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Carbon capital: The lexicon and allegories of US hydrocarbon finance

Sean Field

Abstract

Drawing on ethnographic fieldwork with energy financiers in Houston, Texas, this paper explores how experts use a lexicon of models and metrics to conceptualize and construct allegories about future hydrocarbon projects and companies. I show that allegorical narratives built with this lexicon advance a kind of energy ethics – distinguishing what is good and advocating for particular hydrocarbon futures. As the energy industry pivots toward renewables, I conclude that these metrics, models and allegories are coming to bear on new forms of extraction. This paper contributes to a better understanding of the financial and managerial processes on which extractive energy practices are imagined, valued and decided.

Keywords: hydrocarbons; extraction; energy; ethics; financialization; economization.

It is 7:30 in the morning and the dining room is packed. 'Capital discipline has been demanded', the speaker says looking out into the crowd of faces staring back at him. He continues:

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> The Fidelity's of the world introduced this concept called capital discipline.[1] The general definition is grow within cash flow, pay dividends … 4 per cent dividend yield … 4 per cent production growth within EBITDA … . The definition of an E&P company is the antithesis of capital discipline … . We now have valuations at 20-year troughs, whether you look at TEV, EBITDA … TEV to PV10 … . investors are rightfully sceptical … . are companies just borrowing time? Can they really achieve this?

We are at a monthly breakfast meeting of the Houston Oil Finance Association in late-2019,[2] a monthly ritual in the Houston hydrocarbon finance community. The speaker is a Managing Director at a well-known private investment firm founded by two prominent US arbitrageurs. He has done the math, he says, and the prognosis for US hydrocarbon exploration and production (E&P) companies is bleak. Companies that have led a renaissance in the US hydrocarbon industry with the advent of unconventional extraction (colloquially known as 'fracking') have been financially 'imprudent' he says, and many will not be able to make the transition from 'growth' to 'discipline' in the months ahead. He explains:

> 80–85 per cent of the companies cannot achieve capital discipline. Something between 15 and 20 per cent can. We were being very generous in our math when we got to this. There's another way of running this math that says no one can. It's somewhere between zero and 15 per cent that can achieve capital discipline.

The story he is weaving is an allegorical narrative of a US industry in transition following a 15-year 'boom' associated with the Shale Revolution. For over a decade, investors and lenders poured capital into US onshore unconventional hydrocarbon extraction during a growth phase in the US oil and gas industry not seen since the early-1980s. This created a flurry of E&P activity predicated on 'proving' the future profitability of prospective hydrocarbon reserves that could be sold for a portion of their expected net present value (Field, 2022). Investor fervour for US unconventional E&P was hastened by the early success of private equity financiers specializing in E&P in the mid-2000s and by the Global Financial Crisis that challenged institutional investors to meet their actuarial targets. By late-2019, however, the industry entered a 'bust' cycle with stagnating, and later, falling oil prices, challenging E&P companies to make profits. This is what he refers to when he talks about the shift from 'growth' to 'discipline'. The 'right … strategy going forward' for investors, the Managing Director argues, is 'to buy PDP for cheap and … make all kinds of money'. The 'right' strategy for lenders is 'PDP-covered loans' that are 'priced up relative to [the] history' of the borrower. While this language may have little meaning for people outside of oil and gas finance, for people in this community it constitutes prescriptions about the appropriate way capital should exploit US onshore hydrocarbon resources. Investors and lenders *should* focus on extracting profit from ‘proven developed producing’ (PDP) US hydrocarbon assets, and the companies that own them, by imposing cost-minimizing strategies – discipline. Investors and lenders, by contrast, *should avoid* ‘proven undeveloped’ (PUD) hydrocarbon assets and the companies that want to drill these prospects with the hope of making a profit from future expected extraction – growth – at least for now (see Figure 1).

He is weaving this allegory with the lexicon of hydrocarbon finance, a mixture of Wall Street-infused terms, economic concepts and metrics specific to the hydrocarbon industry. There is some disagreement within this community of financial professionals on what metrics are most important, and the metrics of preference in this lexicon change from time to time, as I will show. Collectively, however, this lexicon forms a regime through which to define the economic value of hydrocarbons and companies, to imagine their value in the future, and to justify flows of capital. The sea of blue and grey suits crested with peaks of white, grey and salt and pepper hair are watching and listening intently; they know, or seem to know, what he is talking about because they too speak the language. They are private equity partners, investment bankers, commercial lenders, asset managers, insurance brokers, financial consultants and lawyers all specializing in oil and gas finance. They connect investment and loan capital from all over the world with small to medium sized E&P companies operating in the ‘lower 48’ states of the continental United States. Their clients are some of the largest institutional investors in the world and they are the people who financially fuelled the US Shale Revolution (Field, 2022). The meeting and the presentation remind me of Mason’s

Figure 1 The breakfast meeting
Source: Author’s sketch of the breakfast presentation.

(2007, 2012, 2019) work on economic experts in the US hydrocarbon industry. Using neoclassical economics, he shows that experts have been architects of future energy imaginaries for decades, building 'consensus around imagined futures' (Mason & Stoilkova, 2012, p. 89). For Mason (2019, p. 128, 137), the concepts and language of economics allow experts to 'speak in the name of the market' and appear to 'transcend proprietary attachments' because of economics near universal currency in industry circles. Importantly, the imaginaries these economic experts craft have an 'egalitarian' quality in their calculation, he suggests, by displacing the 'idiosyncrasies of judgment' with 'depersonalized, highly quantitative approach[es]' to energy markets (Mason, 2019, p. 126, 128). In this regard, he implies, they are a modular-like counterpart of hydrocarbon's material infrastructures highlighted by Appel (2012a) in her exploration of offshore oil platforms. They have a universal-like quality that can evacuate the specificity of particular companies and assets making them comparable across times and places – as well as the subject of moral prescriptions.

