Entelligent | USA Headquarters: 5378 Sterling Drive | Boulder, Colorado 80301 | Office: +1 (303) 443 9447

Energy-Climate Transition Risk for Equities

An Entelligent Research Note
By Elliot Cohen, PhD
March 15, 2021

Abstract

The science is clear – and investors are quickly coming to agree – that a full decarbonization of the global economy is required no later than 2050 to avoid catastrophic climate change. Since the Industrial Revolution, atmospheric carbon concentrations have increased nearly 45% from 286 parts per million (ppm) in 1850 to 410 ppm today; attributed in roughly equal parts to coal (99ppm), land-use change (98ppm), oil and natural gas (108ppm). **If we are to achieve the Paris Agreement of holding global temperature increase within 2 deg C. of pre-industrial levels by 2100, the transition away from fossil-fuels becomes self-evident.**

Energy is the medium of climate change – both the biggest cause and the biggest opportunity. It is for this reason that *Entelligent* uses energy transition pathways to understand and quantify climate transition risk. **This research note demonstrates the use of Entelligent E-score® for quantification of near-term climate transition risk for equity investments**. To explore the impact on portfolio returns, we conduct a simple experiment comparing low and high-climate exposure portfolios (as measured by E-score®) over a 10-year period. The results indicate that by minimizing climate exposure we can achieve reduced volatility and slightly better return, resulting in higher overall volatility-adjusted compound annual growth rates (CAGR).

Science

For the first time on record, carbon emissions from fossil fuels are projected to decrease across all regions (see figure 1). This is due to many factors: a long-term trend in reducing the carbon intensity of energy and the energy intensity of economic activity (see Kaya decomposition, fig. 3); a medium-term trend in acceptance of climate change and an urgency to act; and a short-term reduction in global activity due to COVID-19 (see fig. 2).

Since the Industrial Revolution, humans have un-earthed and burned a staggering volume of fossil fuels: contributing over 1,600 billion tons of carbon (Gt CO2) to the biosphere, increasing atmospheric carbon concentrations by nearly 45% (from 286 ppm in 1850 to 410 ppm in 2019; see fig. 4), and increasing global average temperatures by 1 deg. C. **To keep within 2 deg. C., humans can emit no more than 350 Gt CO_2 cumulative between now and the end of the *century*. At current rates of 35 billion tons of CO_2 emissions per year, we will use up the remaining carbon budget before the end of the *decade*.**

