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Fossilised Capital: Price and Profit in the Energy Transition

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ABSTRACT
Getting renewable energies to a position of price competitiveness with fossil fuels has long been seen as a key challenge to the counter-carbon energy transition. Less discussed, but more significant to future investment trajectories in the capitalist global economy, is the relative profitability of fossil-fuel and renewable-energy production. Having recently pledged over the next few decades to decrease hydrocarbon production and increase renewable-energy generation, Europe's three oil and gas majors – BP, Shell and Total – now institutionally straddle the two energy worlds and their respective economic dynamics. This article takes stock of the companies' announcements and of the existing investment and profit landscape to assess the prospects for their own corporate energy transitions and thus for the global energy transition more broadly.

KEYWORDS
Energy transition; oil and gas; renewable energy; profitability; investment

'The vision of a net-zero emissions world', the International Energy Agency (IEA) announced in the 2020 version of its flagship *World Energy Outlook* report, 'is coming into focus' (IEA 2020). Used by governments to set policy and by companies to calibrate strategy, the *Outlook* peers into the IEA's crystal ball to map possible energy futures. The 2020 *Outlook* models four scenarios, differentiated among other things by the speed with which the coronavirus pandemic is brought under control and with which, in turn, the world subsequently transitions to carbon neutrality. All four scenarios share two crucial features, however. First, the power sector 'takes the lead' in the shift away from fossil fuels; the transition is slower in sectors – such as steel and cement and long-distance transportation – resistant to electrification. And second, within the sphere of electric power generation, solar photovoltaics (PV) is 'the main driver of [renewables] growth'. Why? Primarily, because of price. Solar PV, the IEA notes, 'is consistently cheaper than new coal- or gasfired power plants in most countries, and solar projects now offer some of the lowest cost electricity ever seen'.

If the numbers were new – in the past the IEA had consistently claimed that coal remained the cheapest source of electricity – the nature of the transition narrative was not. The IEA's scenario-building has long fitted within, and arguably even shaped, a much wider, hegemonic interpretive model, which posits that the key economic determinant of the necessary transition to a zero-carbon energy system will be the relative affordability of different energy sources. 'Arguments about fossil fuels versus renewables', as James Purtill (2020) succinctly put it in commenting on the 2020 IEA report, 'often come down to price'. Indeed they do. Earlier in the year, Martin Wolf, the chief economics commentator of the *Financial Times*, offered a paradigmatic example. 'Suppose', Wolf (2020) wrote, 'that a transition towards a global zero-emissions economy by 2050 is indeed technically feasible. That does not mean it is likely to happen as a result of purely economic

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forces'. Wolf gave two reasons. One was what he described as 'huge inertia in making shifts to new technologies'. But the first reason was price: 'the cost advantages of the decarbonised alternatives are, in many areas, at best modest'.

The premise of this article is that this interpretive model gets capitalism substantially – though not completely – wrong; and that, to the degree that the transition away from fossil fuels is, and will remain, fundamentally capitalist, the model also therefore gets the drivers of that transition substantially wrong. The transition, and the 'fossil fuels versus renewables' question at its core, is about investment, not price. To be sure, investment decisions are themselves *shaped* by price, as indeed they are shaped by government policy and regulation – which, needless to say, can and to one extent or another will reshape the 'purely economic forces' acting on technology shifts as referred to by Martin Wolf; and which, deployed in a highly interventionist way, would potentially render the energy transition something other than strictly 'capitalist' (i.e. market driven). But investment decisions are not *determined* by price. The nub of investment is profit.

Informed by this perspective, the article ventures a different type of stock-taking of transition prospects than the IEA's. If our focus should be not on price but on investment and profit (a premise that the article seeks to justify), what can we say about current prospects? The article offers one particular 'cut' at this question, focusing on the activities and investments of major Western fossil-fuel companies – specifically, oil and gas producers.

This may appear an odd analytical choice. But there is a logic. First, the European-based majors – BP, Royal Dutch Shell (hereinafter, 'Shell') and Total – have all recently signalled their strategic intention to ramp up renewables production, thus ultimately pivoting, in BP's words, from being oil companies to energy companies; these three companies are the empirical focus of the article. Second, and more importantly, the pace and extent of the energy transition is as much about the winding *down* of fossil fuels as it is the ramping *up* of renewables – and the trajectories of the oil and gas majors are clearly pivotal in this regard. Of course, there are other important hydrocarbon producers, not least the national oil companies of petro-states; but a consideration of three of the leading Western majors can, at the very least, illuminate pertinent investment considerations.

The main finding of the article is that for all the falling price of renewables such as solar, from the perspective of companies such as BP, Shell and Total the investment logic appears to remain weak.

The article proceeds in three sections. For guidance on understanding the economic drivers of capitalist energy transitions, the first section looks primarily to history: that profit, rather than price, is in fact the critical factor, is the lesson of ground-breaking recent research into the ascendancy of fossil fuels during the formative stages of the Industrial Revolution. The first section also situates the article in relation to the existing literature on energy transition. The second section prepares the ground for the analysis of contemporary oil-major strategies by providing a brief overview of the economics of renewable energy production and considering important recent market developments bearing on those economics. The final section examines recent announcements by BP, Shell and Total as to their own respective transition plans. It argues that there are good reasons to be sceptical even of what are, in reality, relatively modest ambitions for transition and thus emissions reduction – and that close attention to the protagonists' own discussion of their investment priorities underlines why.