In this paper, I examine how financial metrics and economic models are used to craft allegorical narratives of imagined hydrocarbon futures. Metrics and models play an essential role in the construction of ethical narratives on which energy decisions are made, by narrowly defining value and time. The concept of allegories highlights that financial narratives of imagined energy futures are not merely descriptive but advance a kind of energy ethics. I do this by drawing on research that I have carried out in Houston, Texas, since November 2018.[3] I begin by examining the entanglement of hydrocarbon expertise, financial metrics and economic models, as well as the importance of framing expert narratives as allegorical. I then unpack the mainstay metrics highlighted in my opening vignette, before turning to an ethnographic encounter with an interlocutor whom I call Alex.[4] In an era defined by growing public concern about anthropogenic climate change and calls for the decarbonization of capital (Langley *et al.*, 2021), future energy projects are pitched, mineral rights are transacted, wells are drilled, pipelines are built, infrastructure is constructed, and money is invested based on the allegorical imaginaries woven with this lexicon. I conclude by reflecting on how these metrics, models and allegories are coming to bear on new forms of energy extraction. In the process, I advance the social science literature on energy and hydrocarbons (Appel *et al.*, 2015; Huber, 2013; Mitchell, 2009; Rogers, 2015; Strauss *et al.*, 2016; Weszkalnys, 2011; Wilson *et al.*, 2017), and pull back the curtain on the world of US hydrocarbon finance, taking this literature forward by examining the metrics and models on which the materialization of energy resources centre.

Material entanglements, financial imaginaries & allegories

The social science literature on fossil fuels is rich with examinations of the materialities of extraction. Appel (2012a, 2012b, 2019), for example, provides extensive ethnographic accounts of offshore production in Equatorial Guinea. From the parcelling of off-shore territory into E&P leases to the hierarchical division of labour on oil platforms, and from the modularity of platform operations to the US-style onshore enclaves for workers, Appel details the entanglement of hydrocarbon production with place, inequality and identity. Mitchell (2009, 2011) provides an equally enthralling historical comparison between the political-labour regimes of coal versus oil. The material extraction of coal, he contends, provided the conditions necessary for organized labour. The highly mechanized extraction of oil and its movement via pipelines, undermined labour's capacity to organize and disrupt the political-economy forces of capital. Wylie (2015) and Sawyer (2015), meanwhile, focus on the impact of exposure to hydraulic fracturing fluids in the United States and the chemical composition of hydrocarbons in the Ecuadorian Amazon. In these examples, the authors trace the entanglement of extractive materialities with the political-legal regimes that protect companies involved in E&P activities. In yet another example, Barney (2017, p. 80) explores how hydrocarbon extraction and pipelines in Canada are 'the most extensive and important infrastructure connecting' the country, its economy, and 'its self-image'. Materiality ties this literature together along with the way these authors link the material dimensions of hydrocarbons to the political, economic and social dimensions of extraction.

Connecting the material dimensions of hydrocarbons to capitalist political economies, Simpson (2019) and Labban (2008, 2010, 2014) provide helpful insights. Simpson (2019) shows that the circulation of oil depends not just on the time–space compression afforded by high-pressure pipelines, pumping stations and ports, but also storage infrastructures that can slow commodity circulation. These infrastructures, he shows, are tied to the pluri-temporal strategies of capital accumulation, which are driven as much by speculative capital and futures markets as by material supply and demand. In a similar vein, Labban (2010) argues that financialization has, in part, emancipated oil from the confines of its physical buying and selling. While the profits gleaned from financial markets cannot be separated from the production and circulation of hydrocarbon commodities, he shows that 'crises' in the industry have less to do with commodity scarcity than crises in overproduction and the failure of firms to bring expected financial value to fruition for investors and lenders (Labban, 2008, 2010, p. 550).

The scholarly lens has also turned toward the financial and managerial practices in the hydrocarbon industry. Complementing Mason's (2007, 2019) work in this area, Wood (2016) shows that shareholder value is not just produced through a company's *current* E&P activities; instead, the financial value of hydrocarbon companies is based on the estimated value they will produce in the *future* in the form of oil and gas reserves to be extracted – in line with Labban's (2014) argument regarding expected future production. Financial calculations and economic models that are entangled with the geology of a company's reserves are essential to the apprehension of 'hydrocarbon potentiality' and 'future cash potential' (Wood, 2016, p. 44, 46). Geological estimates combined with forward-looking productivity decline curves, and the financial metrics of Net Present Value (NPV) and Discounted Cash Flow (DCF), collectively 'liquidate the future' into the present by framing future hydrocarbon extraction into 'a temporal rate of return', Wood (2016, p. 45, 51) shows. For Wood (2019), economic models and financial formulae take on another temporally entangled dimension. They foster a shared imagination of future 'value creation' and, echoing Muniesa (2017), offer a 'shared moral horizon' between investors, lenders and entrepreneurs (Wood, 2019, p. 68). Metrics orient financial counterparties and collaborators toward common profit-seeking goals and prompt them to collectively imagine the materialization of anticipated outcomes. This is important for attracting and retaining investors and lenders because hydrocarbon finance fundamentally turns on performances of credit (High, 2019; Mason, 2019; Wood, 2019). Derived from the Latin word *credere* meaning 'to trust or to believe', a defining feature of credit is its function in linking the past, present and future (Graeber, 2012; Hart, 2001; Maurer, 2010, p. 146). Investors and lenders are exchanging money in anticipation that they will get their money back plus a profit at a future date. As an interlocutor explained to me: 'the investor has to believe in what he's investing in' because investors, as well as lenders, must anticipate that they will recoup their capital. Financial metrics and economic models lend a sense of imaginary assuredness, 'thickening' expectations into anticipation (Bryant & Knight, 2019, p. 22). Charts, tables and illustrations, Leins (2018, p. 12) shows, 'stabilize' these financial imaginaries and make them more creditable. Financiers play a critical role crafting 'imaginaries' of the future using metrics and models, Leins (2018, p. 12) argues, leading to the subsequent allocation of investment capital in pursuit of these imaginaries. Holmes (2014) makes a similar point; central banks, he argues, recruit their respective publics to collaborate on the monetary goals of price and currency stability. To do this, bankers compose economic narratives with supporting data and charts to project what will happen in the future and propose interventions to materialize imagined outcomes. From *Stories of capitalism*, to *Banking on words*, to the *Economy of words*, it has been shown that economic models and financial metrics play a central role in the construction of narratives about the future (Appadurai, 2016; Holmes, 2014; Leins, 2018).

