15 per cent to 50 per cent. The general rule that applies in terms of curtailment is that congestion curtailments (associated to the grid capacity) are compensated while those related to the security of the national interconnected system are not.[36]

Legal framework of curtailment in Uruguay

Overview of the National Energy Policy and the NDCs

Uruguay is globally considered to be one of the models of energy transition due to the prompt development of renewable energy in recent years.[37] The lack of local fossil fuel resources, the ineffectiveness of hydropower plants during dry periods, the international commitments assumed by the country in the Paris Agreement and its favourable natural conditions for the generation of photovoltaic and wind energy laid the foundations for renewable energy growth, with the exception of nuclear power, which is prohibited by law.[38] This scenario was accompanied by an energy policy that establishes guidelines for the development of renewables during the 2005–2030 period.[39] The central aims of the policy are to achieve diversification of the energy matrix through the increase of renewable energy; reduce the dependency on fossil fuels; and promote energy efficiency. The policy set a target of 50 per cent of primary energy from renewable energy sources by 2015.[40] In 2017, the energy matrix (of generation by source) was composed of 98 per cent renewables,[41] exceeding substantially the fixed policy goals. In consequence, Uruguay became one of the countries in the world - following Denmark - with the highest penetration of renewables.[42] However, although the energy policy defines a schedule to expand the transmission and distribution capacities of the electricity sector,[43] this has still not been implemented. It should be noted that the most significant policy instrument used to incentivize renewables deployment was the Feed-In-Tariffs (FIT) implemented in an auction system.[44] These offered a fixed price (expressed in US dollars), independent of the electricity market price,[45] for every kilowatt-hour (kWh) of electricity produced, during the contract period, which is normally twenty (20) years.[46] These contracts were concluded between energy generators and the state power utility, which has monopoly on the transmission, distribution and commercialization of energy, excluding the generation, which is subject to free competition.[47]

Uruguay ratified the Paris Agreement on 19 October 2016,[48] and since then it has strengthened its commitments to combat climate change, even though according to the United Nations the country's share of global emissions was only 0.05 per cent.[49] The government assumed - in the filed NDCs[50] - the commitment of achieving an energy matrix

[26] M Joos and I Staffell, 'Short-Term Integration Costs of Variable Renewable Energy' (2018) 86 Renewable and Sustainable Energy Reviews 45.

[27] Bird (n 1)

[28] Joos and Staffell (n 26)

[29] The first generator to be curtailed is the last to connect to the network.

[30] Curtailment is divided equally between all generators contributing to a constraint.

[31] Curtailment is based on the order specified in a predetermined rota.

[32] It curtails in order of size of contribution to the constraint.

[33] Curtailment is based on the reductions of CO2/emissions.

[34] Curtail the largest generator that is contributing to a constraint first.

[35] The market supposes the existence of generators submitting bids on an annual/quarterly/monthly basis in which they indicate the willingness to be curtailed. Generators with minimum cost to the system will be curtailed first.[19] Bird (n 9).

[36] Bird (n 1).

[37] 'Uruguay makes dramatic shift to nearly 95% electricity from clean energy' The Guardian <www.theguardian.com/environment/2015/dec/03/uruguay-makes-dramatic-shift-to-nearly-95-clean-energy>; 'Uruguay:revolution rather than energy transition?' (Energy Transition) <https://energytransition.org/2016/08/uruguay-revolution-rather-than-energy-transition/>; 'Energy Transition' (IRENA) <www.irena.org/energytransition> all accessed 23 March 2019.

[38] Law n° 16.832.

[39] 'Energy Policy 2005-2030' (Ministry of Energy of Uruguay) <www.eficienciaenergetica.gub.uy/documents/20182/22528/Pol%C3%ADtica+Energ%C3%A9tica+2005-2030/841defd5-0b57-43fc-be56-94342af619a0> accessed 23 March 2019.

[40] 'Renewable Energy Policy Uruguay' (IRENA) <www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RE_Latin_America_Policies/IRENA_RE_Latin_America_Policies_2015_Country_Uruguay.pdf?la=en&hash=A76CA561F1B9FE54B25756097F5A55D20ED8EB33> accessed 24 March 2019.