Fossil Capital

As in recent decades the urgency of the climate crisis has become more apparent and as clean, renewable energy production has begun to make meaningful inroads into energy delivery infrastructures, a vast literature on the ongoing energy transition being undertaken globally has emerged. This literature is centrally concerned with describing what the transition looks like – its pace and forms and how these vary geographically – and with understanding the key determinants of these transition trajectories.

The transition literature is not primarily 'economic' in nature. Rather, scholars have typically conceptualised the transition in terms of different 'socio-technical' regimes comprising, in the work for instance of the influential Frank Geels, (a) networks of actors, (b) formal, normative and cognitive rules, and (c) material and technical elements. Successful transition, it is argued (e.g. Verbong and Geels 2007), requires positive and mutually-reinforcing developments in all three such domains. Economic factors represent just one of the multiple dimensions – alongside political, cultural and technical ones – on which clean-energy innovations compete with incumbent energy infrastructures.

But, to the extent that the transition literature does concern economics, its focus, like the wider, public-facing, IEA-style discourse referenced earlier (and which at one level it undoubtedly informs), is squarely on price. To win out, renewables must be cheaper. This standpoint is evident, for example, in evaluations of the economic competitiveness of specific technologies (e.g. Breyer *et al*. 2017, on PV solar). It is also evident in evaluations of transition progress in specific territories (e.g. Ouyang and Lin 2014, on China). Indeed, to the degree that there is debate, it is often not about whether cost is the relevant economic driver, so much as which measure of cost is most fit for purpose (e.g. Aldersey-Williams and Rubert 2019).

It is perhaps unsurprising that it is widely believed that renewable energy needs to be cheaper than fossil fuels in order to comprehensively supplant them, for the received wisdom has long been that fossil fuels *themselves* originally became capitalism's principal energy source on such an economic basis. The decisive shift from water and the waterwheel to steam and the steam engine – and thus to coal – occurred in England in the 1820s and 1830s, and was concentrated in the cotton industry. In the historiography of that energy transition, numerous theories have traditionally circulated: for instance, that water power was no longer sufficiently plentiful to power factory-based cotton capitalism; or that coal-fired steam was more productive than water. But the dominant narrative, as Andreas Malm (2016) has shown, was that coal – and steam – was cheaper: 'fossil fuels won the original race because they were cheapest, and the same advantage will now have to be secured for renewable alternatives if they shall have a chance … Capitalists slowly unrolling technologies with lower prices: this is the manual to follow' (p. 14).[1]

Malm's own *Fossil Capital* (2016) shatters that received wisdom, however. It does so in two ways. First, Malm meticulously demonstrates that the existing orthodoxy is belied by the facts. It is simply not true that water was scarce, in absolute terms or relative to emergent industrial requirements. Nor is it true that waterwheels could not generate as much power as steam. And, most significantly of all, it is not true that steam was cheaper. On the contrary: *water* was, and remained, cheaper, mainly because it required no human labour to call forth its powers, whereas coal could only be transformed into an energy source through 'massive' inputs of costly human labour-power (p. 91).

Second, Malm assembles a series of compelling alternative claims. He does so by treating energy transitions as what, under capitalism, they self-evidently are – phenomena crystallized through a series of active 'investment decisions, sometimes with crucial input from certain governments but rarely through democratic deliberation' (p. 268). Why, Malm asks, did early English cotton capitalists and then capitalists in other industrial branches decide to actively invest in steam?

His answer is partly that steam was spatially advantageous. Unlike a waterwheel, a steam engine could be put up more-or-less anywhere, enabling the industrial capitalist to set up in the fast-growing northern towns where labour-power (not to mention other sources of agglomeration economies) was concentrated, and many of the biggest of which happened to be located close to coal-mines. Water power was of course considerably less flexible; firms had to go to *it*, source workers from elsewhere, and then invest in maintaining them – in the shape, most notably, of worker colonies, where the cotton mill-owner, lacking the luxury of being able to readily replace workers, was much more vulnerable to strike action.

Steam was also temporally advantageous. Water's irregularity of supply became a significant problem in the context of the increasing demands of export markets. Furthermore, the flexibilization of working conditions and long working days that were required to compensate for such irregularity and associated work downtime were substantially fettered by the 1833 Factory Act and later the 1847 Ten Hours Act. As Malm (p. 192) writes: ‘water followed its own clock – not that of the factory’. Steam-based production was much less affected.

Last but not least, steam fitted much better in the brave new world of capitalist private property. Largescale, reservoir-based water-power schemes would perhaps have been preferable to steam for cotton capital at large, but such inherently collective arrangements fell foul of opposition from individual capitals who saw such schemes as a restraint on their independence and private property rights. Private property and water ‘did not mix well’; the latter, invested in at scale, required ‘complicated communal relationships’ (pp. 119-120). Coal and steam did not suffer the same ‘collective drawbacks’.

For our purposes, in any event, the specific reasons for the victory of the steam engine and coal are less important than the more general implication of Malm’s account. Not only, he shows, was the early-nineteenth-century energy transition the combination of a series of investment decisions. But those decisions ultimately hinged not on price, but on profit. The spatial and temporal advantages of steam consisted in the fact that that technology represented ‘a superior medium for extracting surplus wealth’ (p. 124).