As with my opening vignette and in line with these works, I suggest that narratives built on models and metrics are the basis of flows of capital in the US hydrocarbon industry. It is not possible to bring investors and lenders down the well hole to show them how much oil and gas there is, nor is it possible to transport them into the future to show them what oil prices will be and how much money is to be made. It is possible to imagine this, however. Financial metrics and economic models provide ways of imagining how much oil and gas is underground and how much it is all worth through virtual 'as-if's' woven around tables of numbers and graphs. In this regard, they constitute what Sneath, Holbraad and Pedersen (2009, p. 11) describe as technologies of the imagination, 'concrete processes by which imaginative effects are engendered' by producing imagined hydrocarbon futures and the place of lenders and investors in these futures. Commonly used in the way described in the vignette, they are in line with what Bear (2015, p. 408, 410) describes as 'styles of imagination associated with capitalist practice' that are 'wielded by exemplary figures … who work with the performative power of words' to 'invoke an invisible realm' in order to make visible and explain the future.

Metrics and models are more than just the building blocks of narratives, however – they double as moral calculative devices about the 'right' energy futures. They project a speculative ethics (Bear, 2020). In his analysis of the Black and Scholes (B&S) formula as a model for estimating options prices, Maurer (2002) makes a similar suggestion. The B&S formula is a 'moral argument', he argues; it 'is a deontology of the way things 'ought' to be and the metrics it produces for options prices are a moral appraisal about the value of things (Maurer, 2002, p. 29). To take this argument one step further, the persuasive power of these models and metrics is not confined to the numbers they produce, however, but by how they are woven into allegorical narratives. In this vein, McCloskey and colleagues have drawn attention to how economic narratives are allegorical, where economic concepts and calculus lends the rhetorical authority of being 'right' (Klamer & McCloskey, 1992; McCloskey, 1995, 1998). Allegories convey not just a descriptive narrative, but also a set of ethical 'sensibilities' and moral conclusions that instruct and orient orators and audiences (Holmes, 2014, p. 28; McCloskey, 1995, 1998). Even general terms like 'economic' and 'uneconomic' not only communicate profitability, or a lack there of, but also communicate a 'rightness' and wrongness' about particular presents and futures. Holmes (2014, p. 95) argues that central banks regularly deploy econometric allegories to instil public confidence in banks' projections and render the economy 'susceptible to policy interventions'. For him, allegories are notable for 'the persuasive labour these narratives are called upon to perform' to render support for monetary policies (Holmes, 2014, p. 11). While brilliant, Holmes (2014) analysis underemphasizes the ethical element of allegories in constructing moral conclusions. When economic narratives about the present and the future are framed as allegories it draws attention not just to the persuasive labour of these narratives but to their moral message(s). In the hydrocarbon industry, the concept of allegory draws attention, firstly, to the ethical frameworks that models and metrics furnish economic narratives. Secondly, it draws attention to the fact that they are also moral arguments about what are the 'right' courses of action and the 'right' futures to strive for. In this regard, models, metrics and the allegories constructed with them, are endowed with a sort of energy ethics (High & Smith, 2019; Smith & High, 2017). Smith and High (2017, p. 1) use the notion of 'energy ethics' to 'capture the ways in which people understand and ethically evaluate the world … and futures that they deem to be good and valuable'. Common arguments (supported by metrics) amongst interlocuters, such as 'the economics of the project', 'it has to work out on an economic basis', 'the economics are challenged', 'none of that drilling is economic', 'are these resource plays truly economic?', and 'the economics suck' are not just hollow rhetoric but ways of conceptualizing what is right and wrong, and advocating for certain energy and hydrocarbon futures. Financial metrics and economic models are the scaffolding that allegories about which energy present and future are good and valuable are built. Elsewhere I discuss how ethics inform interlocutors' sense of self and professional personhood in relation to broader notions of ethics and responsibility, which are distinct from notions of CSR and resemble a forward-looking gaze toward materializing envisioned outcomes rooted in hydrocarbon capitalism (Field, 2022). My task in what follows is two-fold. First, I highlight that economic narratives in the US hydrocarbon industry are allegorical – advancing particular energy futures as 'right' and others as 'wrong'. Framed as objective narratives about rational choices – as in the opening vignette – this characterization disguises the moral-ethical work these allegorical narratives perform in shaping individuals' ethical frameworks and in crafting shared moral horizons among financial stakeholders. Second, I examine how metrics and models are drawn into, and shape, these allegorical narratives, defining what is valuable for whom, and framing the time horizons worth consideration – with energic, socio-economic and anthropogenic ramifications for us all.