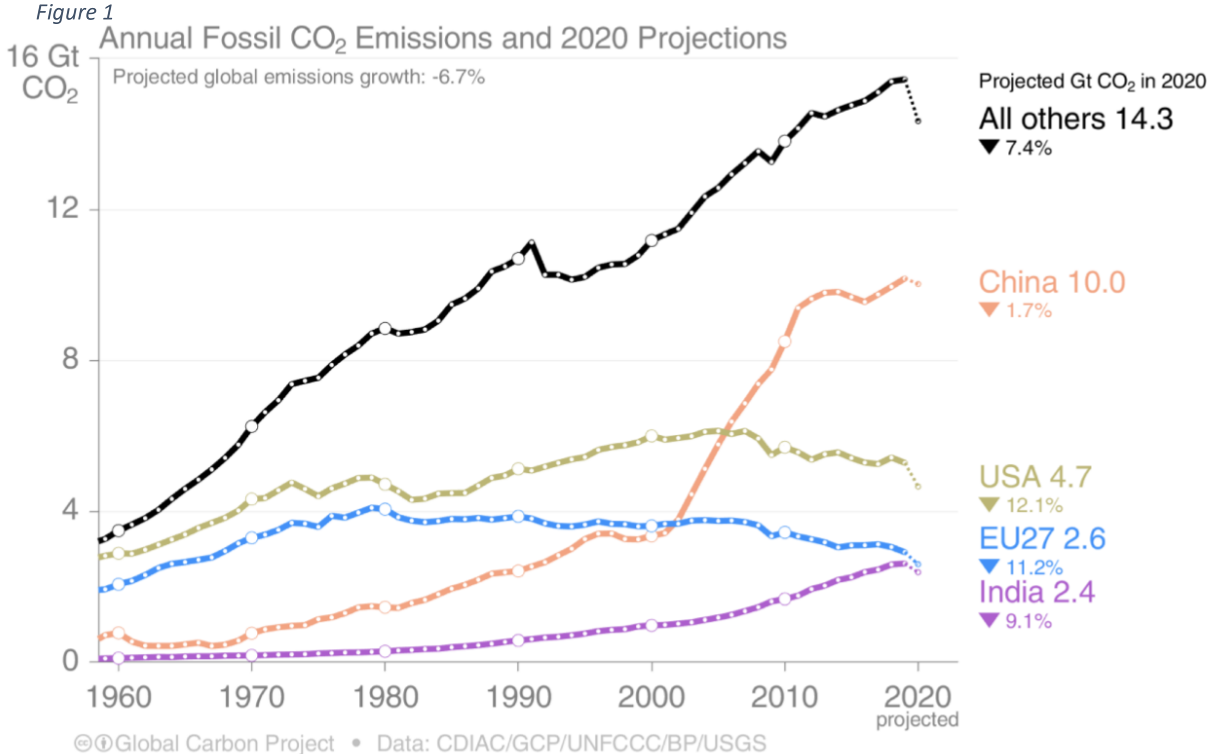
Investment Case

Global fossil carbon emissions are projected to decrease by 7% in 2020 -- putting the world (nearly) on track for the first time towards the Paris Accord target of holding global warming within 2 deg C. above pre-industrial levels by 2100. **To stay on track, we will have to maintain and accelerate the reduction in emissions year over year at least through 2050**. As Larry Fink, CEO of Blackrock, stated in his recent 2021 letter to investors:

It's important to recognize that net zero demands a transformation of the entire economy. Scientists agree that in order to meet the Paris Agreement goal of containing global warming to "well below 2 degrees above pre-industrial averages" by 2100, human-produced emissions need to decline by 8-10% annually between 2020 and 2050 and achieve "net zero" by mid-century. The economy today remains highly dependent on fossil fuels, as is reflected in the carbon intensity of large indexes like the S&P 500 or the MSCI World, which are currently on trajectories substantially over 3°C.[2]

The time to invest in a de-carbonizing economy is now. **Simple exclusionary-divestment strategies are not enough: they steer capital to companies that are low-carbon and have always been low-carbon, and do not reallocate capital to companies with high potential for *reducing* emissions.** To reach those companies, we need to invest in leading companies across all sectors -- including energy and utilities -- and chasten the laggards to catch up.

Figure 1



Entelligent | USA Headquarters: 5378 Sterling Drive | Boulder, Colorado 80301 | Office: +1 (303) 443 9447

