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Macroanalyst

Spencer helps lead the firm's analysis and discussion of economic, thematic, and social issues around the world. He pursues an active, idiosyncratic research agenda on topics ranging from climate change to the relationships between data, markets, and society.

FIGURE 1

**Climate models have offered many clear predictions**

- ✓ Rising average temperature
- ✓ More rapid temperature rise at the poles
- ✓ More record-high nights than days
- ✓ Increasingly intense rainfall (fewer showers, more downpours)
- ✓ Higher ocean levels
- ✓ Decreasing Arctic sea ice
- ✓ Hurricanes and typhoons at higher latitudes
- ✓ Later winter and earlier spring

FOR PROFESSIONAL OR  
INSTITUTIONAL INVESTORS ONLY

## What should we do about climate change?

Amid recent extreme weather events, many clients have asked for insights on climate change. Macroanalyst Spencer Glendon has spent several years researching climate science and writing about it for our investors. Here we share excerpts from a series of his notes to our firm.

I became interested in climate change because it was a topic that was complex but might actually be tractable, and because people in finance didn't want to talk about it, so it might be mispriced. What I found was much more tractable — and fascinating, beautiful, and useful — than I had imagined.

The more I work on this topic, the more I appreciate the clarity it offers: Due to amazing advances in science, in technology, in thinking, and in exploration, we can understand our world in a way that provides a valuable forecast — something we humans have never had before. The predictive power of climate models would impress most investors (FIGURE 1). I have come to believe that climate forecasts will one day be seen without controversy as one of the greatest achievements of mankind. Moreover, with each passing month, the science gets better informed by more data from the past and by additional experiments and analyses. (For more on Spencer's research on climate science, you can watch a short video [here](#).)

So as investors and asset owners, what should we be doing about climate change?

### 1. Talk about it

In conversations about climate change, a common limitation is the paranoia that the topic is "political," which has become a taboo word over the last 50 years in supposedly polite society. But outside of finance, the world is moving on to an understanding that the climate is changing in ways that, while not precisely certain, are informative and offer us choices about how we live and work. We talk all the time about health care and national defense, both of which are at least as political, and we should be doing the same when it comes to climate change.

## Life in a 4°C world

Life in a world where the average global temperature increased by 4°C would be unrecognizable to us. I have read many ways of illustrating the different scenarios in science journals. Here are some that resonate with me:

- Almost every summer would be hotter than the hottest summer of the 20<sup>th</sup> century.
- In Boston, every day of summer would probably have a high temperature over 90°F (32°C) and there would be entire weeks when temperatures would be over 100°F (38°C).
- The summer Olympics could probably only be held in Canada, the northern UK, and Scandinavia. That would make sense because the populations of those places will have more than doubled as billions of people will be going somewhere cooler than their uninhabitable homelands.
- Actually, the summer Olympics would probably be indoors, like most things. Many cities' offices would be linked by tubes, while London's Tube would have to be massively overhauled.
- Shanghai would probably be uninhabitable as it would be both underwater and unbearably hot.

With whom should we be talking? The list includes suppliers and other businesses on which we rely. Some have thought about it and some have not — it affects reliability, sustainability, planning, etc. And of course it includes companies in which we invest. Are they planning? Does their outlook depend on narrow assumptions? Are they defiant? It can also be a good way to understand how they see the world and their company's role in it. I make no assumption that it's the number one issue for companies, but it is part of the mosaic and can tell us things about the rest of the mosaic.

Here are just a few things I have learned from colleagues by talking about climate change:

- One colleague's family is from upstate New York where Indiana farmers are showing up to buy land because they see their own land getting too hot and they want access to fresh water.
- A colleague from Japan tells me that the Olympic organizers are considering running the 2020 marathon starting at midnight because it will likely be far too hot to safely run in the daytime.
- A colleague from San Francisco sold her home by the ocean because there was such a strong bid from wineries trying to move closer to the coast from the increasingly-too-hot inland areas of northern California.