Metrics & models

Npv, IRR, EBITDA and FCF

Wood (2016, 2019) vividly draws attention to the maps, gamma ray logs and financial metrics that help stabilize hydrocarbon imaginaries. While importantly contributing to the analysis of hydrocarbon finance, she leaves the metrics in her analysis largely black boxed. MacKenzie's (2001, p. 118) now classic examination of the Black–Scholes-Merton options pricing theory (B&S) is an excellent and instructive example of opening the 'black box' of financial formulas. He shows how the application of Brownian assumptions from physics to finance are flawed but have, nonetheless, had wide ranging effects on the performance of finance, envisioning the future, and the materialization of economies. While not nearly as sophisticated as the B&S formula, the financial metrics of EBITDA, FCF, PV10, IRR and NPV are mainstays in the US hydrocarbon finance community and no less important. It is common to hear my interlocutors describe companies and oil and gas assets in the lexicon of these metrics. In casual conversation they say things such as: 'target returns of 20 per cent IRR or 2.0x ROI', 'median EBITDA was 1.7 billion', 'you could probably get double-digit IRR out of a deal', and 'generate free cash flow'. They are central to the everyday discourse of oil and gas financiers, the practice of economic evaluation, and help determine what energy futures are materialized. While my interlocutors may be guided by coexisting idiosyncratic regimes of values – their personal faith in God, nationalistic pride, and various views of family values for example – when they talk about, conceptualize and evaluate hydrocarbons, they do so in the constellation of financial-economic value articulated by this lexicon, where value is located and defined by profitability.

This has not always been the case, however. The integration of metrics and models into US hydrocarbon finance have evolved over the last 90 years. In the early part of the twentieth century, few US oil companies were able to secure commercial loans because banks were 'unable to predict future production rates and prices' that would allow them to figure out if they were likely to be paid back (Clark, 2016, p. 65). According to Clark (2016), the few short-term loans that were made considered the net worth of the borrower and were secured against real estate and the value of oil in-transit (also see Wilson, 1966 [1962]). Historical bank documents show that DCF methods were not yet applied in the US oil and gas industry in the 1930s. Correspondence between the vice president of First National Bank in Dallas and the vice president of First National Bank in Houston, dated 14 August 1934, indicate that the 'most important feature [of an "oil loan"] to consider is the matter of title' – referring to the land to be collateralized with little consideration for the value of future oil production.[5]

Modern DCF methods can be traced back at least to the 1930s, although its principles can be traced back much further (Parker, 1968). Fisher (1930), notably, applied the concept of discounting to the theory of interest rates. He argues,

> The basic problem of time valuation which Nature sets us is always that of translating the future into the present, that is, the problem of ascertaining the capital value of future income. (Fisher, 1930, p. 14)

By the early 1950s, US hydrocarbon finance had changed. More reliable reservoir engineering, economic price forecasting, and the integration of DCF made calculating future profitability possible (Clark, 2016; Wilson, 1966 [1962]). Reserve based lending and other financing schemes flourished alongside these calculative techniques (Clark, 2016). A paper presented by two vice presidents of Chase National Bank of New York on 17 February 1953, for example, mentions the incorporation of DCF in assessing the worthiness of hydrocarbon commercial loans:

> The method of valuation generally used by the institution with which the authors are associated is the estimation of the present worth of future profits at that discount rate which it is believed will result in the fair market value. (Terry & Hill, 1953, p. 1)

Since the 1950s, NPV and DCF analysis have been at the core of US hydrocarbon finance, in lockstep with their adoption across the US finance sector

(Biondi, 2006; Svetlova, 2012). NPV expresses the current value of future expected cash flow and is the end result of DCF analysis; it allows investors and lenders to imagine the future, evaluate its financial value, and decide what projects should be materialized. They are central to the superficially benign but critically important political vernaculars of financial valuation (Muniesa, 2017; Ortiz, 2021). For hydrocarbon companies, DCF and NPV are crucial analytical lynchpins linking anticipated future income and profits to present day financial values – financializing the value of material geological reserve estimates into imagined temporal rates of return (Wood, 2016). Not only do they inform investing and lending decisions, but they also prompt assets and companies to be bought and sold today for a portion of the value they are anticipated to produce in the future (Field, 2022). The equation for calculating NPV is:

$$\mathrm{NPV} = \sum_{t=0}^{T} (R_t/(1+i)^{t)} \tag{1}$$

R_t stands for anticipated net revenue for one time (t) period in the future; i represents the discount rate (the rate by which the value of future money is eroded[6]), t represents specific time periods (e.g. year 1, year 2, etc.), and T refers to the total number of time periods under consideration.

The internal rate of return (IRR) metric is an adaptation of NPV. It presents future economic value as a rate of return, in the present, that is readily comparable across a diverse range of investments. The higher the IRR metric, the more profitable an investment is expected to be. The IRR can be reiteratively calculated using the formula (Ahmed & Meehan, 2012 [2004]; Gallun & Wright, 2008)[7]:

$$\mathrm{IRR{:}0} = \mathrm{NPV} = \sum^{T} t = 1[C_t/(1+\mathrm{IRR})^t]-C_0 \tag{2}$$

C_t stands for net cash inflow during time period t; C_0 stands for total initial investment costs; t represents specific time periods; and T refers to the total number of time periods. These metrics are among the most common techniques of calculating the 'time value of money'[8] (Gallun & Wright, 2008, p. 61, 361; Souleles, 2019), a way of imagining the future expected profitability in the present.