Figure 2

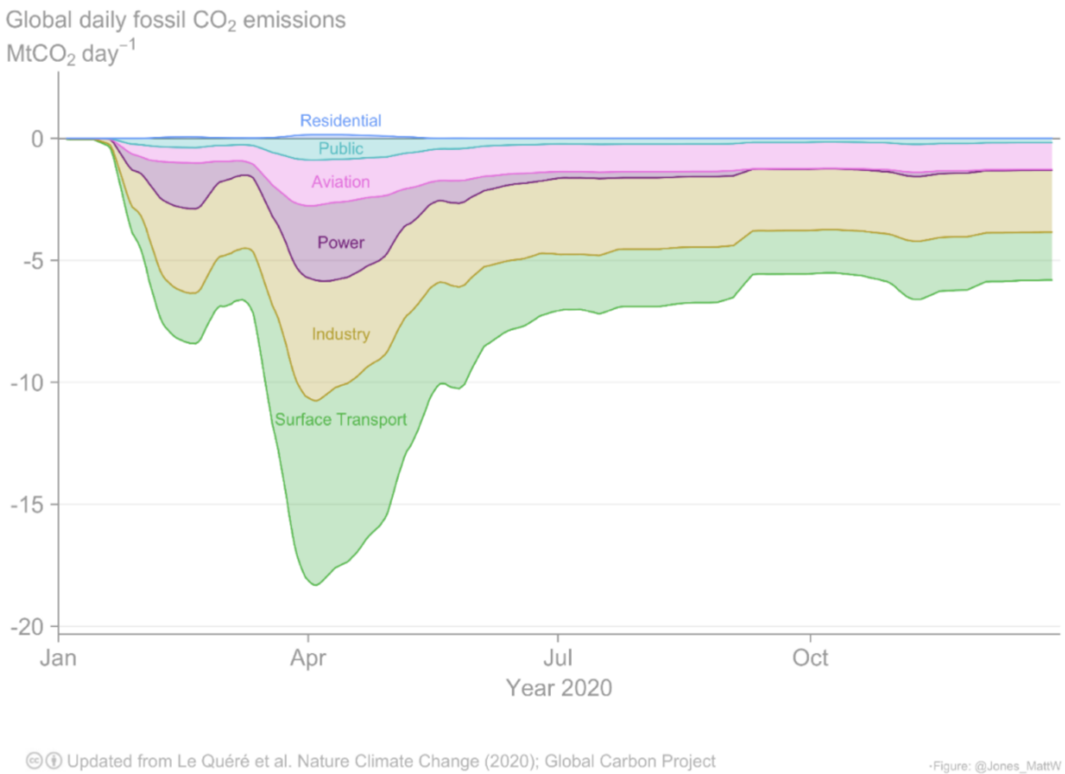


Figure 3

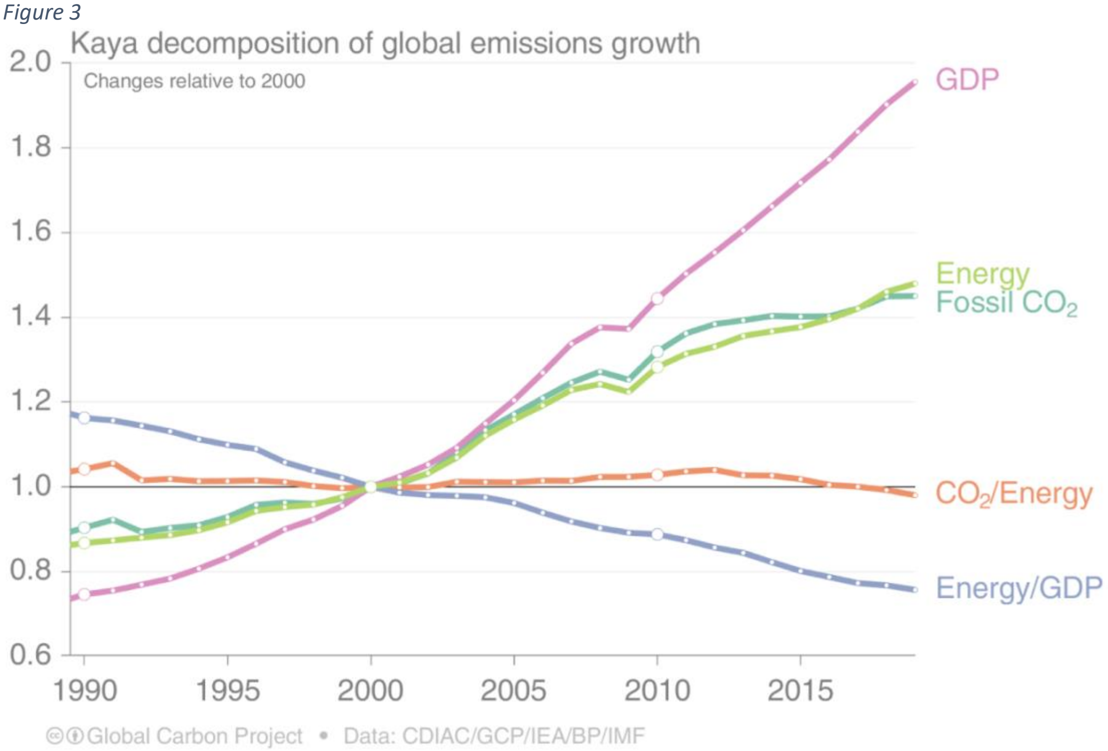
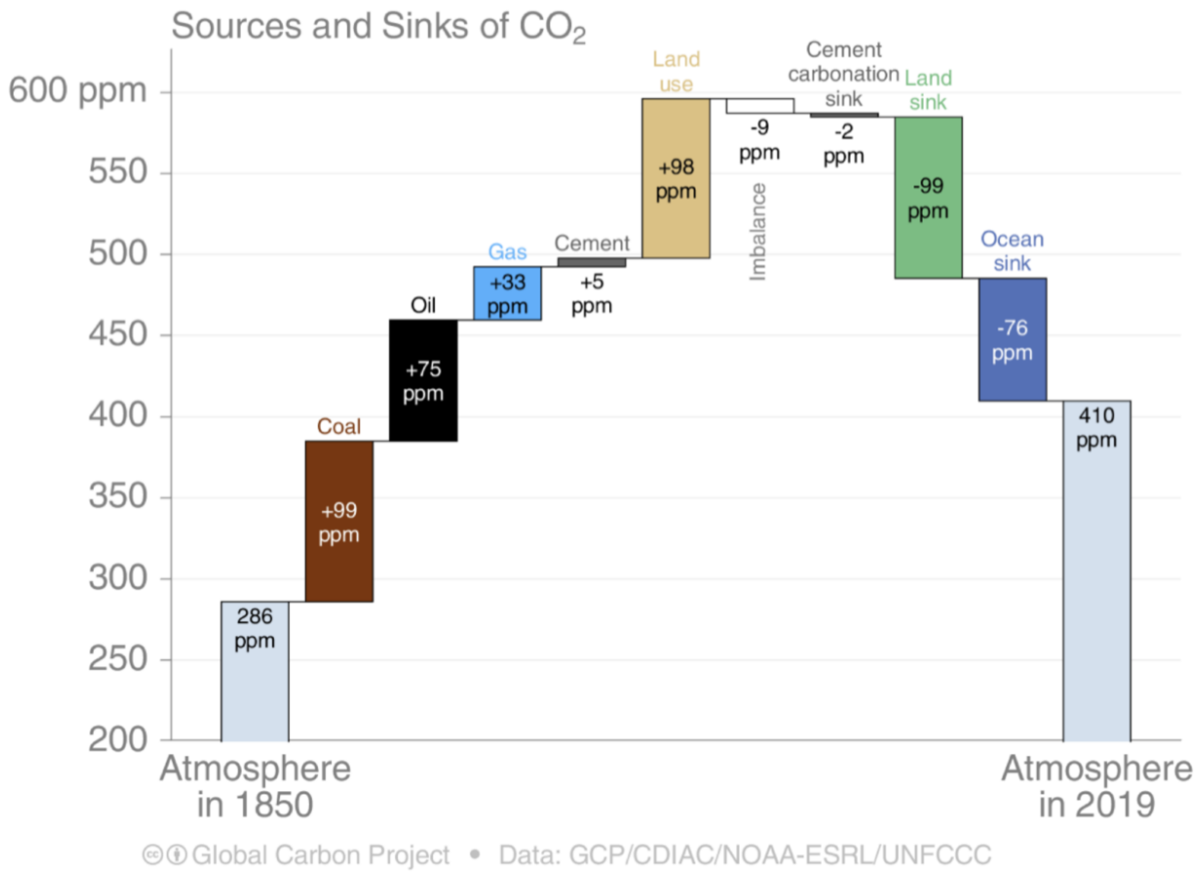