[41] 'Energy Balance/2017' (Ministry of Industry of Uruguay) <www.miem.gub.uy/sites/default/files/presentacion_ben2017_final.pdf> accessed 24 March 2019.

[42] G Wynn 'Uruguay nears world record wind and solar' (Energy & Carbon) <https://energyandcarbon.com/uruguay-poised-overtake-denmark-wind-solar-leader-market-share/> accessed 24 March 2019.

[43] IRENA (n 40).

[44] Steven Ferrey, 'Sale of Electricity' in Michael Gerrard (ed.), *The Law of Clean Energy* (Chicago, American Bar Association, Section of Environment, Energy, and Resources, 2011).

[45] Bird (n 1).

[46] Ibid.

[47] Law n° 16.832

[48] Paris Agreement (UN Treaty Collection) <https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en> accessed 24 March 2019.

[49] 'Report Paris Agreement' (UN) <https://unfccc.int/resource/docs/2015/cop21/eng/10.pdf#page=30> accessed 24 March 2019.

[50] 'Uruguay first Nationally Determined Contribution' (UN) <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Uruguay%20First/Uruguay_First%20Nationally%20Determined%20Contribution.pdf> accessed 24 March 2019).

composed of 57 per cent renewables in 2015, which was far exceeded. Nevertheless, it also has as goals for 2025 - which are still to be achieved - the introduction of electricity storage technology (including accumulation and pumping systems), the consolidation of smart grids and meters, and the development of transmission infrastructure.

The Uruguayan example demonstrates how by removing regulatory barriers and developing a well-designed auctioning system, the investment in wind and photovoltaic energy projects could increase considerably in a short period of time.[51] However, as will be exposed hereinafter, the incentives granted to support the development of renewables are not enough by themselves to develop the sector properly. Moreover, a certain level of deregulation is still required to fill the new gaps that have appeared as a consequence of the accelerated growth.

Analysis of Decree 59/015

Decree 59/015 was approved to determine the allocation of curtailment risk to the state utility,[52] imposing an obligation for the utility to purchase the energy that generators of wind and photovoltaic energy are able to produce but are not delivering to the grid as a consequence of an operational restriction imposed by the grid operator. Moreover, it provides that the curtailed energy must be compensated at the same price as agreed in the PPA. In order to calculate and obtain compensation for the energy curtailed, the generator must deliver the measures of wind resource or solar radiation registered in the power station to the entity who administers the electricity market (ADME). The decree provides that the measure of the quantity of energy curtailed, which is one of the most difficult aspects to be determined considering that it is non-generated energy, must be calculated by ADME, who must approve a technical procedure for that purpose and implement a wind resource and solar radiation forecasting system.

However, curtailment regulation in Uruguay contains conceptual inaccuracies that are giving rise to different interpretations by diverse stakeholders. This could lead to disputes between participants of the electricity market. The lack of an express definition of what is meant by 'operational restriction' is the first challenge faced in interpreting the text of the decree. Thus, it is not clear if commercial restrictions are included within the scope of the decree. Considering that the categorization of a restriction as operative or commercial might determine the obligation of paying compensation or not, the lack of conceptual clarity could cause disagreement over whether the compensation is due. Likewise, the decree does not stipulate a calculation formula for the quantum of the energy curtailed, allowing ADME to determine this at its discretion.

Additionally, the curtailment risk is allocated to an actor - the utility - that has no intervention in the curtailment decision. The utility has to bear overall responsibility for the decision taken by a third party (the grid operator). This seems to be in discordance with the general principle that the risk must be assumed by the party who is in the best position to manage it. In other jurisdictions the curtailment risk is shared (between generator and utility). All things considered, it seems reasonable that the curtailment risk should be assumed on a shared basis and not only by the state power utility as the decree provides.