Interlocutors also often refer to EBITDA and Free Cash Flow (FCF). An industry veteran explained to me that when he first started as a financial analyst in the 1970s, he used to look at company's FCF and DCF. Then, he explained, 'somehow, EBITDA came into the mainstream, and then that became the nomenclature of purpose'. EBITDA stands for earnings before interest, taxes, depreciation and amortization; it was popularized by US billionaire and media CEO John Malone in the mid-1970s (*Forbes*, 2003; Petacoff, 2016). FCF was popularized by Jensen (1986). Interlocutors tell me it was used well before Jensen, but became a common metric used by analysts and investors after it was popularized. There is no unitary definition of FCF, but it is typically defined as cash available to company managers after capital expenditures (Bhandari & Adams, 2017). EBITDA and FCF provide a financial snapshot in time. They allow people to imagine how much money is flowing through companies, how much debt companies can service, and how quickly this debt can be paid down, adding to the equity value of shareholders (Souleles, 2019). As current measures of profitability and financial health, they help investors and lenders imagine the likelihood of near future profits – whether companies will be profitable tomorrow, next week, next month, or next quarter (Ahmed & Meehan, 2012 [2004]; Gallun & Wright, 2008).

What EBITDA and FCF share in common with DCF, NPV and IRR is that they are imported from economics and finance into the hydrocarbon industry. They are economic-finance metrics invented for investors, lenders and analysts to modularly apply across assets and companies. They were brought to bear on the US hydrocarbon industry, alongside their broad scale adoption in the US lending and investing communities (Biondi, 2006). Interlocutors, combine these metrics with other terms in the lexicon such as return on investment (ROI)[9], rate of return (ROR)[10], and total enterprise value (TEV)[11] to weave allegorical narratives of imagined futures. The use of these metrics to imagine, value and decide on future hydrocarbon projects and companies form part of the changing financialization and economization of US oil and gas (Çalişkan & Callon, 2009; Hann & Kalb, 2020). 'Changing' because US oil and gas has been increasingly financialized and economized since the industry's founding. As I have shown above, an evolving assembly of qualification and analytical practices have rendered hydrocarbons the subject of economic logic, transformed underground deposits into assets to be exploited, and determined whether they are extracted based on allegorical financial narratives. These allegories, in turn, have been pitched to increasingly wide swaths of investors (Field, 2022). Reflecting on this trend toward economization-financialization an industry veteran lamented to me that she longed for the days when the industry was driven by charismatic oil men with 'two-day shadows [beards] and cowboy vests'. Now, she said, everything is driven by financiers – its more calculated and less collegial.

Pv10 & price decks

Adapted from the more general NPV, the most important financial metric in the oil and gas industry is present value 10 (PV10). It incorporates the material specifics of estimated hydrocarbon reserves underground with the expectation that the financial value of these reserves will be eroded by interest and inflation at a rate of 10 per cent per year (i.e. the '10' in PV10) and, thus, is a key metric in the 'assetization' of hydrocarbons (Birch, 2017, p. 468; Ouma, 2020, p. 70). In 1982, the US Security and Exchange Commission (SEC) standardized it as the reporting measure for proven oil and gas reserves for publicly traded companies – solidifying it as an industry benchmark since.[12] Reservoir engineers make PV10 calculations based on reserve estimates of how much oil and gas is underground, expected production costs, expenses, production decline over time,[13] and projected energy prices (called 'price decks').[14] Determining how much recoverable oil and gas there is and valuing it, has been described by those at the centre of hydrocarbon finance as the 'single most important determinant of how much money a producer can get' from capital providers (Shearer, 2000, p. 7; also see Boone, 1980; Sherrod, 1968). It is the fulcrum where the qualitative composition of hydrocarbons, the number of units, and the cost of extracting them are synthesized into monetary values to be realized over time and given a present-day dollar value. As an interlocutor explained, PV10 allows people to imagine 'the actualization of the future cash flows' and is the basis for all other metrics. Table 1 shows a simplified PV10 calculation for a hypothetical unconventional set of hydrocarbon wells.[15]

An interlocutor named Peter explained that when he started in the industry in 1982, PV10 was a standard metric for evaluating drilling projects. He started as a reservoir engineer but later moved into hydrocarbon finance, holding senior roles as a private equity financier, endowment investor and director. He explained, 'NPV10 was a standard metric', although, he added: 'we also used other NPV hurdles (12, 15, 20, etc.), IRR, ROI, pay out times to evaluate projects'. Used in combination with other metrics such as IRR, Peter said, 'PV10 … is a consistent, standard metric for comparative purposes'. Like numbers and metrics for Zaloom's (2003) traders, for Peter, PV10 and IRR convey objective information distilled from heterogeneous materialities and are critical for comparative informational transparency. The materiality of extraction in hydrocarbon finance stops here, however. My interlocutors are not engaged in the hands-on visceral activities of drilling and extraction, although they occasionally make site visits.

Integrating future price forecasts into the metrics of the industry has been standard practice since the 1950s. Formalized into 'price decks', these forecasts integrate current and historical data into probabilistic models that predict future hydrocarbon prices (Duff & Phelps, 2017). Figure 2 is a graph of the oil price decks of several banks published in the fall of 2019.[16] These price decks are integrated into metrics and are used by lenders and investors to imagine, value and decide on hydrocarbon loans and investments (Haynes & Boone, 2019). Price decks are important, an interlocutor explained, because:

> If you have a price deck that is flat, instead of a price deck going up every year, it is a completely different PV10. For the same property, you could have a 100 million going down to 25 [million]. All because of the flat nature of the price deck.

As central factors in calculating NPV, DCF, IRR and PV10 metrics (through their R_t and C_t variables), price decks are powerful economic forecasting models for imagining, valuing and deciding on energy futures in monetary

Table 1 Simple hypothetical DCF and PV10 calculation.