Of course, there are limits to what communication can achieve. Climate scientists have come to the conclusion that the public will not react in response to fear of a scary future, so they a) focus on a "target" of a maximum average temperature increase of 2°C; b) don't say much about what life would be like under the 2°C scenario; c) don't say very explicitly that holding the rise to 2°C will require massive change; d) don't talk much about the non-linearities that are likely as we get further away, including the steadily increasing news that the effects on Greenland's and Antarctica's ice are bigger than prior estimates; and e) never really talk about what life in a 3°C or 4°C world would be like (see sidebar at left).

## 2. Prepare for a networked, renewable electric future

Using the electric grid for almost all forms of work — lighting, power, heating, mobility, information, etc. — makes a lot of sense, and deriving the electricity from renewable sources makes even more sense. The coming modern electrical infrastructure will likely be flexible, networked, truly commodity-based (think of electrons as analogous to zeroes and ones in the data world that used to be analog; electrons do not have to be refined, nor are they light or sweet or heavy). I would expect the modern network to exist at many different scales. Small networks and small providers, massive grids and huge providers — all can get along. This diversification should make the network more resilient. All of these things are already underway and accelerating.

The scale of the existing electricity network in the developed world is already big enough to provide most of the backbone for the future network. New sources of power will replace the old model of high capex and high, volatile variable costs with biggish capital investment and near-zero marginal cost. Individual companies as well as neighborhoods, municipalities, and regions will probably all choose predictable cost structures for a given supply of electrons over the current system.

How would society pay for this? First of all, the world is awash in capital looking for predictable long-term returns, so there is already financial fuel to pay for the new grid. In addition, fossil-fuel based energy will



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eventually fall as a share of markets, freeing up money to build around the electrical network.

I find it very likely that electric utilities will grow considerably. They are engineering companies that have a mindset of reliability, capacity, and systems dynamics, all of which will be increasingly valuable. I think it's likely that much of the market cap that is now in fossil fuels will go into utilities. I would expect utilities to own an expanding set of assets, including a more substantial core grid. They may also get into other businesses that have network effects, like charging stations for electric vehicles and management of energy infrastructure for large clients like community solar projects.

All of the above is not to say that this future will arrive completely tomorrow or that there won't be some uses of liquid and solid fuel in the future (airplanes, maybe trucks, some heat, etc.), but a bias toward electrification and away from fossil fuels could well be to an investor's advantage.

### 3. Expect higher volatility of oil prices and lower-demand scenarios

This may be a great opportunity for alpha-oriented fossil fuel investors who think about multiple scenarios. At the same time, low-conviction and benchmark-like investors may need to change how they invest in energy. For those who don't have a strong view about fossil fuel prices, I think the average allocation should probably be lower than in the past because it's likely that average returns will be lower, periods of very low prices will be more common, and volatility will be higher, all of which would make the risk/reward trade-off less attractive.

The world still depends on fossil fuels and will for a while. Change in demand may only come gradually, but there have already been big changes in some fossil fuel markets and many more are to come. It is now abundantly clear that coal is doomed in the developed world, and eventually will be everywhere. There will be swings in the commodity, and they may be violent, even to the upside because people will be reluctant to commit new capital to new coal endeavors.

I am confident that oil prices will be more volatile than they were historically due to climate change and that when prices are low, those lows will tend to be lower. I can imagine scenarios where the highs will also be higher because capital will be slow to respond to shortages, but there probably aren't many such episodes left. In short, I don't expect the market to clear the way it has in the past as the owners of large oil reserves have to be increasingly worried that their resources could be worthless in the future.

There is a tendency to think something like "most people don't really care about climate change." This may be true, but "most people" don't set the marginal price. I suspect that price is set by people who have the lowest discount rate and want to bring their production forward.

In addition, the fossil fuel industry is facing competition that it never has before. Smart people want to work for companies whose goal is to put fossil fuels out of business and are willing to accept less money to do it. (Would you prefer to be the director of recruiting at a technical university for Chevron or Tesla?) Some investors will accept somewhat lower returns to fund alternatives to fossil fuels. Some regulators and governments are likely to make business more difficult for fossil fuel companies. Investing in a sector whose competitors get cheaper skilled labor, incrementally cheaper capital, and face lower regulatory prospects is risky.