From the generators' perspective it could be alleged that the provision for compensation is appropriate as it guarantees to the investor that during the term of the contract all energy produced or able to be produced will be purchased by the utility at a fixed price. However, from the utility´s point of view, the solution is not reasonable, as it obligates them to compensate for 'invisible energy' at the same price agreed in the PPA, which is usually higher than the energy price in the electricity market. The lack of flexibility in Uruguay to implement mechanisms such as a competitive system of bidders in which the determination of the price of curtailment is subject to market rules is related to the monopoly that the state power utility has in all the stages of the electric cycle except generation. Uruguay is a clear example of how with a dose of flexibility (such as through incentives, FIT and tax exceptions) it is possible to develop renewables in a short period of time. Nevertheless, it seems that the monopoly of the state power utility needs to be modified. A competitive system would probably make the electricity market more efficient, with more convenient prices for all stakeholders.

There is no criteria in the decree that must be followed by ADME in order to take the curtailment decision, suggesting that the grid operator can curtail arbitrarily without following a specific criteria. Although this may not be a problem for the generators as they will be compensated regardless of the criteria followed, new disputes could appear if a certain level of coordination (regarding the curtailment decision) is not implemented. Namely, if the curtailment decision always affects the same generators, the lifespan of the technology used by them - solar panels or wind turbines - could be affected disproportionately compared with those who are never curtailed. Indeed, there is not a provision in the decree that determines that renewables have priority dispatch to inject the energy produced to the grid. Thus, the grid operator can curtail renewable power plants without considering the effective cost of the production from an economic or environmental perspective. This does not go hand-in-hand with the obligations that Uruguay assumed in the Paris Agreement.

It should be noted that to date the utility has not refused the payment of any curtailment compensation, having applied the decree even in cases in which the application seems to be questionable. The reasoning of the utility, after doing a global analysis of the cost of demand–supply, is that it is less costly to pay a curtailment compensation - when it is due - than to pay the price that would have been set for the energy if the energy curtailed had not been available in the market at the moment when the curtailment occurred.[53] Behind the reasoning there is an analysis that not only considers the price of the generation of energy in comparison to the price of other

[51] 'Uruguay Wind Energy Programme' <www.thegef.org/news/uruguay-wind-energy-programme-uwep> accessed 25 March 2019.

[52] National Administration of Power Plants and Electric Transmissions of the State (UTE).

[53] 'Interview to Casaravilla' <www.enperspectiva.net/enperspectiva-net/entrevista-central-viernes-23-de-diciembre-gonzalo-casaravilla-2/3/> accessed 02 April 2019.

energy sources such as fuel oil or gas, but also an eventual profit if energy is exported to Brazil and Argentina.

From the investor point of view, the curtailment regulation gives a reliable legal framework to invest in renewable energy, not only because the energy curtailed is compensated, but because of the convenient price of the compensation.

Nevertheless, from the state power utility perspective, the curtailment regulation is not favourable to its interests and there are still many aspects to be addressed. Indeed, curtailment regulation is having a negative impact on public opinion, which is not only against the rise in the electric tariff but also expresses notorious disagreement with the curtailment compensation paid by the state.

The method to calculate the quantity of energy not produced is not defined in the decree but has been defined by ADME through a calculation formula described in the separate document 'Procedure for operational restrictions'.[54] The legal validity of the document has not been challenged, but is questionable considering that ADME is a non-state public entity and, according to the Uruguayan constitution, lacks the power to enact any kind of legislation.[55]

Notwithstanding the above, the document provides a definition of curtailment including commercial and operational varieties in the scope of its concept. It establishes a list of situations that are expressly excluded from the definition of curtailment such as operational restrictions allowed in PPAs, those that happen due to a force majeure event, and those caused by acts, facts or omissions directly or indirectly attributable to the generator affected by the restriction. With regard to the two latter situations mentioned, new difficulties could arise at the moment of interpreting their extent. Force majeure events are not defined either in the decree or in the separate document, and as a consequence the force majeure definition provided in the Uruguayan law should be considered. The Uruguayan Civil Code does not define force majeure neither defines which conditions must fulfil an event to be considered as a force majeure event. Therefore, the definition by scholars must be considered: force majeure events are those that are out of the control of the parties and appear as unpredictable, irresistible and unavoidable.[56] Taking into consideration the wide range of causes that may lead to a curtailment, the technical nature of these causes and the difficulty in proving the causal link, it seems it would be difficult to contemplate the force majeure nature of a curtailment event.