Figure 4



Policy

The International Finance Corporation (IFC) has indicated that management of traditional investment risk will become significantly more difficult if institutions fail to properly manage climate risk. Therefore, identifying, measuring, and acting on climate risk information is crucial to protecting the value of current investments.

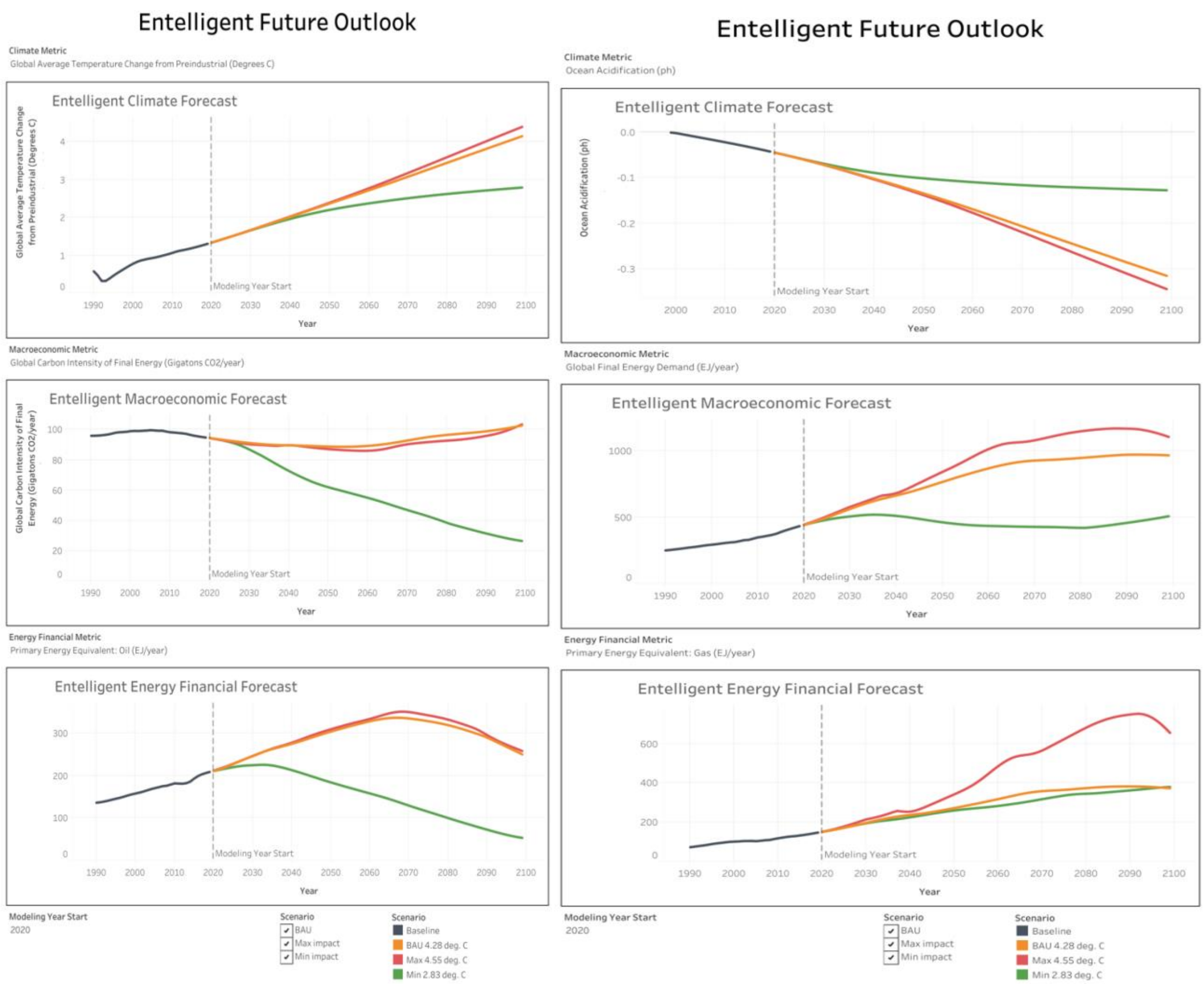
Entelligent's mission is to help asset owners and asset managers incorporate the realities of climate change into their investment decisions. **Our solutions are designed to minimize climate risk exposure, reduce volatility, and outperform comparative benchmarks while accelerating positive social and environmental change.**

