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# HAVE CAPITAL MARKETS FORGOTTEN ABOUT SUSTAINABILITY?

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THE VOLATILITY AND RISK INSTITUTE, NYU STERN  
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V.2

# RISK

- A risk is a bad event that may occur in the future.
- We want to know how bad it is and how likely it is.
- Then we will decide how to manage this risk.
  - We may decide not to take the risk
  - We may decide to try to reduce its likelihood or its impact
  - These policies may be costly and give rise to the traditional trade off between risk and return in finance.

# LONG RUN RISK

- When the event is far in the future and possibly at an uncertain time, we call this a long run risk.
- As we manage such risks, we will react today to long run risks even though they are far in the future. If we choose not to manage these risks, we will ultimately be exposed to them.
- Climate change is such a long run risk. We will examine in this talk how the risks of climate change affect us today. We will consider ways to manage such long run risks.

# AN EXAMPLE: *BEACH FRONT HOTEL*

- Suppose you are the owner of a luxury beach front hotel. You know that someday the rise in sea level will destroy the hotel. What should you do?
- If you try to sell the hotel, the buyers would also know about rising sea level.
- You should decide not to renovate the hotel if the time to recover the cost is longer than the time you expect the hotel to survive. Reduced investment for the future would save money and make the hotel temporarily more profitable.
- If all the beachfront hotels follow this strategy, then there would likely be a shortage of luxury beachfront rooms which would raise the price and further increase profits.

# INVESTORS

- What would investors pay for a share of this hotel? By finance theory they should pay the present discounted value of the future profits until the time when the hotel is destroyed less a risk premium. This would be much less than the original cost of the hotel but could still be substantial.
- Would investors pay more if you take the profits and begin to produce electric vehicles? Probably not since they would not expect you to have expertise in this and would rather invest in their own favorite EV maker.
- Would companies that supply services such as food and linen continue to do so? Yes as long as the hotel survives but they might underinvest in their own businesses as well.

# INSURANCE

- Insurance that would pay to rebuild the property would be prohibitively expensive if the insurer understands the risk.
- Insurance that would pay the market value would not fundamentally change the economics.
- Government flood insurance policies may pay more than the market value if the policy is not adequately calibrated.

# DEMAND FOR BEACH VACATIONS

- How would this hotel respond to increased demand?
- If the hotel expands, it will only have a short period of room rental so it would probably expand much less than would a non-beach front hotel.
- Because supply cannot easily be increased, this would simply result in higher room rates.
- Investors would be happy because the cash flow was increased even though the end might be the same.



# TERMINATION RISK

- Let us call this risk, “termination risk.”
- It is a long run risk which motivates owners to underinvest and to return cash flow to the investors up until the termination date.
- If demand increases, the owners would most likely expand very little.
- The value of stock in this company would respond to information on the demand for services and the expected terminate date.

# PHYSICAL RISK

## Sea level rise is a physical risk

- There are many other forms of physical risk.
  - Wildfires
  - Heat Waves
  - Drought
  - Floods
  - Hurricanes
- Each of these could terminate businesses and we might expect similar behavior from such businesses.

# Record Heat Unleashes Deadly Floods From New York to Libya

Thousands killed as soaring temperatures lead to heavier rainfall



Extreme heat is usually associated with drought and wildfires. But across five continents this year, it's also unleashed a different kind of disaster: deadly flooding.

Cities around the world have seen record rainfall 139 times in 2023. A rare hurricane-like storm inundated Libya last month, killing thousands. More than 100 people died across Asia during an intense monsoon season in July. After fatal floods pummeled the US Northeast over the summer, torrential rains paralyzed New York City last week.