The document determines that the following criteria for making the curtailment decision must be adhered to by the operator of the grid in the following order: first, the criteria for the security operation of the system (without defining a security operation of the system); and second, the criteria of economic dispatch in which the curtailment decision will be based on the cost of generation, curtailing those that have the highest costs first. Thus, the curtailment decision is always based on the security of the grid and an economic decision without taking into consideration, as in other jurisdictions, environmental aspects like the carbon emissions of the generator to be curtailed.

The USA and China´s curtailment regulation

Curtailment is only an issue in jurisdictions where the offer of energy soars beyond the demand. Consequently, the USA and China will be used as comparable examples with the Uruguayan curtailment regulation. Although it is not an objective for this paper to deeply examine the curtailment regulations in the above jurisdictions, they will be briefly analysed for the sole purpose of comparing with the Uruguayan regime.

Firstly, in the USA the curtailment risk is not addressed through legislation as it is in Uruguay, but it is left to the market rules or the parties' freedom under PPA clauses, resulting in varying curtailment practice from state to state. Progressively, negotiated contract provisions are addressing use of curtailment hours and in most cases a sharing of risk between the generator and off-taker is agreed.[57] Although this method may be more convenient for the off-taker and the developer, the system is not perfect and there are still aspects that need to be addressed. For instance, a certain level of coordination between the Renewable Energy Certificates Systems and the curtailment decision should be considered. If a developer does not comply with the renewable target because of an act of a third party - as happens when curtailment occurs - it is not clear whether the penalty for not complying should be applied. This was exactly what happened in the case of *TXU Portfolio Management Company LP v FPL Energy LLC* 2010 Tex. App. Lexis 5905.[58] In that case, the off-taker sued the generators for damages caused as a result of an alleged breach of the PPA - for not delivering a minimum quantity of energy and renewable energy credits - due to curtailment decisions taken by the grid operator. The generators counterclaimed the off-taker arguing they had breached the PPA by failing to ensure enough 'transmission capacity' to allow generation and delivery of all of the electricity they were theoretically able to generate given wind conditions.[59] Finally, the Court of Appeals ruled that the purchaser of electricity was entitled to liquidate damages because the wind power station did not meet their contractually required generation amounts.[60] The case highlights the importance of utilizing clear drafting language in PPAs concerning the curtailment matter and parties' responsibilities if it occurs.[61]

[54] 'Process for the implementation of curtailment' (ADME) <https://adme.com.uy/dbdocs/Docs_secciones/nid_324/ProcedimientoParaGestiondeRestriccionesOperativas_v201512091831.pdf> accessed 26 March 2019.

[55] Law N° 16.832, art 4.

[56] 'Force Majeure concept' <http://guiasjuridicas.wolterskluwer.es/Content/Documento.aspx?params=H4sIAAAAAAAEAMtMSbF1jTAAAUMjc3NDtbLUouLM_DxbIwMDCwNzAwuQQGZapUt-ckhlQaptWmJOcSoA4q2LTjUAAAA=WKE> accessed 02 April 2019.

[57] Bird (n 1)

[58] Willian H Holmes 'Texas Court of Appeals Decision in Important Wind Curtailment Case' <www.lawofrenewableenergy.com/2010/08/articles/renewable/texas-court-of-appeals-hands-down-decision-in-important-wind-curtailment-case/> accessed 01 April 2019.

[59] Ibid.

[60] 'Wind Power Stations Must Pay For Lack of Generation' (IOWA University) <https://www.calt.iastate.edu/article/wind-power-stations-must-pay-lack-electricity-generation> accessed 11 April 2019.

[61] Ibid.

Secondly, China is combating curtailment mainly through the implementation of new technologies, improving generation scheduling, forecasting and the application of automatic generation control systems. To promote grid-integration of wind and solar, a Renewable Portfolio Standard was promoted, requiring grid operators to meet targets for lower-carbon generation. China is an example of a country that is on the way to reducing curtailment by organizing the production of energy per location, implementing energy storage, smart power generation, and techniques to forecast the resource availability and the demand of energy. Curtailment in China is mainly concentrated in the north regions with abundant wind resources and centralized installed capacity, thus there is a geographical mismatch between generation-resource-rich areas and load consumption centres.[62] As curtailment goes uncompensated, China's renewable energy owners bear big financial uncertainties and a policy was implemented by the Energy Agency banning investment in provinces with more than 20 per cent curtailment rate.[63]