If the history of capitalist energy transitions suggests that today’s focus on price is misplaced, so also does political-economic theory. As Anwar Shaikh (2016, pp. 615–7), among others, has observed, political economy – or what Shaikh refers to as the ‘classical economics’ of Smith, Ricardo and Marx – fundamentally turns not on price but on profit. Unlike neoclassicism (supply-side) or Keynesianism (demand-side), political economy, Shaikh says, is ‘profit-side’. Production ‘is always initiated on the basis of prospective profit’, and ‘both effective supply and demand are regulated, through different channels, by expected profitability’. If capitalists do not foresee profitability, they do not invest. While notable in Smith and Ricardo, profit-sideism is most pronounced in Marx. ‘Production is organised and investment is undertaken by capitalists’, writes Weisskopf (1979, p. 341) of the Marxian theory, ‘in order to make profits; a fall in the average rate of profit – and consequently in the expected profitability of new investment – is bound sooner or later to discourage such investment’. Even if they are confident about demand conditions, firms will be reluctant to invest if they think the return on investment will be too low.

Working in this tradition, contemporary political economists of energy systems have certainly highlighted the centrality of profit. Tim DiMuzio (2012, p. 369–70), for instance, submits that to grasp the core dynamics of carbon capitalism, it is necessary to refer to ‘business decisions based on profit margins’ and not ‘engineering, ecological or environmental concerns’. Matt Huber provides one powerful example, demonstrating that attempts in the 1930s to limit oil production in the US through prorationing were designed to stabilise prices precisely to safeguard industry returns – this was ‘not so much “cheap oil” for consumers but “cheap-enough oil” to facilitate mass consumption *and* profitable operation for high-cost producers’ (2013, p. 185). The profit–investment calculus is also integral to accounts of fossil-fuel capitalism provided by orthodox economists with political-economic sensibilities, not least Michael Grubb (see Grubb *et al*. 2014).

Yet, to date, such profit-sideism has not been mobilised analytically specifically in relation to today’s energy transition, notwithstanding Malm’s rooting of the transition *to* fossil fuels in profit considerations. Instead, the political-economic literature on the contemporary energy transition tends to be concerned with different (if connected) matters. The predominant research themes have been the role of the state and of vested industry interests in enabling or frustrating the transition (e.g. Breetz *et al*. 2018; Newell 2019; Hochstetler 2021). It is of course true that profitability – and its relation to investment patterns – is uppermost in mind of those industry interests. But political-economic scholars have not explicitly examined the shifting profit nexus associated with different energy generation technologies – the ways and extent to which, that is, these different technologies enable capitalists to extract surplus value and to accumulate capital, and with what implications for transition prospects. This, then, is the focus of the present article.

Trajectories of Renewable Energy Investment

Around a decade ago, the world saw a step-change in levels of investment in renewable energy. Prior to 2010, total annual global new investment had never exceeded c. $180 billion; since 2010, it has never been lower than c. $235 billion (Frankfurt School-UNEP Centre/BNEF 2018, p. 12).

Needless to say, there were numerous different reasons for the historic slowness in the growth of renewables investment. But many of the most important were economic in nature. As Tobias Schmidt (2014), among many others, has pointed out, the cost structure of low-carbon technologies such as solar and wind – the two energy sources that account for the vast bulk of renewables investment in the past two decades – was and is a crucial factor. Both are highly capital intensive, which is to say that almost all the costs of energy production are incurred upfront: think of wind turbines. Here, notably, there is a significant contrast with high-carbon alternatives, where, for say a coal or natural gas-fired power plant, between 40 and 70 per cent of the costs are related to fuel and operating and maintenance expenses (Krohn *et al*. 2009, p. 8).

The capital-intensive nature of solar and wind projects long heightened perceived investment risk and, as a result, project financing costs (Schmidt 2014, p. 238). '[P]romoting renewables requires considerable resources with very long payback periods for projects with no proven track record', Sujata Gupta wrote, as late in the day as 2012. 'Banks have a high risk perception of such projects and are hesitant to finance renewable energy projects' (Gupta 2012, p. 175). The economic constraints on the development of renewables were, as Gupta further noted, only compounded by the fact that governments worldwide continued to massively subsidise competing fossil-fuel energy sources, to the collective tune of an estimated $312 billion in 2009 (ibid.).

In the face of these perceived economic hurdles to renewables investment, governments in both the Global North and South, at various junctures, responded by introducing mechanisms of promotion and subsidisation. In the UK, for example, the Renewables Obligation – which offered effective (if indirect) subsidies for large-scale renewable electricity generation projects – was introduced in 2002. It was later replaced by feed-in tariffs with contracts for difference (CfD), which provide producers with a constant off-take price uncoupled from the wholesale market price. It speaks volumes that Ofgem, the industry regulator, rationalised these tariffs with the observation that investors wary of 'the high fixed costs and low marginal costs of most low-carbon generators' require 'certainty of revenues' in order to commit financing (Ofgem 2017, p. 88). Meanwhile, in Indonesia, to take an example from a very different part of the world, historic barriers to renewables investment were lowered after 2015 through regulatory measures such as the introduction of favourable long-term tariffs designed to support the development of new solar projects (Kennedy 2018, p. 232).

Stimulated by such government measures, capital responded with alacrity. Around the world, investment leapt, both in the technology deployed at renewable-energy plants and in the development and operation of solar parks and wind farms themselves. As it did so, costs fell dramatically, driven down by intensifying levels of competition. 'The barriers to entry in the [renewables] sector', as Nick Butler (2019) has observed, 'are low – anyone can become an electricity producer and schemes that allow surpluses to be sold back into the grid are encouraging both businesses and households to build their own capacity'. Between 2010 and 2020, the average lifetime ('levelised') cost per megawatt-hour of electricity generated fell by 56 per cent for onshore wind, 62 per cent for offshore wind and fully 87 per cent for PV solar (Economist 2020). Projects that would not have been remotely viable at earlier cost levels now were.