Climate transition risk can be conceptualized as the gravitation pull of a low-carbon socio-economic state. It is characterized by the introduction of new policies, changes to regulatory regimes, deployment of capital, advances in technology, and shifts in consumer behaviour. **While the physical manifestation of climate change (e.g. global average temperature rise, sea level rise, ocean acidification, etc.) is a cumulative process with significant inertia, the economic and financial impact is fast-acting, with companies and investors needing to respond today to future expectations**.

A key aspect of Entelligent's methodology is to bring mid-to-long-term impacts of climate change, and climate change mitigation, to the present to yield timely, actionable information to equity investors in the capital markets. The following sections illustrate how Entelligent guides investors towards climate risk-adjusted equity portfolios that we believe are more robust to the range of possible future climate scenarios.

Figure 5

Time horizon of expected climate change impacts. Source: Entelligent IAM Dashboard



Quantifying Near-Term Transition Risk

With the energy sector contributing nearly three-fourths of all carbon emissions, it follows that any serious action to mitigate climate change will directly or indirectly manifest as a change in the investment, production and consumption of energy. Further, predicated on the general understanding that energy is central to development, it is not hard to accept that the supply, demand, and price of energy will influence the economy at large (Smil, 2017). This is the foundation upon which **Entelligent uses the pulse of the energy sector to monitor near-term climate transition risk.**

Entelligent applies a 20 to 40-quarter moving window to estimate statistical relationships between stock performance and energy price / profitability indicators (see fig. 6 as an example). Our models yield a dynamic measure of exposure of company performance to energy prices and energy sector performance.

From a machine learning perspective, our target is security-level total return. Our IP-protected features include global energy prices and profitability indicators for all major energy carriers. The cost function to minimize is the variance between observed and predicted returns over a historical training period. Model predictions are structured as two-year forecasts of expected active return under three climate scenarios: business as usual, low carbon, and high carbon. The return-spread between high and low-carbon scenarios are standardized into a unique measure we define as Energy-Mix Transition Risk (EMTR). EMTR form the basis of our E-score suite.

Estimates of transition risk are observational, not causal: we identify patterns in stock performance relative to energy information (historical, derived and simulated) and use these patterns to forecast what may happen under various climate scenarios. It is important to note that these relationships are complex: sometimes direct, but often indirect. Consider the following examples.

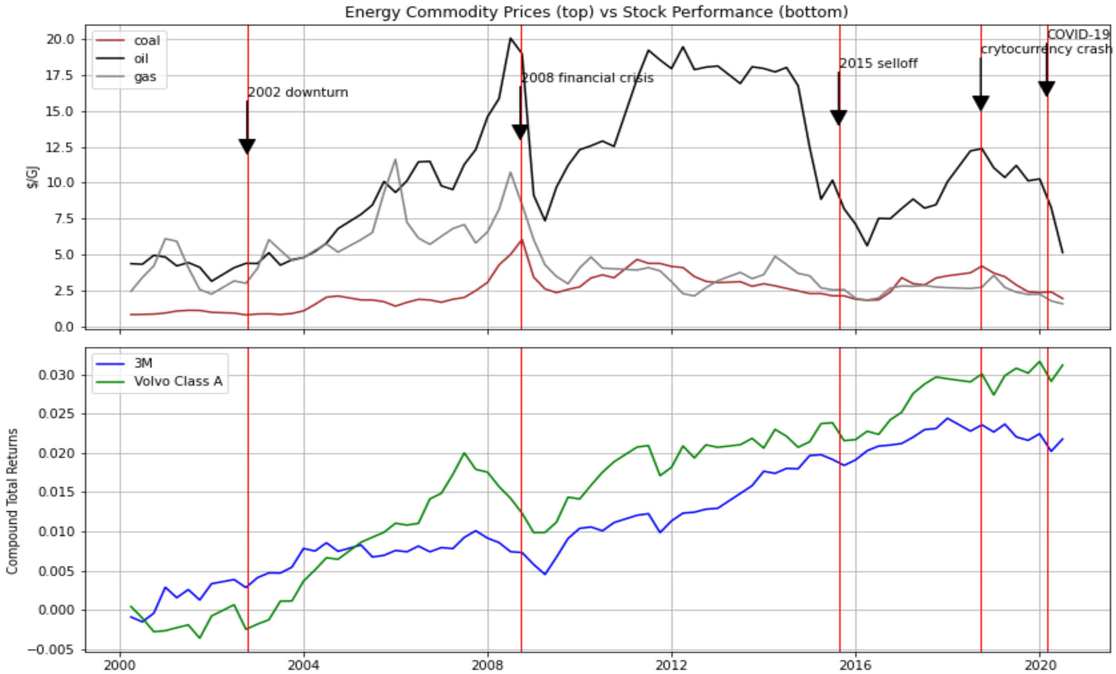
- *Consumer Durables:* When the price of oil decreases, demand for SUVs and trucks increases, often raising profits for auto companies (trucks and SUVS are higher-margin vehicles compared to sedans).
- *Consumer Discretionary*: When the price of oil increases, the operating cost of companies with large vehicle fleets (e.g. FedEx, Amazon, etc..) increases.
- *Utilities*: When the cost of natural gas declines, the profitability of coal declines due to fuel-switching.
- *Information Technology*: When the price of renewables decreases, the operating cost of companies with ambitious climate action plans (often in tech; often purchasing renewable energy/credits) decreases.
- *Real Estate*: When the price of oil decreases sharply, it can be an indicator of an economic slump, cooling the real estate market and driving down profits.