## **Bloomberg Green**

**Georgieva Says IMF to Boost Climate Funding, Weighs Debt-for-Nature Swaps**

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**UAE Starts First Wind Power Plants Ahead of UN Climate Summit**

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**Blackout Risk Pushes Brazil to Diesel as Amazon Drought Worsens**

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**New York Forecast to Get More Snow This Winter: Weather Watch**

Soaring temperatures were at the root of all these weather calamities. June, July and August were the hottest ever for that period. Higher air temperatures mean the atmosphere can hold

# CLIMATE MITIGATION

- As the physical risks mount and the forecasts become increasingly pessimistic, the question arises – can we stop this?
- The answer is simple - stop emitting greenhouse gasses. Decarbonize the economy.
- Carrying this out is very hard as we are highly dependent on fossil fuels for energy in almost every aspect of the economy.
- The Paris Agreement or Accord of 2015 allows each country to adopt its own approach to decarbonization but seeks commitments to reach net zero emissions by 2050. If this can be accomplished we will avoid the most severe outcomes and hopefully keep global temperatures from rising more than 1.5 degrees Celsius above historical levels.

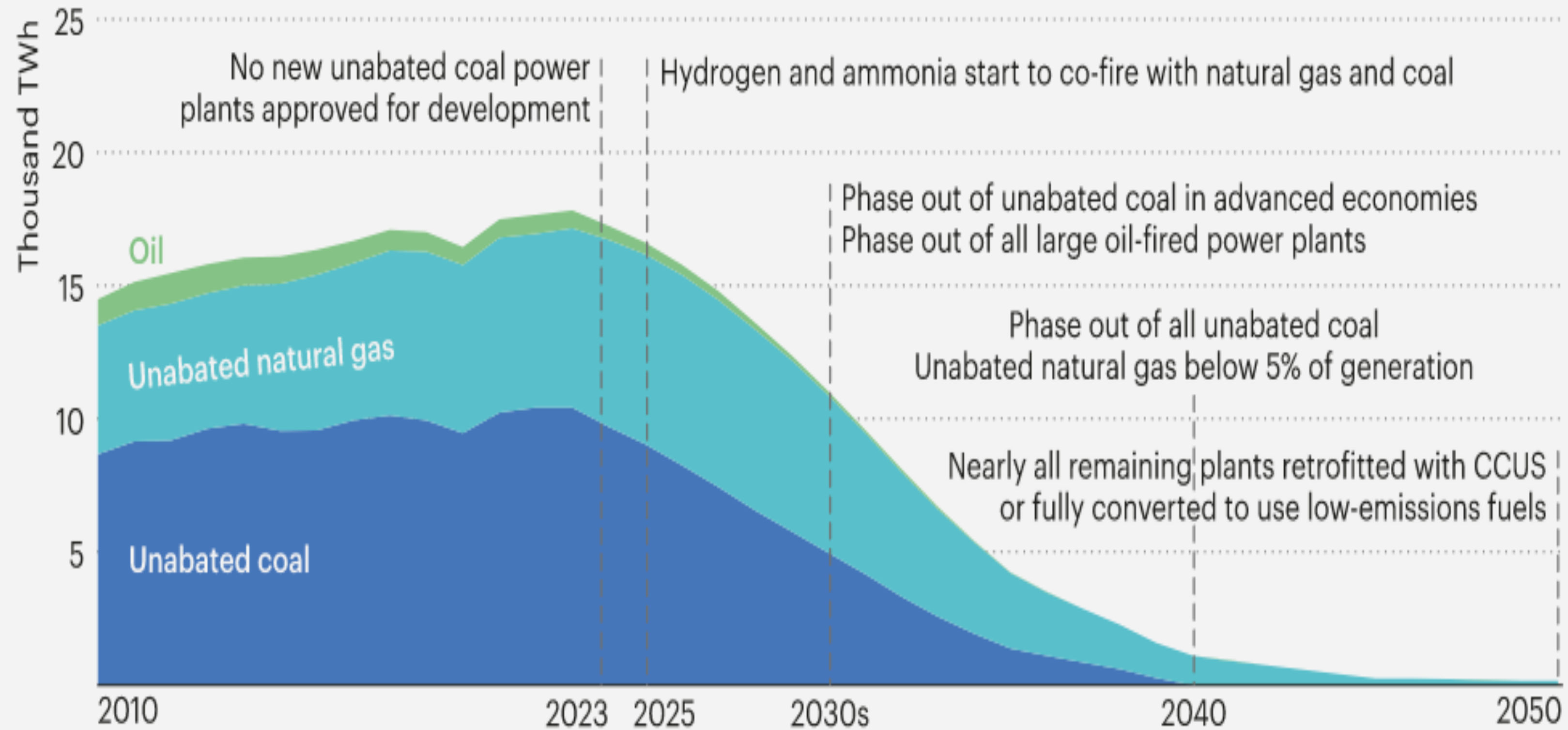
# STRATEGIES FOR ACHIEVING NET ZERO

- Carbon taxation: charge every business for emitting GHG with a charge that rises over time and reflects the Marginal Social Cost of Carbon. Make it comprehensive and implement a border carbon adjustment to charge imports the same tax as domestic producers. Cap and Trade or traditional tax.
  - The marginal social cost of carbon is the present discounted value of the worlds damages due to an additional ton of carbon emissions.
- Subsidize Renewable Energy. Expand clean energy sources and make them even cheaper so that fossil energy demand falls. Subsidies will lead to improving renewable technology and infrastructure.
- Regulate emissions. For example, prohibit gas hookups and gasoline cars after a certain date.
- Hope the good intentions of the private market will be sufficient.

# Unabated fossil fuels in electricity generation

Electricity output from unabated fossil fuels falls by 40% to 2030 and virtually disappears by 2050, as plants are run less, retired, retrofitted with CCUS or repurposed to use low-emissions fuels.

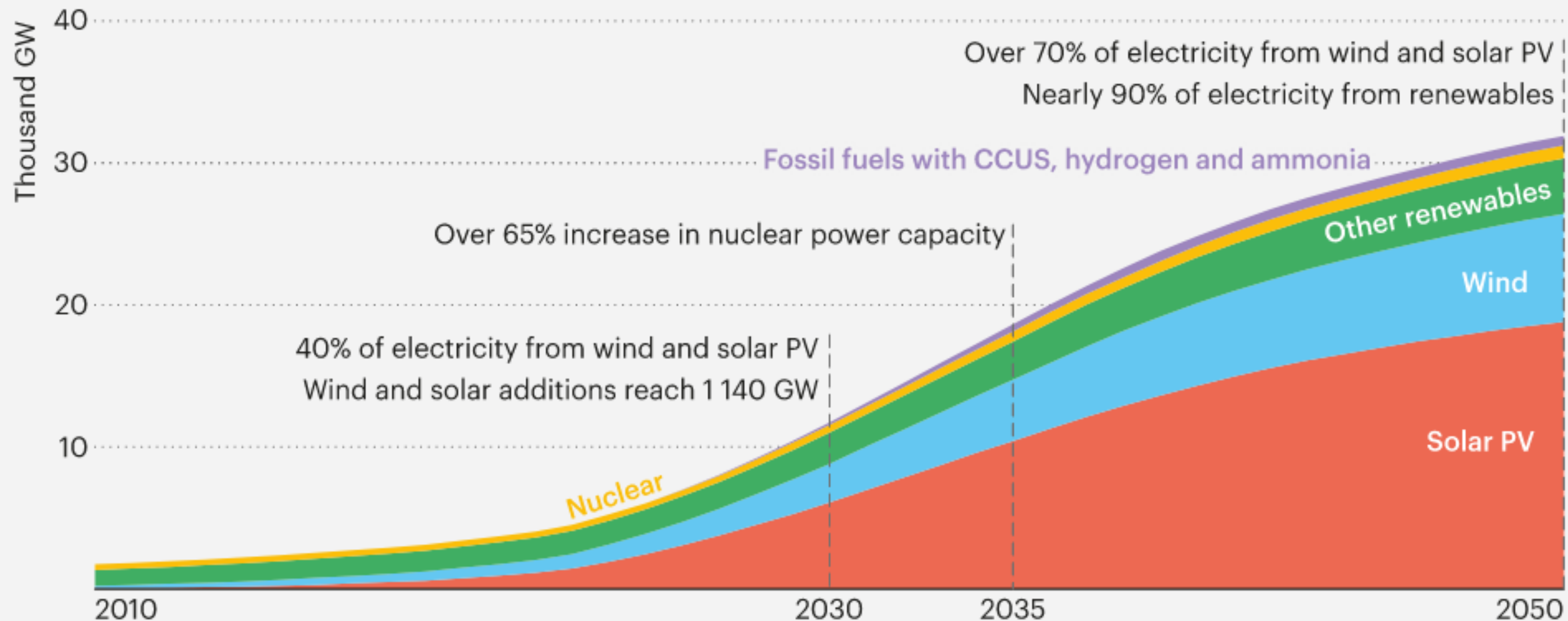
Unabated fossil fuels electricity generation