If the prices that generators of renewable energy were able to charge had remained the same, profits would have boomed. But of course, prices ordinarily did not remain the same. In the context of the aforementioned lack of entry barriers and associated intense competition, producers accepted lower and lower prices, and utilities and other major off-takers eagerly encouraged and exploited their willingness to do so. Governments, meantime, saw the fall of production costs as reason to swiftly move to reduce or even remove the subsidies they had previously offered, widely transitioning to awarding renewable-energy contracts on the basis of reverse auctions whereby, rather than buyers bidding prices *up* (as per traditional auction formats), sellers bid prices *down*.

By 2017, zero-subsidy bids were recorded for the first time in European offshore wind auctions (Frankfurt School-UNEP Centre/BNEF 2018, p. 12), and the UK's first solar farm to be built without subsidy opened for business (Ofgem 2017, p. 87). Reverse auctions as a rule had become, in Frankel *et al.*'s (2019) words, 'extremely competitive'. And the terms of the private power-purchase agreements (PPA) through which generators frequently contract to sell specified volumes of electricity were becoming markedly less attractive for renewables operators. Not only did prices on renewable-energy PPAs fall to record lows, but the period over which off-takers were willing to offer generators fixed prices – thus shielding them from the merchant-price risk of spot-market volatility – shrank (Merchant 2019).

The upshot of all this is not hard to fathom. Profits have been substantially squeezed. 'In today's competitive renewable energy environment', the International Renewable Energy Agency (IRENA) observed in 2018, 'margins are increasingly narrow' (IRENA 2018, p. 4). And as profits were squeezed, so also, in turn, were investor returns. 'You have all these investors that are like, "How do I get my hands on the next solar project?"', Richard Matsui, a specialist in risk management for solar investments, told Emma Merchant in January 2019. 'The aggressive guys win the deal right now', Matsui continued; and as Merchant (2019) noted, 'aggressive' in the investor world means 'a willingness to accept lower returns, which puts pressure on everyone else in the market to shift their standards as well'.

The key question, of course, is how far such investor willingness to accept lower returns will stretch. Matsui's comment suggested significant tolerance; and Merchant, seemingly, concurred, referencing a 'flood of new investors' bringing a 'wall of money' to solar. But a matter of months later, in May 2019, IEA data showed renewable energy deployments stagnating for the first time since the turn of the century; and the agency's executive director, Fatih Birol, described the development as 'deeply worrying' (cited in Crooks 2019). IRENA had actually sounded the alarm a year earlier. 'There is not a lack of investment finance', it pointed out. 'There is no lack of capital in the marketplace for good projects; there is, however, a lack of bankable projects to attract investment and fulfil today's appetite for renewable energy projects' (IRENA 2018, p. 3).

In other words, in terms of project viability (IRENA's 'bankability'), renewable energy production was now in many ways back at square one. A decade or more after governments stepped in to stimulate investment in a sector suffering from perceptions of excess investment-risk, things had come full circle. Industry participants fundamentally lack the market power to maintain price at significantly above cost; and where the external government stimulus to investment was removed, the investment case once again became marginal.

The example of South Africa, as related by Lucy Baker (2015), is something of a case study in the nature of this investment cycle. A key year was 2011, when the government launched the country's much-feted Renewable Energy Independent Power Producers' Programme, whereby developers bid for electricity-generation contracts. Although bids must meet certain economic development criteria, price is decisive once those criteria are met, with the lowest price winning. This, predictably, set in motion a self-perpetuating race to the bottom, with 'increased competition [seeing] smaller national players priced out of the market and unable to compete with the low costs offered by foreign companies'. Thus, despite the 'apparent success' of the opening bidding rounds, by as early as round three – for which the winners were announced in November 2013 – the 'unexpectedly low prices' tendered by bidders were widely considered to be 'unsustainable both financially and in terms of the longer term development of a national industry that will have benefits for the wider economy' (pp. 149, 153).

Widespread, increasing pressure on project margins and investor returns is a substantial part of the explanation for one of the most notable trends in renewable-energy investment during the second half of the 2010s: a geographical shift from Global North to South. The former received the bulk of investment historically, but

> the balance shifted in 2015. Both then and in 2016, developing economies made up the majority of investment in renewable power and fuels – and in 2017, the gap grew sharply, so that the developing world accounted for 63% of the global total and developed countries just 37%. (Frankfurt School-UNEP Centre/BNEF 2018, p. 15)

It is true, as Sean Kennedy (2018, p. 232) says, that there are other reasons why renewables investment in the Global South has grown sharply, including 'low electrification rates, increases in energy demand driven by rapid economic growth, [and] national and international greenhouse gas reduction commitments'. But as Kennedy also explains, when margins and returns come under pressure, the imperative to minimise costs becomes acute, and this is where the Global South has come into its own. The availability of, most notably, 'cheap land and labour have made many countries in the Global South … lucrative sites for the absorption [in renewable energy projects] of abundant finance capital'.