Getting to zero emissions would only stop the CO<sub>2</sub> concentrations from rising, so zero is not “good” but just “flat.”

I agree with the assessment that it is unlikely that the world will dramatically restrain emissions to achieve the 2°C goal that is a common focal point for policy (the COP21 talks<sup>1</sup> were aimed at 2°C with an ambition for 1.5°C). At present, almost no country has pledged to do enough to get to 2°C, so the safe consensus is that there won't be much change. This, however, is not the same as saying that I am confident that it won't happen. Once you start assigning a meaningful probability to action to limit climate change, the calculus gets different quickly. In addition, there have been big changes in technology in the past, the infrastructure for a fossil-fuel-free world isn't actually that hard to imagine and a lot of it already exists, and the evidence of climate change is getting stronger all the time.

It's worth thinking about the world's “carbon budget” and the pathways to getting there. There are many potential pathways, but the ones that lead to a chance of 2°C involve declines in greenhouse gas emissions starting soon, get all the way to zero, and go negative. Fossil fuel use would have to go to almost zero well before other uses because fossil fuels have good substitutes and are relatively easy to monitor, while getting rid of all ruminants on the planet and changing land use will likely be harder with a growing population. Of course, getting to zero emissions would only stop the CO<sub>2</sub> concentrations from rising, so zero is not “good” but just “flat.”

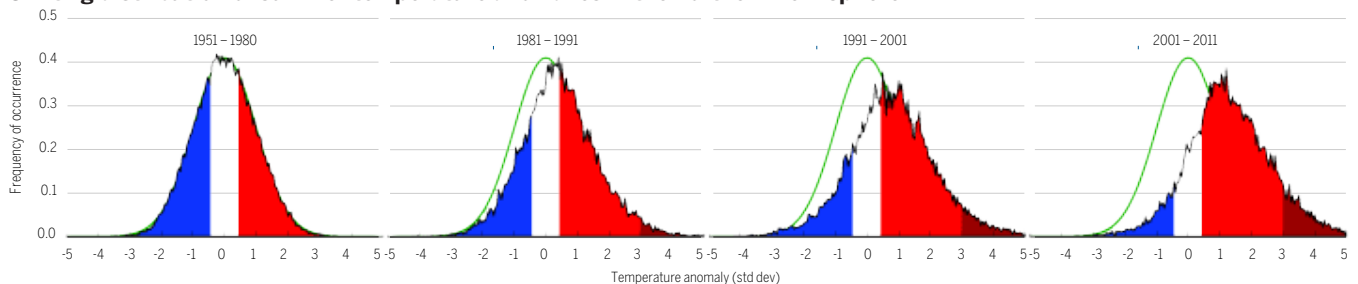
My point for investors here is that different people in the market will plan around different scenarios, and in many scenarios lots of the players in the oil market would be in trouble and face shortening windows of opportunity and would thus be less likely to act as they have in the past (or predictably at all). In addition, the alternatives to fossil fuels have network effects and cost curves that cause each additional agent who switches from oil to electrons to lower the cost for the next buyer.

**4. Beware of seasonal data and investment analysis**

Taking less weather-related risk with assets will require moving away from the use of narrow reversion to recent means for temperatures. There are still about the same number of unusually cold days, far more unusually hot days, and more spread in the middle. **FIGURE 2** illustrates the change in the distribution of summer temperature anomalies in the northern hemisphere from 1951 to 2011. There are two points about this distribution that are really important: 1) it has moved to the right, and 2) it is much wider. I haven't found an update of this chart, but since 2014, 2015, and 2016 all set new records, the shift has continued.

<sup>1</sup>The 2015 Paris Climate Change talks — officially the 21st Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change.