# Low-emissions sources of electricity

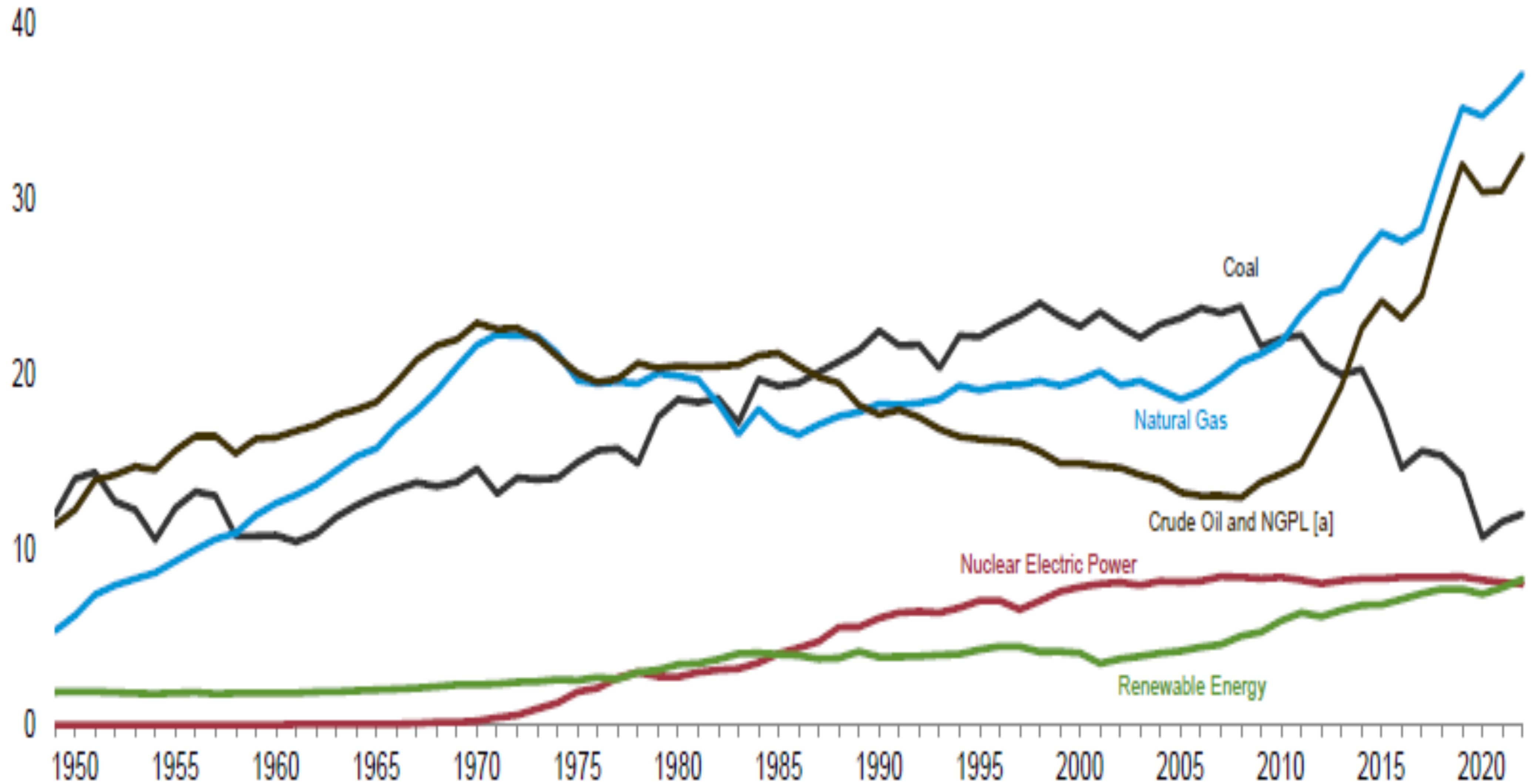
Renewables capacity triples by 2030 led by solar PV and wind, complemented by growth in nuclear and other sources, raising the share of low-emissions sources in electricity generation from 39% in 2022 to 71% in 2030 and 100% in 2050.