Today, then, solar and wind-based energy generation for the most part are *not* attractive investment propositions. 'The low cost and ready availability of renewables', as Butler (2019) observes, 'means few projects can make returns of more than 5–8 per cent'. Merchant (2019) cites similar figures for renewable project returns, which, she says, 'usually range from 6 to 8 percent'. Others give even lower numbers: 4–6 per cent (see, e.g. Mallet and Keohane 2020).

Not only that, but, as Merchant (2019) explains, shortened PPAs 'mean that a project has a tighter window to hit its required returns'. Revenues arising after PPAs and their (typically) fixed prices come to an end are referred to as 'residual value'. It used to be the case that investors essentially ignored such value when assessing potential project returns; it was too distant, and too dependent on unknowable forward electricity prices – it was thus treated as mere 'gravy'. Not now, however. So parsimonious have PPAs become that renewable project sponsors reportedly are 'relying on over half of their returns coming from the post-PPA period' – an investment stance that, as Merchant notes, represents 'a gamble on merchant power price forecasts that extend 15–20 years in the future'.

As if that were not enough, governments – in, among other places, the Czech Republic, Spain, Italy and most recently France – have risked exerting a chilling impact on future investment in renewable energy by contesting the terms of legacy contracts that were signed when renewable technology costs were significantly higher than they are today. In November 2020, for instance, the French government announced its intention to cut tariffs on around 800 large PV solar contracts signed by public-sector buyers between 2006 and 2010 (Mallet and Keohane 2020). Those contracts, the government says, are the source today of 'excessive [generator] profitability', with some investments generating margins of over 20 per cent. Operators of the solar farms in question, needless to say, reacted with outrage to the government's proposed reneging.

Given all of this, it is small wonder that the major players today in the renewable energy space are generally distancing themselves from the energy generation business *per se*, and focusing instead on technology manufacture and/or the development and servicing – but *not* the ownership and operation – of generation plants. First Solar, of the US, is emblematic. It manufactures solar modules; and it provides power-plant system 'solutions'. The latter, development division had over 1 Gw of solar-farm projects in the pipeline at the end of the company's 2019 financial year. But while noting that 'we may also temporarily own and operate certain of our systems for a period of time based on strategic opportunities or market factors', management made it clear that this was very much the – temporary – exception, not the rule (First Solar 2020, p. 134). Generating electricity from solar, for now at least, is not where the money is to be made.

What should be clear from this capsule overview is that there is no simplistic relation between energy prices and energy transition prospects. Low prices for renewable energy products can certainly help drive the transition to carbon neutrality, but only if generators can deliver such low prices *profitably* – if they cannot, or if the path to profitability is not clear and compelling, the incentive to invest in renewable energy production will not be nearly substantial enough to drive investment on the scale that is ecologically necessary. Developments of the past few years have cast significant doubt on extant investment incentives. And it was in this febrile investment context that, in 2020, three of the giants of the fossil-fuel energy landscape announced their intentions to meaningfully enter the renewables fray.

Fossilised Capital

BP, Shell and Total are three of the West's five oil and gas production 'majors'; the other two are the US-based Chevron and ExxonMobil. Between them, these three goliaths currently produce over 10 million barrels of oil equivalent (BOE) – a metric that incorporates both oil and natural gas production by converting cubic feet of the latter into 'equivalent barrels' of the former – *per day*. They are always high on the list of companies identified as being primarily responsible for global industrial greenhouse-gas emissions. In 2020, however, as national governments around the world increasingly made pledges to transition national economies to 'net zero' within the coming decades, all three of these companies similarly pledged to substantially reduce the emissions for which they are directly or indirectly responsible. Reducing hydrocarbon production would be the pivotal mechanism. But, the companies emphasised, this would not be a matter of voluntary corporate euthanasia: while scaling *back* fossil-fuel production, they would simultaneously scale *up* renewable energy production, thus giving them a renewed *raison d'être* for the post-carbon economy.

First, in February 2020, BP said it would cut its own emissions to net zero by 2050 or earlier. Over the following months, it gave more detail of how it would get there (BP 2020b): it expected its hydrocarbon business to have shrunk in size by 40 per cent by 2030, by which time its renewables generating capacity – mainly in solar and wind – would have jumped from 2.5 Gw (in 2019) to 50 Gw, and 40 per cent or more of investment would be going into its non-hydrocarbon businesses. Shell followed suit in April, targeting net-zero emissions from its operations within the same timeframe – '2050 or sooner' – while also pledging to reduce its 'net carbon footprint' – the lifecycle CO_2 intensity of the products it sells – by 30 per cent (on 2016 levels) by 2035 and by 65 per cent by 2050 (Shell 2020a). A month later, Total made a similar announcement: net-zero by 2050; a big reduction (60 per cent in its case) by the same date in the carbon intensity of Total products used by its customers; and a rapid upscaling of renewables capacity, to reach 35 Gw by as soon as 2025 (Total 2020b).

Reaction to these announcements was mixed. While many commentators welcomed the initiatives, holes were picked. Net zero is not actual zero, and it relies on technologies of carbon capture, as yet unproven at scale. Nor are pledges relating to carbon 'intensity' quite what environmentalists demand: 'intensity targets', as Natasha Landell-Mills (2020) wrote, 'are not the same as delivering absolute reductions'. And the fine-print contained significant caveats, not least in the case of Shell, which, in its annual report for 2019 (published in April 2020), said it would aim to make the abovementioned cuts to its net carbon footprint 'assuming society aligns itself with the Paris Agreement's goals' (Shell 2020b, p. 2). As Landell-Mills (2020) observed, such conditionality amounts to 'promising to jump when you are pushed'.