Year	Expected Oil Production Volume (Barrels)	Decline Rate Year-to-Year (%)	Average Expected Price per Barrel ($)	Simple Gross Cash Flow ($)	Lease Operating Expenses, Other Expenses, and Taxes ($)	Simple Net Cash Flow ($)	Discounted Cash Flow (PV10, $)
Initial Investment				-12,000,000			-12,000,000
1	300,000		55	16,500,000	2,000,000	14,500,000	13,181,818
2	105,000	65	60	6,300,000	2,039,669	4,260,331	3,520,934
3	73,500	30	58	4,263,000	2,072,531	2,190,469	1,645,732
4	58,800	20	58	3,410,400	2,108,264	1,302,136	889,376
5	49,980	15	57	2,848,860	2,143,987	704,873	437,671
6	44,982	10	56	2,518,992	2,180,941	338,051	190,821
7	42,733	5	55	2,350,310	2,219,191	131,119	67,285
8	42,306	1	55	2,326,806	2,259,539	67,267	31,381
	717,300		57	40,518,368	17,024,122	23,494,246	7,965,018
						PV10	**7,965,018**
						IRR	**56%**

Source: Author.

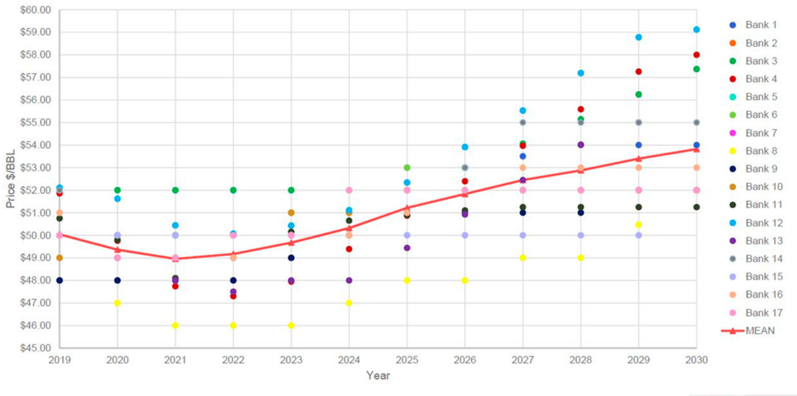

Figure 2 Energy bank price deck survey
Source: Haynes & Boone LLP (2019, p. 3). Reproduced with permission.

terms. In this way, price decks are not entirely dissimilar to central banks' GDP growth projections or US Treasury yield curves, in that they represent expectations of economic futures that incorporate uncertainty about what lies ahead (Holmes, 2014; Zaloom, 2009). They offer financiers' collective assessment of future hydrocarbon prices and illuminate economic allegories about what energy futures should or should not be materialized based on how much economic value they are calculated to have (see Figure 2) – based on specific time horizons and distillations of life.

Time horizons

PV10, NPV and IRR cast future profitability in terms of the present through the variables that segment time into units and the total time horizon under consideration.[17] These metrics encourage users and audiences to imagine time as simultaneously linear and circular (see Figure 3). Linear, because they have starting and ending points that coincide with loan and investment time horizons. Circular, because their purpose is to represent the future in present monetary terms. While the time horizons of major oil companies range up to 25 years, timelines are much tighter for non-majors and their financiers. The time horizon for oil and gas investments typically range from 'three to five years'. For loans, time horizons typically span from three to eight years. The far distant future for both investors and lenders, lurks around 10 years; by that time, many told me, so many things could change that the reliability of financial metrics and models fades into the fog of the future. Metrics and modelling are tailored around these times.

The choice of metrics to use has a lot to do with whether oil prices are rising and falling, instigating a 'boom' or 'bust', and associated growth or discipline allegories. In a boom, financiers may focus more heavily on EBITDA than

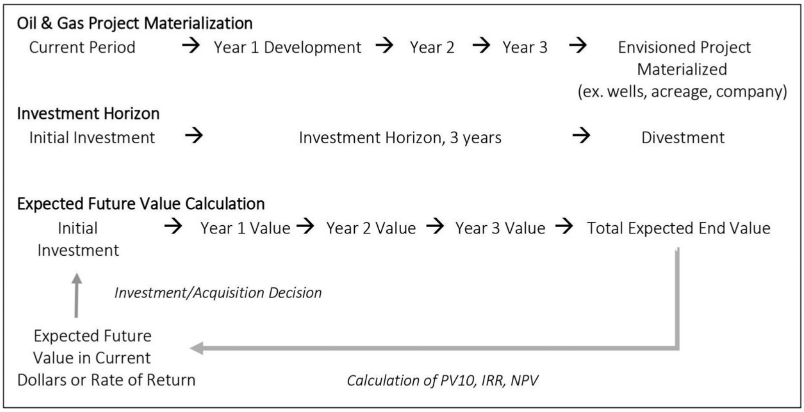

Figure 3 Example of the linear and circular temporality of investment
Source: Author.

FCF because EBITDA conceals from investors changes in asset values and how much a company is spending on equipment and land. If the future looks optimistic, financiers and their clients may accept EBITDA and are 'happy … talking about things like net asset value' several years in the future, an interlocutor explained. In a bust phase, however, financiers and their clients want to see more immediate signs of profitability. As prices stagnate or fall, as they did in the latter half of 2019, the sentiment and the lexicon shift to emphasize positive FCF, as well as near-term NPVs and IRRs. The shift between 'growth' and 'discipline' narratives and the metrics of choice, thus, reflect lenders and investors anticipations about when they will be paid back.[18] There are some disagreements about which metrics best reflect financial value and when, but there has been no critical upheaval in terms of how value is measured and imagined in the future over the last 40 or so years. How these metrics and models define time, and how time is woven into allegorical narratives, is a formative part of the ethics they advance and the moral conclusions they precipitate – excluding the distant past and non-near future. Framing near future in terms of its present financial value, these metrics and models remind me of Irvine's (2019) discussion of presentism:

> What is striking … is that the closely drawn time horizons of economic activity in the present lack sufficient depth to understand the very environment upon which that economic activity depends. (Irvine, 2019, p. 79)

Distilled life

As moral calculative devices that illuminate allegories about hydrocarbons, these metrics distil all factors associated with making oil and gas finance decisions (including people, places, the environment, etc.) into unitary measures of current and future anticipated financial values. They distil information about hydrocarbon assets and companies into net cash inflow, net revenue, initial investment and the discount rate. In doing so, they exclude a wide range of qualitative information about people, places and things outside of their modular calculus. Synthetizing the materiality of hydrocarbons, companies and assets into financial metrics allow a wide range of objects inside and outside the industry to be readily compared and evaluated based on their future anticipated profitability. As Mason (2019) suggests, their narrow objective focus lends a sense of transparency and authority to their resulting figures and to the allegories they support. They cut out all the messiness of hydrocarbons – the places of extraction, the people it affects (for better or worse), and the outcomes of refining and consumption – and construct rational and numerically 'clean' imaginaries of value creation from the perspective of investors and lenders. In doing so, they make a double move: distilling the calculative variables under consideration, while at the same time presenting totalizing imaginaries of assets and companies. As technologies of the imagination, they provide calculative reasons as to why oil and gas investments, loans and projects should or should not happen, and illuminate the moral process of assetization, which I illustrate with an encounter with an interlocutor I call Alex.

'There can't be reserves unless there is economics'

Alex trained as a reservoir engineer and worked for several well-known oil and gas companies with E&P activities in the United States and around the world. Now, he is the vice president of a medium-sized oil and gas E&P firm, and his role straddles the divide between financial expert and in-house reservoir engineer. There is a large poster with interlocking squares and rectangles superimposed on a map of the Gulf of Mexico on the wall in Alex's office showing how the area is divided up for oil and gas production leases. On the white board beside me there is a hand drawn picture of an oil well with numbers scribbled beside it in dry erase marker, and there is an 11 × 8 piece of paper with a colourful seismic graph plotting the geological layers of a drilling prospect taped to the wall. These artifacts reveal the engineering side of his work – estimating the location, size and quality of hydrocarbon reserves.

Alex tells me that he does 'the economics' for his firm. I ask: 'when you say you're doing "economics" … what do you mean specifically?'. 'It's the reason I'm here' he says, 'I do the economics for the exploration, and I also do the economics for the acquisition'. Whether a company is looking to drill a new well or buy a new land prospect, the most important thing he has learned, he tells me, 'Is really people want to make sure they're going to get their money back, and if you can't show them … you're not going to get anybody to do anything'. He learned how to do 'economic analysis' when he worked at AnaOil.[19] He explains:

> What I learned with them is that the economics are everything. You got to have reserves to boot the economics, and that's what guys like me do. We do the reserves too, but then we usually run the economics … . It's critical. We got investors coming in to look at these blocks [of land to drill]. They want to see how much money they can make.

By 'economics' he means financial metrics and models that anticipate – that 'see' – the future and inform decisions about what hydrocarbon projects should be materialized based on what is profitable. Investors are not interested in the material aspects of extraction, that's Alex's job; they want to know what it financially means for them. If a company cannot make 'a 20 per cent rate of return' for its investors, he says, 'you don't do it … that way, you cull a bunch of stuff … separate all the junk off'. He shows me how he puts all the information about various oil and gas wells into a programme on his computer and runs a probabilistic distribution on the development of each. 'I run all the probabilities, all the outcomes … . all the way through to your dollars-per-share impact' for investors he says. The data he includes in his calculations are price decks, expected oil well decline rates, and discount rates. DCF analysis and metrics like IRR and PV10 are key to Alex's analysis.

> We're big into Discounted Cash Flow. We'll look at what [investors] are going to get back in time, at a discounted rate … . We do a full suite of the economics … they're very rigorous … . Nothing gets done without the numbers.

Figuring out the value of an oil well or oil company is 'the biggest part of an acquisition', he says, 'because unless you can figure out a value on it, it's worthless'. He tells me,

> There can't be reserves unless there is economics … . You have to show that it has value. That it has more cash flowing than it costs, or you can't call it reserves.

His observation that hydrocarbon reserves exist, insofar as they can be imagined as having future financial value, reveals insight into the power of metrics and models in shaping allegories about what energy futures should be materialized, or even imagined. Hydrocarbons locked underground cannot be classified as energy reserves if they do not have financial value. Using economic models and financial metrics he separates what imagined futures have value and what futures are 'worthless'. The allegories he weaves are not inconsequential – they are the basis for whether wells are drilled, hydrocarbons are extracted, and companies and acreage are bought and sold. Alex's job is to 'make sense' of oil and gas futures, as he puts it. In the world of energy, the metrics and models he uses are more consequential than the Black and Scholes formula and its variants (MacKenzie, 2001; Maurer, 2002).

Alex is not unique in this regard. As he said, this sort of economic-financial analysis is 'what all these big companies do'. My other interlocutors also perform similar economic analyses – weaving stories of future value with economic concepts and financial metrics. What Alex, Peter and the managing director have in common is that they frame what makes sense, imagine the future, and craft allegories about energy in the financial lexicon of the industry. They are at the heart of the US hydrocarbon sector, the epicentre is Houston; and they are connected to sites of extraction and financial centres across the United States through limited partnerships, supply chains and industry networks. Their lexicon of metrics and models is not drawn from a unique Texas-brand of oil capitalism. With the exception of PV10, the models and metrics they use are imported from the broader US finance sector. Modularly applied to companies and assets, they synthesize the diverse and heterogeneous world of hydrocarbons into a homogeneous set of indicators that can be compared and woven into allegories about the futures and the right course of action for capital providers.