Low-emissions electricity generation capacity by source

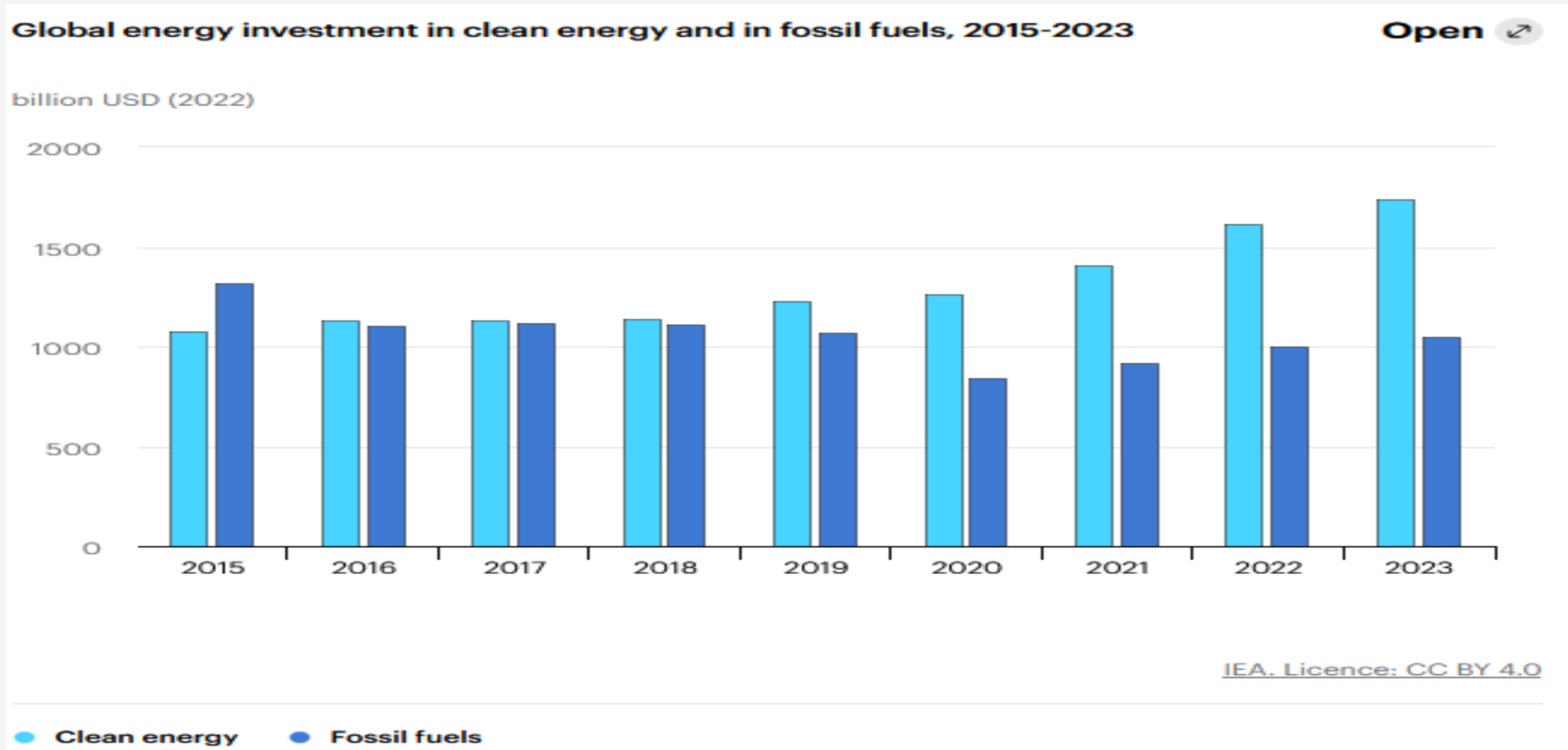




By Source, 1949-2022



# INVESTMENT (IEA)



## Comparing Key Expansion Periods of Innovative Technologies

Technology and timeframe	Average annual deployment growth (%)	Average annual cost reduction (%)
EV batteries (2010-20)	69	-19
Solar PV modules (2010-20)	24	-18
Wind, onshore (2010-20)	13	-4
Wind, offshore (2010-20)	19	-4
US WWII aircraft (1939-44/1942-45)	75	-13
Ford Model T (1910-20)	34	-9
Gas turbines (1970-80)	18	-2

Sources: IEA; Lafond, Greenwald and Farmer (2022); Zeitlin (1995); Abernathy and Wayne (1974); Grubler, Nakicenovic and Victor (1999)

Note: the datasets for US aircraft production in WWII run from 1939 to 1944 for average annual deployment growth and 1942 to 1945 for average annual cost

# TRANSITION RISK

- All decarbonization policies create winners and losers and are therefore hard to implement.
- Many voters and businesses however see it as inevitable that we will need to decarbonize and the uncertainty is on when and how.
- The threat that we will implement such policies changes expectations and business models today.
- Termination risk is real for heavy fossil fuel producers and emitters that cannot decarbonize.
- We should see such firms underinvesting, shrinking supply, returning cash flow to investors, and shrinking the elasticity of supply.

# WHAT SHOULD CLIMATE INVESTORS DO?

- Invest in Climate Hedge Portfolios
  - These are portfolios that will outperform when climate risk rises above what the market expects and underperform otherwise.
  - These portfolios are overweight assets that will do well in a bad climate and underweight assets that will do poorly in a bad climate.