Indeed, the companies' 'promises' are shot through with such hedging. 'Oil products accounted for 66% of [our] sales in 2015, 55% in 2019, and *could* decline to 35% in 2030. By 2050, this share *could* shrink to 20%', Total, for instance, said (2020b, p. 32; my emphasis). If one were to try to capture the thrust of the companies' overall messaging in one sentence, perhaps the best one could do would be: 'We aim to do this, *but* … '. And, crucially, the essential substance of that all-important 'but' turns out to be concerns about profit. Investment returns, as much as environmental exigencies, will drive the pace of the companies' respective energy transitions.

Shell has made this especially clear. It will invest in new energies only 'where the returns meet our criteria', Shell's head of integrated gas, Maarten Wetselaar, said in 2019. 'We will plan our steps carefully and we are investing with care', reaffirmed Ben van Beurden, the chief executive. 'We have to prove the investment case before we scale up this business. We cannot get ahead of ourselves. We have to see if we can prove these business hypotheses' (cited in Elliott and Bowles 2019). One can almost hear the echoes of Malm's cotton capitalists. 'Our New Energies business explores emerging opportunities linked to the energy transition, and invests in those where we believe sufficient value is available', states Shell's 2019 annual report. 'Between 2021 and 2025, our investments in [renewable] power *could* grow to $2–3 billion a year on average, *if* certain financial conditions are met' (Shell 2020b, p. 95; my emphasis).

At all three companies, all major proposed investments, whether in hydrocarbon production or in other businesses, must be greenlit by the board or an investment committee. Each proposal is weighed against a series of criteria, both financial and nonfinancial. BP's financial criteria, for example, include hurdle rates – that is, minimum acceptable expectations – for a project's internal rate of return (IRR), net present value, and 'discounted payback' – the last of these representing the number of years it will take for a project to break even from the time of initial expenditure, which, as BP says, is crucial 'as a measure of commercial risk in the context of the energy transition' (BP 2020a, p. 20). In modelling project cash-flows, BP builds cases based on a range of both commodity (e.g. oil and natural gas) and carbon prices. These price assumptions reflect scenarios in which the energy transition is sufficiently rapid to reach the Paris Agreement goals, 'as well as scenarios in which the transition is not, or may not be, sufficiently rapid' (ibid.) – again, as at Shell, a case of hedging of bets. Meanwhile, Total assumes a long-term carbon price of $40 per tonne as a 'base case' scenario for project evaluation; it adds a 'sensitivity analysis' where carbon is priced at $100 per tonne from 2030 (Total 2020b, p. 32).

If profit potential is a prerequisite of the renewable-energy generation businesses that the three companies aim to build, how do they currently perceive such potential? BP has been the most forthright of the three on this issue. It looks, it has said, for an IRR 'of around 10%' (BP 2020b, p. 48). But its realistic assessment is that 'expected returns' on its renewable power projects will be in the 8–10 per cent range (BP 2020d, p. 13). That, of course, is higher than the returns – in the 4–8 percent range – that, as we saw earlier, existing operators are achieving. Is BP ignoring market realities, then? Not entirely. It accepts that 'normal' returns are lower – around 5–6 per cent. But it thinks it can lift returns to the 8–10 per cent level by virtue of three special 'differentiating' factors that it putatively brings to the table: operational and project expertise; integration; and structured financing. The last of these stands out: elsewhere in the same document, 'innovative financing' is identified as a key source of the 'enhanced returns' achieved by Lightsource BP, the 2 Gw solar developer in which BP holds a 50 per cent stake (p. 11). In fact, BP suggests it can possibly lift renewables returns to *above* 10 per cent if it utilises so-called 'farm-down' (otherwise known as asset rotation or build-sell-operate), which involves selling equity stakes in projects to outside investors during the pre-construction phase in order to free up capital for further projects. Meantime, Total offers a facsimile of BP's returns picture, suggesting that the combination of leverage, farm-down, integration, and operations and maintenance can get it from a 'typical' renewables IRR of 5–6 per cent to one of above 10 per cent (Total 2020c, p. 27). What would all of this imply in terms not of project IRR but company profit? BP (2020b, p. 41) says its target for its renewables business is a return on average capital employed (ROACE) by 2030 of 8–10 per cent.

A couple of things are striking about these expectations. One is the explicit reliance on clever financing techniques. The other, more striking still, is the relatively low level of returns that BP and Total envisage being able to generate *even with* such clever financing successfully doing its job. They recognise the fact that, as we saw in the previous section, this fundamentally is not, for now at least, a high-profit business.

That they do so is to be expected. As is widely known, BP and Shell both made reasonably concerted efforts to build renewables businesses in an earlier period, but both pulled out – their current renewables operations, such as BP's Lightsource partnership, are essentially immaterial – precisely because they found they could not make significant profit, which was the case precisely because prices were declining so fast (Malm 2016, p. 370-1). None of this is new to the majors, in other words. They *know*, from experience, that wind and solar are not like oil and gas – that since, in Malm's words, 'the fuel is not hidden away in a separate chamber, but rather hangs like a fruit for anyone to pick, there is little surplus-value to extract in its production' (p. 372).