**FIGURE 2**  
**Shifting distribution of summer temperature anomalies in the northern hemisphere**



Sources: The National Aeronautics and Space Administration and the Goddard Institute for Space Studies



Here are several related points that I believe investors should think about:

- “Seasonal” patterns of things like construction and retail sales are changing in part because the seasons are changing and growing much less predictable. If winter is short and might not be that cold, it’s less clear to me that people will buy much “winter” apparel. In addition, more weird days are probably worse for brick and mortar retail and better for online. If it’s really nice outside, you don’t want to go shopping. If it’s lousy outside, you stay in and shop online.
- Forecasts of winter heating demand and summer electricity demand should be biased to reflect higher temperatures relative to the past and investors should use wider expected ranges because climate change increases volatility even more than average temperature (there will likely be a smaller drop in the number of very cold winters than one might expect, but there will likely be a substantial increase in very warm ones because the distribution moves warmer but the tails get fatter).
- Seasonal travel away from the north to the south may diminish if the north isn’t so cold and the south is too hot. Temperate vacation properties are much better bets than ski resorts or warm weather beaches.
- At the country level, countries that depend on specific weather patterns are likely at higher risk of having unusual outcomes than in the past. I don’t know enough about agriculturally dependent countries to say intelligent things about monsoon seasons and the like, but in general I would shy away from reversion to the mean in any of these patterns. As some countries are extremely dependent on them, investors should investigate and take risk appropriately.

### **5. Shy away from climate-strained areas and think about refugees**

My approach to this topic has been first and foremost empirical. As a result, I focus on the best documented, most robust parts of the science. For example, strong evidence that the force at work here is the greenhouse effect is that there have been many more record hot nights than record hot days (it’s not more hot sunshine but less escaping heat). This was a clear prediction of the science in the 1980s. Since the predictions were made, hot nights have consistently outstripped hot days.

As a result, I think that it is worth first considering which places in the world are most likely to have climate strain and whether those places can cope with it. This draws my attention to the Middle East and some other emerging markets with hot, arid climates. These are countries with weak infrastructure, weak economies, huge populations, and already nearly unlivable climates. I think it is unlikely that the next decade will go by without a refugee crisis from climate in the Middle East and North Africa. The first effect will likely be across the region as refugees try to go to neighboring states, but since these states are a) also super-hot and dry and b) have many weaknesses, the problems will be contagious. Since Europe is proximate, comfortable, and connected by land, it is the natural place for these refugees to wind up. I find it easier to imagine hundreds of million fewer people in the Middle East and North Africa in the coming decades than more. This may sound like hyperbole, but I would wager that Europe will average more than three million refugees a year over the next 40 years.



**If we want to save South Florida for another few decades, we can. What's not clear to me is who will pay for it.**

I would not own long-dated assets in the Middle East and North Africa and would want a premium relative to other assets (e.g., government bonds) compared with non-desert countries of similar creditworthiness. It's not clear to me what I would do with European assets now from the perspective of climate change. Europe faces less severe weather but being the relative winner next to the absolute loser is politically complicated.

What about arid parts of Australia and the US Southwest where temperatures continue to rise and drought is more frequent? I know much less about Australian finances, but state and local finances in many parts of the southern and southwest US assume many more in-migrants. For investments in those places to go bad, the residents don't need to flee; there just needs to be less in-migration. If the municipal bonds and banks in these areas don't offer a discount, I would stay away.

The highest point in all of Florida is 100 feet above sea level and the sea is rising. Florida isn't like the Middle East, though, because it is rich and has infrastructure. In addition, sea level rise is gradual and cities in Florida can continue to build new infrastructure — new aquifers, pumps, roads, breakwaters, etc. In the long run, all of these things will probably be futile, but in the short run, all of them are going to be expensive. Part of Florida's appeal, though, has been that it is cheap. Fighting off the ocean isn't cheap. Florida floods now not principally from the beach but up through the sewers. The Floridian peninsula is made of porous limestone and the increasingly high ocean is increasingly heavy, pushing harder on that limestone and permeating into aquifers. If we want to save South Florida for another few decades, we can. What's not clear to me is who will pay for it. ■

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*We have no "house views" and the perspectives of our investors often vary. We believe this diversity of thought strengthens our investment discussions and decision making.*





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