Intuition alone is often not enough to capture the direction, let alone magnitude, of these relationships. A rigorous statistical approach is required.

Figure 6 (below) illustrates the relationship between standardized energy prices ($/GJ) for benchmark commodities (coal, oil, gas) to the cumulative returns of two companies in the industrial sector (3M and Volvo; chosen at random). While these types of relationships are observational and not causal, they are often predictive of company performance when combined with robust energy price forecasts. Our research indicates that energy price signals often explain a small but statistically significant level of variance in stock price returns.

Figure 6

Relationship between energy commodity prices and company performance, with market event overlay



Source: Entelligent Data Science Team

Investigating the Drivers of Return with Entelligent E-Score

To demonstrate the E-score as a driver of portfolio return we developed a simple experimental design. We compared low and high-climate exposed portfolios, all else equal, over a ten-year period from 3/31/2010 to 3/31/2020. Constituents are selected on a sector-neural basis from the MSCI All Country World Index.

We apply an E-Score filter to place securities in the top half of each sector (independent of weight) in an "included" portfolio with the remainder placed in an "excluded" portfolio. This is done independently for each quarter in the time horizon. The two resulting portfolios have approximately the same number of companies overall (1300) and the same number of companies per sector. The "included" portfolio is a subset of the benchmark with superior E-Scores, while the "excluded" portfolio is a subset with inferior E-Scores.

We observe positive effects on an equally weighted basis (highlighting security selection). This controls for the fact that large-cap leaders have enjoyed a tremendous return advantage over the past 5 years.

From an arithmetic average perspective, there is very little single quarter expected value added for individual securities using the E-Score. However, this hides the true value of the metric. The decreased observed standard deviation of the cohort of high e-scoring securities is the real underlying driver. When compounded over multiple quarters, the lower volatility combined with slightly better return yields much higher expected volatility adjusted compound annual growth rates (CAGR) : the actual compounded returns one would expect from an average security. Below we see how **a minor (7bps) advantage in average quarterly returns coupled with lower volatility yields an incremental 69 basis points of annual performance.**

Table 1: Security Level - Equal Weighted

	Included	Excluded	Difference
Avg Quarterly Returns	1.76%	1.69%	0.07%
Standard Deviation	15.03%	15.68%	-0.65%
%Win	57.60%	57.30%	0.30%
Vol Adj CAGR	2.60%	1.91%	0.69%

Source: Entelligent Data Science

Assessing E-Score performance over time

E-score portfolios have demonstrated impressive outperformance in hypothetical back tests across multiple timescales (see Table 2 for comparison of three E-score screened portfolios of the S&P500). However, no one beats the market every time. Likewise, E-score portfolios at times underperform the benchmark, as seen during the period 2011-2014. The period 2011-2014 was one of relatively stable energy prices. With less volatility, the energy price–stock price signal that Entelligent uniquely measures is attenuated. That is, during periods of relative stability in energy prices, there is less spread in expected return due to energy-climate transition risk.