  - Such portfolios can be constructed based on firm characteristics such as accounting or ESG data or on statistical performance when there is news of worsening climate risk.
  - There are many publicly traded “sustainable” portfolios. Are they really climate hedges?

# VLAB CLIMATE RESEARCH

[Vlab.stern.nyu.edu](http://Vlab.stern.nyu.edu)

- Stocks exposed to long run risk are less desirable than equivalent stocks that are not. Thus they should be less expensive and have higher returns.
- Climate hedge portfolios are underweight such stocks and therefore have a negative risk premium as we would expect for any insurance like product which is risk reducing.
- But when there is new bad news on the climate, assets are repriced to make hedge portfolios appreciate.
- VLAB follows over 200 publicly available “sustainable” funds under a variety of definitions.

# RESULTS: October 5, 2023

Average CAPM alpha: -9.9 for 1 year, -5.38 for 3 years, -3.18 for 5 years

Security	Return	Volatility	Sharpe Ratio	↓ $\alpha_{CAPM}$
<a href="#">KraneShares European Carbon AI</a>	25.27%	37.87%	0.52	21.77 (0.73)
<a href="#">ETF Series Solutions-Carbon ETF</a>	28.02%	27.15%	0.83	18.75 (0.93)
<a href="#">KraneShares California Carbon</a>	26.66%	15.00%	1.42	17.78 (1.46)
<a href="#">KraneShares Global Carbon Strategy ETF</a>	21.64%	24.80%	0.65	14.56 (0.81)
<a href="#">VanEck Uranium + Nuclear Energy ETF Fund</a>	27.05%	20.41%	1.06	12.91 (0.84)
<a href="#">Columbia International ESG Equ</a>	25.05%	15.65%	1.25	11.01 (1.04)
<a href="#">ClearBridge Large Cap Growth ESG ETF</a>	24.29%	20.71%	0.91	10.69 (1.55)
<a href="#">Natixis Oakmark International Fund</a>	21.20%	19.81%	0.80	9.90 (0.64)
<a href="#">Nuveen ESG Large-Cap Growth ETF</a>	22.51%	20.60%	0.83	8.70 (1.91)
<a href="#">BrandywineGLOBAL - Dynamic US Large Cap Value Fund</a>	-26.22%	26.50%	-1.19	8.08 (0.88)