Conclusions and recommendations

Uruguayan curtailment regulation should be modified to make the curtailment decision more economically and environmentally efficient. Curtailment regulation through a decree does not seem to be the best solution to the problem that the curtailment risk presents. Not only because of the difficulties in its application - as a result of the imprecision of the decree - but also because the solution it provides allocates the risk without taking into consideration the variables that could appear at a given time in the electricity market. The curtailment regime is entirely favourable to the investors, allocating the whole risk to the state power utility, which has to pay a compensation for energy not delivered at a fixed price. Curtailment should be addressed by the stakeholders freely through the PPAs rather than regulated by a decree. The international experience of curtailment, as it occurs the USA, suggests that the best way to manage curtailment risk is either through the PPA agreeing a risk shared between the utility and the generator or through a market-based system of bidders.

The FIT used in Uruguay, in which a fixed price per kW/h of energy generated is agreed for a term of 20 years, does not seem to be the best instrument to address curtailment risk. It is impossible to know that the best drafting for the parties at the moment of the signature of the agreement will remain as such until the end of the contract. Therefore, a curtailment price fixed in a PPA under FIT might not be an acceptable option. The monopoly of the state electricity utility in Uruguay appears as the principal obstacle for the creation of a curtailment market. The curtailment could be regulated through a curtailment market in which all the off-takers - which should be registered in a curtailment registry - must express their willingness to be curtailed, bidding a price in an auction system for the case being curtailed. The successful bidders (the ones that offered a lower price for the curtailment) would be curtailed. This competitive market should have a certain level of organization so that all the off-takers are curtailed in the same proportion with a cap percentage allowance per year. A trade of curtailment certificates could be created between the off-takers to achieve the aims fixed in the rules. Equally, to avoid the curtailment proliferation, as in the example of China, many actions should be implemented, such as the enforcement of the grid capacity, strengthening of interconnection with neighbouring countries to facilitate the export of electricity, and the development of technologies to store energy. Regarding the latter, and considering the advances China is experiencing in the field, Uruguay should consider attracting investment in the scope of the Bilateral Investment Treaty (BIT) that both countries have signed.[64] If storage techniques are developed in the country and the export of energy to Brazil and Argentina continues to increase, the levels of curtailment will progressively decrease becoming insignificant. If that happens, curtailment will probably cease to be a risk giving rise to new problems-as are those connected with energy storage- that will required a rapid response from a legal point of view.

Biography

Maria Eugenia Bagnulo Cedrez is a Uruguayan-qualified lawyer specialised in arbitration and litigation in the energy sector who also holds a Bachelor in International Relations. She completed an LL.M. at Queen Mary University of London, in 2019, with a focus on energy and arbitration. She has 6 years' experience working as a state-lawyer, for the state-power utility in Uruguay, where she worked in the legal affairs department, in the wind-farms projects group and the litigation department. She also worked as a legal assistant in an International Oil Company in London and currently is working, in the International Litigation and Arbitration group of an International Law-firm in London.

[62] 'China Renewable Curtailment risk' (Bloomberg) <https://data.bloomberglp.com/bnef/sites/14/2017/10/Chinas-Renewable-Curtailment-and-Coal-Assets-Risk-Map-FINAL_2.pdf> accessed 01 April 2019.

[63] Qui Ye, 'Wind Curtailment in China' (Energy in Transition Series) <https://www.brookings.edu/wp-content/uploads/2018/03/wind-curtailment-in-china-and-lessons-from-the-united-states.pdf> accessed 14 April 2019.

[64] BIT Uruguay & China <https://investmentpolicyhub.unctad.org/Download/TreatyFile/794> accessed 02 April 2019.

Reflections: A year in an age of uncertainty.
Pablo Sobarzo Bahamondes

Pablo Sobarzo Bahamondes

The beginning of the LLM was a time of discovery and excitement. I remember that slightly carefree feeling of just enjoying yourself, open to the possibilities the year brings.