(Hydro)carbon capital

The ethnographic encounters, models and metrics explored here contribute to broader debates about financialization and economization by showing how metrics and models are used to frame time and value for the purpose of making hydrocarbon decisions in the United States. These metrics and models are the ethical scaffolding on which allegorical narratives are crafted. Allegories, I have suggested, are important for highlighting the moral messages embedded in the hydrocarbon narratives of financial experts, whose job it is to weave imaginaries of the future and how the future should be acted upon by capital providers – lenders and investors. The concept of allegories highlights that financial narratives are not just descriptive but prescriptive evaluations about which energy futures have value and which should be materialized – advancing a kind of energy ethics (High & Smith, 2019). In this regard, this paper advances the works of Leins (2018), Holmes (2014) and Maurer (2002) who explore how the practice of economic-financial expertise involves crafting skilfully composed narratives. Unpacking these metrics, where they came from, how they are used, and their components – in line with MacKenzie (2001, 2004) – helps us better understand how they define time and value, as well as the allegories that are constructed with them. The temporal horizons defined in these metrics, I have shown, are not a 100 years, or 50 years or even 25 years. The futures they imagine and the decisions they inform about energy projects are much shorter than that. Moreover, what constitutes value becomes starkly clear. From the diverse and heterogeneous universe of things that might be considered values – or, crudely, what we consider to be important – value is very narrowly defined in terms of profitability (Graeber, 2013). While these are not new revelations, unpacking these metrics clearly renders how energy financiers conceptualize value, time and make energy decisions on our collective behalf from the opaque fog that shrouds the American hydrocarbon industry from those outside it. As such, the ethnographic data above complements and advances the now vast literature on the materialities of extraction, and the financial practices that support it, by exploring the financial processes that prompt extractive activities and the ethical dimensions of these processes.

Beyond understanding how these metrics, models and allegories have come to shape the present energy landscape in the United States, they have broader implications. The interlocutors I describe here financially fuelled the US Shale Revolution and their clients are amongst the largest institutional investors in the world. Some hydrocarbon-focused firms I know are in the process of (or have just finished) raising renewable energy funds alongside their upstream and midstream oil and gas funds. As the US energy industry pivots toward a mixture of renewable and hydrocarbon energy, these and similar metrics, models and allegories are coming to bear on new forms of energy extraction and potential futures – helping people imagine, evaluate and advocate what should and should not be materialized. Langley *et al.* (2021) have recently noted that private capital is being championed as central to climate change mitigation – calls for which reached heightened levels of public discourse with the COP26 meeting in Glasgow. As they suggest, this existing assembly of qualification and analytical practices are similarly transforming these technologies into familiar allegorical financial narratives. This has made the decarbonization of capital and divestment from high-carbon assets 'contingent, contested and compromised' (Langley *et al.*, 2021, p. 511). While the shift to 'low-carbon' investments is real, investors need to meet their actuarial targets remains the same. The decarbonization of capital, many tell me, has more to do with dismal investment returns in oil and gas between 2015 and 2020 than a 'green' shift in investor sentiments. Recently reflecting on this, Peter suggested:

> $70 per barrel [oil] is helping the industry overall. Question is, when will the investment community forgive the industry for destroying many billions of dollars in capital?

It is a 'good time' to reinvest in US hydrocarbon companies he said. Understanding how this lexicon makes sense of the world, the imaginaries it creates, and the realities it materializes, opens opportunities to better shape (or oppose) the larger energy worlds we find ourselves in. Moreover, it provides an occasion to reflect on whether the ethical frameworks embedded in this lexicon and the moral conclusions of its allegories coincide with our own ethical frameworks and moral ambitions for the future we want to create.

Notes

1 'Fidelity' refers to Fidelity Investments Inc.

2 This is a pseudonym.
3 Interlocutors I know are engaged in the practice of energy investing and lending, most in senior and leadership positions. They generously let me into their offices, homes and lives. I also joined two prominent industry associations in Houston in 2019 while conducting fieldwork.
4 The names of all interlocutors are pseudonyms.
5 These historical documents were given to me by an interlocutor.
6 Alternately, the discount rate can be interpreted as the return from investing elsewhere (Chiapello, 2015).
7 'Internal' refers to the omission of the cost of borrowing and inflation, 'external' factors, from the IRR (Wright & Gallun, 2008, p. 301).
8 NPV is expressed as a monetary value, IRR as a percentage.
9 ROI = [(Value of Investment – Initial Cost of Investment)/(Initial Cost of Investment)].
10 ROR = [(Value of Investment – Initial Value of Investment)/(Initial Value of Investment)] x 100.
11 TEV = market capitalization + market value of debt + preferred stock – excess cash and equivalents.
12 PV10 disclosure requirements for public companies were formalized, effective, on 15 December 1982. Before then, some undiscounted disclosures of future net revenues were required but did not include PV10. Source: e-mail exchange between author and Associate Chief Accountant of the SEC, dated 24 June 2021.
13 Reserves are depleted and production declines over time as hydrocarbons are extracted.
14 These calculations are usually done by engineers from independent firms and cross-checked by 'in-house' engineers in investment firms, banks, and E&P companies.
15 An interlocutor confirmed the accuracy of this representation and the correctness of these calculations. IRR was calculated in MS Excel using the 'IRR' function.
16 The banks surveyed in Figure 2 each use a proprietary algorithm for forecasting prices (Haynes & Boone LLP, 2019).
17 't' often represents years but can also represent quarters, entering the equations as consecutive sequences of numbers (1, 2, 3, 4 …) giving time a linear characteristic.
18 Companies with little or no current profitability but a portfolio of hydrocarbon wells that are anticipated to produce profit in the future, are likely to use NPVs with longer time-horizons (e.g. five years).
19 This is a pseudonym.

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