The key question, therefore, is the one that is posed by Nick Butler. Observing that 'typical investments in oil and gas projects, where the barriers to entry are much higher, earn returns of 15 per cent or more', and highlighting the 'tension' that the differential profitability of hydrocarbon versus renewables projects creates for the majors' investment committees, Butler (2019) asks: 'How can the next offshore wind farm, selling power into the hugely competitive electricity market, be justified over the next oilfield?' The simple answer is that, ordinarily, it cannot be – and certainly *has* not been to date. And it has not helped the renewables' case that, even now, they often remain visually as well as operationally and financially peripheral at the oil and gas majors. Most proposed renewables investments are too small even to appear on the radar at board level. 'The Board receives regular updates and maintains oversight of the operations of the New Energies business', Shell's 2019 annual report, almost dismissively, stated, 'even though many of the investments in this area are below the threshold for Board decision' (Shell 2020b, p. 25).

It is arguable that the coronavirus pandemic has shifted the investment calculus somewhat. From just below $70 per barrel at the end of 2019, Brent Crude – the main global oil price benchmark – collapsed to a low of around $20 in April 2020 as the pandemic savaged demand. But prices had recovered to the $50–55 range by the time of this writing. And even at these relatively depressed prices, the big new hydrocarbon projects being undertaken by the majors promise significantly higher returns – and, of course, on a significantly greater scale – than renewables do. In a September 2020 update, for instance, Total (2020c, p. 40) highlighted three large recently-greenlit projects in Uganda, Angola and Brazil, all of which would produce at least 150,000 BOE per day, the first of which would generate a 15 per cent IRR at an oil price of $50 per barrel, and the second and third of which would generate IRRs in excess of 20 per cent at the same oil price. Meanwhile, while BP, in the light of the recent commodity price volatility, has said it now expects the ROACE of its hydrocarbon business to be only in the 12–14 per cent range at the end of this decade, that is nonetheless 50 per cent higher than the 8–10 per cent ROACE that it is targeting for its innovative-financing-turbocharged renewable power business (BP 2020b, p. 41).

And so, in the context of the fundamental investment tension referred to by Butler, our three majors are presently investing only meagrely in renewables; moves such as those by BP and Total in early 2021 to acquire options to develop UK offshore-wind leases in the Irish and North Seas respectively are eye-catching by virtue of their rarity. The profit levels the oil majors would *like* to see in renewables are generally not there; and the companies are hesitant to take the investment risks that others are absorbing. Witnessing, for example, solar investors' increasing willingness to gamble on residual project value, BP – via Lightsource – is refusing to do likewise. Lightsource, says its chief commercial officer, is 'more careful in dealing with projects that may rely on residual value' (cited in Merchant 2019). The greater a project's exposure to post-PPA variable prices, the more heavily Lightsource discounts it. Its focus remains on '20- and 25-year [PPA] deals'.

This risk-averse stance is certainly understandable. But it is probably also unrealistic: few if any such deals remain on the table. Indeed, there is an air of unreality about the majors' pronouncements vis-à-vis their renewable-energy plans more generally. All three, as we have seen, have pledged strong growth. But while all three clearly recognise the profitability constraints that exist, all are nevertheless hoping to find projects that somehow evade those broader market pressures. If Shell sticks to its dual insistence that renewables projects 'must deliver returns in the 8% to 12% range' and that its overall renewables business 'must demonstrate that it is on a path to be self-funding before 2030' (cited in Elliott and Bowles 2019), the likelihood seems high that Shell never will have a substantive renewables business to speak of. Equally, Total's mission statement for its renewables business – 'Capturing profitable opportunities with low entry cost' (Total 2020c, p. 28) – strikes one as fanciful. *What* such opportunities? It claims that 'predictable cash flow' is to be found in the form of long-term 'guaranteed PPA, CfD' (p. 27), but, as we have seen, that ship has by-and-large sailed. Meantime, BP *says* that it thinks it can achieve its hurdle IRR of 8–10 per cent on its newly-optioned offshore-wind leases in the Irish Sea, but the renewables industry is deeply sceptical, with experienced developers insisting that the option price paid by BP 'is too steep, and the returns on investment will be too low' (Ambrose 2021).

The flip side of the investment-calculus coin is the majors' continuing robust investment in new hydrocarbon projects, which, by contrast, *do* still reliably offer the returns they demand. Total, as we have seen, has substantial new projects underway in, among other places, Uganda, Angola and Brazil. Shell, in a recent update for investors, identified no fewer than 21 major oil and gas projects presently under construction, spread across every continent bar Antarctica, and of which 11 would enter production in 2020–21 and 10 in 2022 (Shell 2020c, p. 21). In 2016, BP set a target of 900,000 BOE per day of *new* oil and gas production by 2021. By mid-2020, with 25 new projects generating 700,000 BOE having come on-stream, it was over three-quarters of the way there, and it announced that by the end of 2021 the target would be achieved (BP 2020c, p. 17).

And BP is not stopping there: at least seven major new decisioned projects will start up in 2022, and at least four more in 2023 or later (ibid.) BP's board approved six new major upstream hydrocarbon capex projects during 2019, having evaluated each one, the company claimed, for consistency with Paris. It did so through its assessment of each project's carbon intensity (which was expected to be lower than that of BP's existing portfolio) and profitability (which had to be resilient to low commodity prices and high carbon prices) (BP 2020a, pp. 22-3). Interestingly, one of the approved investments did not satisfy the carbon-intensity criterion but was pursued regardless thanks to a short payback period, thus 'reducing the timeframe during which the investment would be exposed to uncertainties associated with Paris consistent pathways' – an extraordinary example, when one thinks about it, of exactly how *not* to be consistent with Paris, or at least the spirit of Paris.