1 year  
Top 10 out of 215

# TWO CLIMATE HEDGE PORTFOLIOS

- ▣ Stranded Asset Portfolio:  $SPY-.7*KOL-.3*XLE$
  
- ▣ Climate Efficient Factor Mimicking Portfolio
- ▣ De Nard, Engle, Kelly (in draft)
  - Form dynamic, long only portfolios of publicly available climate funds
  - Minimize the variance of these portfolios
  - Maximize the correlation with climate news after taking out the effect of standard investment factors and Stranded Asset Portfolio
  - Hold the portfolio for one month and then recalculate.
- We are developing several other hedge portfolios for both transition and physical risk.



# WHAT CAN WE DO WITH THESE HEDGE PORTFOLIOS?

- Invest in them directly to achieve climate hedge performance.
- Invest in portfolios that have a high beta on these funds to achieve similar performance
- Invest in stocks with a high beta on these funds. These are approaches to evaluating the greenness of stocks and funds
- Stress test banks by examining the impact of rising climate risk. How green are the banks? Will an effective decarbonization, bring on a financial crisis?

# HEDGE PORTFOLIO PERFORMANCE

Benchmark		Return	Volatility	Sharpe Ratio
iShares MSCI ACWI ETF	15.51 Years	5.93%	21.02%	0.06
SPDR S&P 500 ETF Trust	30.67 Years	9.68%	18.83%	0.26
Stranded Assets	24.78 Years	7.46%	22.68%	0.33
SPY:US - XLE:US	24.78 Years	-5.50%	21.80%	-0.25
Climate Efficient Factor Mimicking Portfolio	22.26 Years	10.22%	24.63%	0.21

# 5 YEAR PERFORMANCE: TWO FLAVORS OF GREEN

Security	Return	Volatility	Sharpe Ratio	Cos Sim	Tag Index	$\alpha_{CAPM}$	$\beta_{SA}$	$\downarrow \beta_{CE}$
<a href="#">Invesco Solar ETF</a>	27.13%	42.03%	0.56	-0.044	-0.007	19.28 (1.21)	-0.26 (-4.45)	0.3 (2.34)
<a href="#">Global X Lithium &amp; Battery Tech ETF</a>	13.89%	33.61%	0.30	-0.057	-0.062	6.54 (0.60)	-0.39 (-8.69)	0.3 (3.73)
<a href="#">KraneShares MSCI China Clean Technology Index ETF Fund</a>	5.89%	34.54%	0.06	-0.030	-0.064	3.57 (0.25)	-0.41 (-5.68)	0.2 (2.87)
<a href="#">iShares Global Clean Energy ETF</a>	19.94%	31.09%	0.52	-0.101	0.003	11.43 (0.94)	-0.16 (-3.97)	0.2 (2.47)
<a href="#">Invesco WilderHill Clean Energy ETF</a>	13.49%	42.29%	0.23	-0.053	-0.029	6.21 (0.42)	-0.19 (-5.19)	0.2 (2.37)
<a href="#">Invesco Global Clean Energy ETF</a>	11.00%	31.66%	0.23	-0.072	-0.015	3.44 (0.32)	-0.22 (-7.34)	0.2 (3.13)
<a href="#">First Trust NASDAQ Clean Edge Green Energy Index Fund</a>	22.92%	38.60%	0.50	-0.064	-0.009	13.19 (1.11)	-0.16 (-4.59)	0.2 (2.52)
<a href="#">VanEck Low Carbon Energy ETF Fund</a>	15.74%	30.18%	0.40	-0.096	-0.012	7.14 (0.79)	-0.17 (-5.24)	0.2 (3.40)
<a href="#">Guinness Atkinson Funds - Alternative Energy Fund</a>	16.29%	25.16%	0.50	-0.089	0.028	7.89 (1.04)	-0.17 (-5.20)	0.2 (3.72)
<a href="#">First Trust Global Wind Energy ETF</a>	8.49%	23.50%	0.20	-0.164	0.039	1.34 (0.19)	-0.12 (-4.35)	0.1 (3.10)