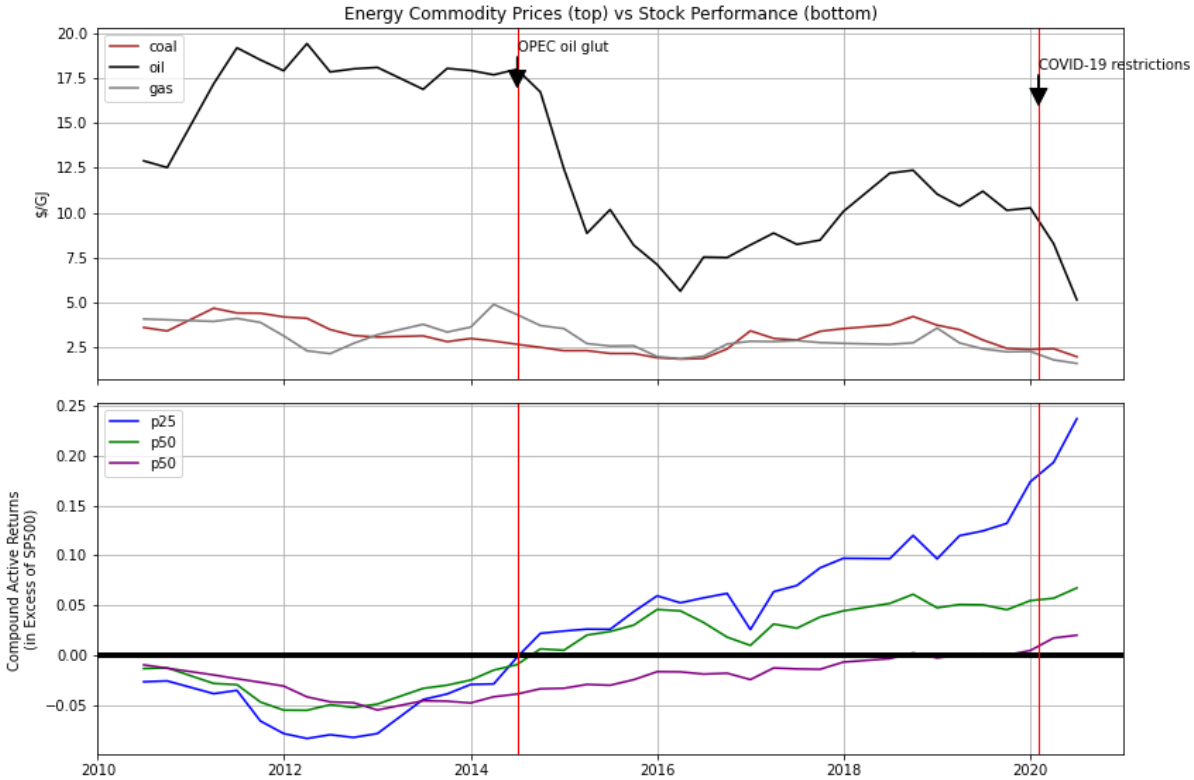
Table 2 : Financial Performance of E-Score screened portfolios in a Hypothetical 10-year Back-test

	S&P500	Smart Climate[75]	Smart Climate[50]	Smart Climate[25]
Alpha		1.11%	0.69%	3.73%
Beta		1.00	1.01	1.02
Sharpe Ratio	0.58	0.63	0.61	0.74
Total Return	66.65%	75.57%	72.95%	99.58%

Source : Entelligent Data Science

In summer of 2014, OPEC announced a glut of oil supply and a slump in demand from emerging markets. This precipitated a crash in oil prices of almost 50% in less than a year. This is precisely the type of energy shock that Entelligent E-score are designed to protect against. When this “natural experiment” arose, it kicked off a period of strong performance for Entelligent Smart Climate portfolios. The figure below demonstrates this relationship.

Figure 7



Source: Entelligent Data Science

Conclusion

Climate Change is real and its far-reaching impacts are becoming more evident every day. A concerted global effort to mitigate and adapt to Climate Change is of paramount importance. The economy-reshaping force of climate action may also represent the largest business and investment opportunity in decades, if not centuries. Entelligent's E-Score is precisely designed to help investors reimagine transition risk as opportunity. By constructing (or re-balancing) equity portfolios to minimize climate risk exposure, the E-Score can help investors realize higher overall volatility-adjusted compound annual growth rates (CAGR).