An LLM is a once-in-a-lifetime opportunity to meet new people. Everyone had a different reason to embark on the programme. There were commercial lawyers, seasoned litigators, aspiring activists, or simply graduates with a newly found passion. Add geographical diversity on top, and the variety shows: no two students fashioned their study curriculums the same.

However, students flocked towards the programme's 'core', formed by Introduction to Energy Law, Petroleum Law and Contracts, and Energy Transactions. The modules in Energy Arbitration and Renewable Energy also proved tremendously popular.

Yet taught modules are only one side of the LLM experience. Meetings, conferences, student parties, cultural activities, networking events, careers fairs, there is an unfathomable number of things happening in London. The City is one of the most exciting places I've lived in and the CCLS lies at its very centre.

Nonetheless, we soon received news from China, at first, and then other countries. COVID-19 grew into a pandemic and disruption ensued. Some colleagues chose to travel back home, forsaking career opportunities. Some chose to stay – either unable to go back or hoping to reap the rewards of staying put.

It is hard to transcribe in a few lines the vast complexity of the crisis. My youngest colleagues were aghast at their career prospects crumbling. Others were worried about their families and home countries, or their own health. My colleagues kept commendably level-headed as they hoped for the best. Most students focused on keeping themselves busy and in touch with their classmates, making the most of the technology at their disposal.

The end of the lockdown came certainly as a liberation. Social life was returning for those who had chosen to remain. Now the question was, what to do after the masters?

COVID-19 has impacted the energy sector in various forms. For the oil and gas industry, it's been a double whammy – the virus on top of a sharp decline in prices. For the energy and power subsector it has been a different experience. In the UK, the National Grid reported its longest streak in history of coal-free electricity generation.

The current challenge is reconstructing a greener, better economy in the wake of the virus. Sustainability means bright prospects for renewable energy sources; to the point that oil and gas companies are now changing their investment focuses – and even their names (think Ørsted!).

The same sense of radical change applies to the labour market. COVID-19 heralds an unprecedented and very competitive period for recent graduates. COVID-19, combined with the digital age, has the potential to democratise access to opportunities beyond borders. People from any place and background might be able to have a shot at a vacancy.

At the same time, firms will likely be more cautious and demanding when recruiting. Students will need to differentiate themselves at each step of the recruitment process. Excellent academic credentials are now only a part of what's expected from future lawyers: soft skills, business acumen, languages and experience in different sectors can make the difference between two outstanding candidates.

Contrary to some pessimist views, I believe these changes are not a storm – not for the market, nor for students – but an opportunity.

Countries and companies are declaring their intention to go carbon neutral in the upcoming decades. Recent legal reforms – in the UK and France for instance – are opening the doors to new forms of corporate governance, more in line with the

sustainable development paradigm boldly brought forward by Dr Brundtland over thirty years ago.

A few years into the past, decarbonisation of some sectors seemed unthinkable. Now, Tesla is one of the largest automobile companies in the world. Several 'activist funds' are pressuring the stock market to take climate change into account when planning their investment decisions. The EU is working on its own Green Bond Standard. This is encouraging news; however, we remain far from achieving the necessary reductions in greenhouse gas emissions to ensure our common future.

Perhaps some of the longest-lasting effects of COVID-19 will not be health-related. Coupled with technology, the virus has radically changed the manner in which law firms and in-house teams work. Cost-cutting will be central to these developments, leading to an increased use of artificial intelligence and software, streamlined decision-making processes, and the emergence of ultra-specialised boutique firms. Business travel is likely to get reduced too.

Flexibility and resilience can help students a great deal. As a former boss once told me, a career in law is like a marathon. Think long-term: instead of coveting a specific position, developing in-demand skills seems a more sensible option. Not achieving 'plan A' – a defeat for many law students used to overachievement – might actually be an opportunity and the solid foundation of a successful career.

These are, as a lecturer told me, strange times. But I take solace in the fact that I've enjoyed a solid year of formation and Queen Mary has prepared us thoroughly to face this period of change.

Biography

Pablo Sobarzo Bahamondes is a Chilean qualified lawyer and holds LLM degrees from Heidelberg University and Queen Mary University of London. He was the 2019/20 Energy and Natural Resources Law LLM student representative. He currently works in a leading London-based boutique firm specialising in public international law.

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