As innumerable observers have noted, this vast ongoing investment in oil and gas production creates huge, long-term inertia, locking the world into fossil-fuel energy landscapes for many, many years to come. Not only, as Malm (2016, p. 358) notes, can it take several decades to recover initial capital outlays on say a tar sands mine. But the obligated costs of hydrocarbon projects themselves stretch far into the future, creating a further imperative to sustained fuel and thus revenue extraction. In its annual report for 2019, for example, Total recognised $147.5 billion of future 'enforceable and legally binding' contractual obligations to purchase goods and services including capital items, of which $98.6 billion were due more than five years hence (Total 2020a, p. 16). Lease payments are another important example of sunk-but-not-yet-incurred costs: $21.3 billion of the total $46.1 billion of future lease payments that Shell is presently obligated to make, for instance, fall due five or more years hence (Shell 2020b, p. 219). How far out do such obligated payments stretch? BP's 10 per cent interest in the ADNOC Onshore lease in Abu Dhabi does not expire until *2054* (BP 2020a, p. 306).

All of this underlines the fact that unless the regulatory environment shifts in dramatic fashion, the world's leading fossil-fuel producers, guided by the investment logics we have described, will long remain primarily fossil-fuel producers: they constitute *fossilised* capital, not mere fossil capital. The 'Proved reserves replacement ratio', which measures how successfully current hydrocarbon production is being replenished by new reserve additions and which represents one of BP's key performance indicators, is, after all, hardly the metric of a company meaningfully committed to winding down its oil and gas operation (see BP 2020a). Indeed, BP makes no bones about the fact. Far from now beginning an ineluctable decline, greenhouse-gas emissions from the use of products that BP sells 'will likely rise for several years' (BP 2020b, p. 29). Hydrocarbons will not only be the company's 'key source of earnings and of growth in returns over the next several years' (p. 39). They 'will remain core to BP for decades' (p. 57).

Some environmentally-minded commentators have found hope in the fact that, in the midst of the coronavirus pandemic, the markets have turned against fossil-fuel producers. Total's shares have lost around a third of their value since the onset of the pandemic; BP's and Shell's have fared even worse, falling by 40–50 per cent. Seeing the loss of market confidence and unable to issue new equity on the favourable terms they were previously able, the companies, it is thought, will hasten their exit from a dying business.

But it is more likely that the reverse will be true. The majors self-finance most of their investments with cash-flow from operating activities as it is (see, e.g. Total 2020a, p. 75). If the markets really have soured on them, the necessity to self-finance will increase, not decrease, and where else – other than in their profitable core business of hydrocarbon production – will the companies be able to generate the cash needed to continue to invest? This, ultimately, is the terrible paradox: to fund the transition to being something else (renewable energy producers), the oil and gas majors are relying heavily on what they currently *are*. The more negative market sentiment becomes, the more important the hydrocarbon business becomes. 'The cash generated by hydrocarbons will be key to supporting [our] transition', concedes BP (2020b, p. 21). Surviving through, still less prospering from, the energy transition requires 'allocating sufficient capital to our resilient hydrocarbons business to generate sustainable cash flow' (p. 28). The sooner governments and regulators recognise this sobering reality, the sooner something substantive can be done about it.

Conclusion

The ongoing energy transition is at the forefront of social and political debate. It would be easy to assume that once renewable energy sources are cheaper than fossil fuels for those uses where they represent a viable substitute, the transition will be comprehensive and swift. But if easy, it is also wrong. For one thing, it ignores inertia. More importantly, it ignores the fact that production comes *before* consumption, both temporally and, many political economists would submit, structurally. If price is assuredly one of the variables that companies consider when making decisions about future production, it drives those decisions only to the extent that it shapes a far more important variable: expected profit. Unless they think that they will profit, capitalists *will not* invest. This is as true of the production of energy as it is of the production of widgets.

This article has shown that while renewable energies may now be widely competitive with fossil fuels on price, it is far from clear that they are competitive in relation to the producer profits they afford. In fact, the evidence strongly indicates otherwise, even in the wake of the depressive impact of the coronavirus pandemic on oil prices. This suggests that there is good reason to be cautious about the pace and extent of the transition from being dirty fossil-fuel companies to clean energy companies that three of the West's biggest oil and gas producers – BP, Shell and Total – have recently said they propose to pursue.

Focusing on these *companies* is crucial for another reason. The energy transition is often pictured in terms of a transition in energy types. Of course, it is that; but it is not only that. It is necessarily also in significant part a transition in the nature of a set of existing capitalist institutions. Investments that may appear logical from the perspective of economic theory and its bloodless and rootless agents and its ready availability of capital may be illogical from the perspective of worldly institutions that arguably now face an existential battle and for whom the question is not fossil fuels *or* renewables, but rather what mix of the two in the short and medium term will enable a long-term shift from the former to the latter that is maximally profitable while also meeting complex, fluctuating and overdetermined criteria of social, political and ecological tolerability. By examining what the three aforementioned companies have themselves had to say on the matter, this article has attempted to posit the most likely answer to that question, as things stand. But the one thing we know for sure is that as the goalposts shift in the years ahead, the answer – and the implications for planetary futures – will too.

Note

1. Indeed, this price-focused explanatory narrative dominates the historiography of past energy transitions more generally (Fouquet 2016).

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