Appendix

Figure 1: Timeline of oil market episodes since 1990

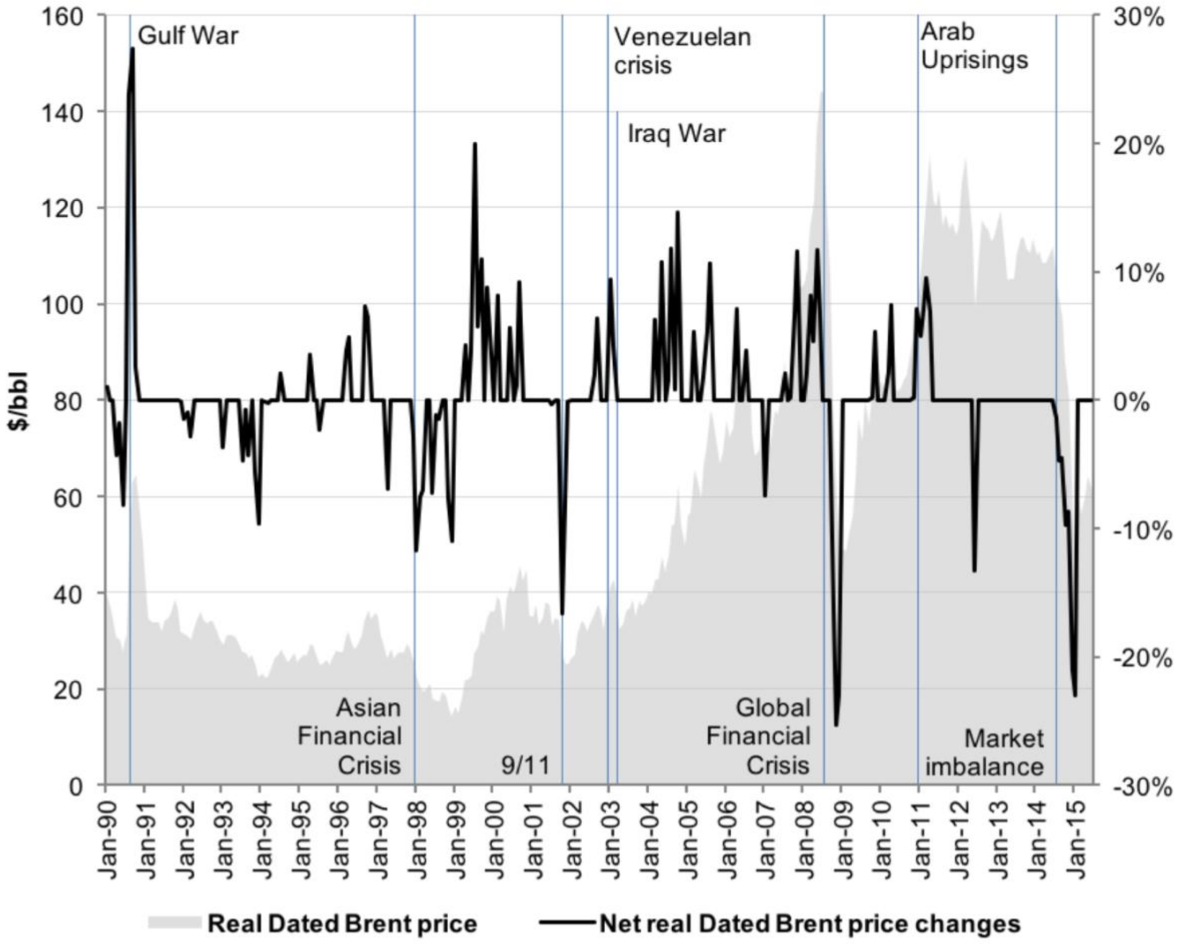


Table 1: Summary of the key factors of historical oil price shocks

Oil price shock (Chronology)	**Key Factors**
53% (Aug 90 – Oct 90)	*Gulf War*; Supply shock and precautionary demand shock
- 57% (Dec97-Dec98)	*Asian Financial Crisis*; Demand shock
77% (Jun 99 – Sep 00)	*Strong global industrial growth*; Supply cuts and strong demand
13% (Dec02–Mar03)	*Venezuelan crisis and Iraq War*; Supply shock
145% (Jan03–Jun 08)	*Commodities supercycle*; Strong demand and *stagnant* supply, precautionary demand shock
- 102% (Jul08–Dec08)	*Global Financial Crisis*; Demand shock
35% (Dec10–Apr11)	*Arab Uprisings*; Supply shock
- 73% (Jul14–Jan15)	*Excess capacity*; Strong supply and *stagnant* demand, precautionary demand shock

Source: The Oxford Institute for Energy Studies (2016)

Bibliography

Fink, Larry. *Larry Fink's 2021 Letter to CEOS*. BlackRock. https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter. Accessed 18 Mar. 2021

Le Quéré, C., Jackson, R.B., Jones, M.W. *et al. Temporary reduction in daily global CO_2emissions during the COVID-19 forced confinemen*t. *Nat. Clim. Chang.* **10,** 647–653 (2020). https://doi.org/10.1038/s41558-020-0797-x

Ritchie, Hannah; Roser, Max. *Emissions by sector*. Our World in Data https://ourworldindata.org/emissions-by-sector . Accessed 12 Mar. 2021

Smil, Vaclav. *Energy and Civilization: A History*. REV - Revised, 2 ed., The MIT Press, 2017. *JSTOR*, www.jstor.org/stable/j.ctt1pwt6jj. Accessed 12 Mar. 2021.

Stenek, Vladimir; Amado. Jean Christophe; Connell, Richenda*. Climate Risk and Financial Institutions ; Challenges and Opportunities*. International Finance Corporation https://www.ifc.org/wps/wcm/connect/fe18be47-a0cc-4b5d-a134-078a995ce8bd/ClimateRisk_FinancialInstitutions.pdf?MOD=AJPERES&CVID=n48iBMz. Accessed 12 Mar. 2021