# BNP PARIBAS, CLIMATE BETA

from

09/28/2018



to

09/28/2023



6M · 1Y · 2Y · 5Y · 10Y · All

V-Lab (2023)



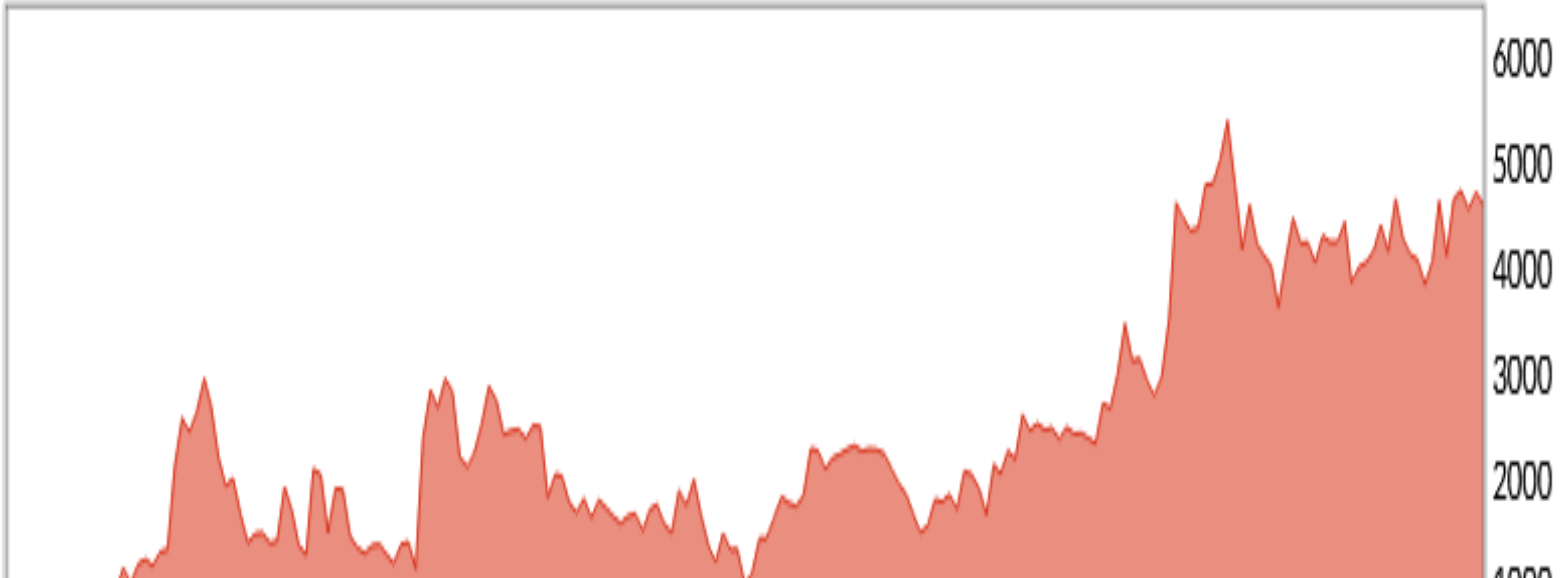
— BNP Paribas SA Climate Beta

# WORLD CRISK:

## AGGREGATE CAPITAL SHORTFALL FROM A RISE IN CLIMATE RISK

World Financials - Total CRISK (US\$ billion)

V-Lab (2023)



# HAVE CAPITAL MARKETS FORGOTTEN ABOUT SUSTAINABILITY?

**EVERYTHING IS PROCEEDING AS I HAVE FORESEEN**



# WHAT DO WE SEE TODAY

- Most Sustainable funds are underperforming the market.
- This is not surprising because they are underweighting fossil energy which has strikingly outperformed the market.
- But why has energy done so well? Because of the private sector approach to decarbonization. The *long run risk of stranded assets*, has lead to under investment in fossil energy and reduced supply. This generates price increases and profit increases in fossil energy as demand recovers.
- This profitability has only a small impact on supply as any new investment is potentially going to be stranded.



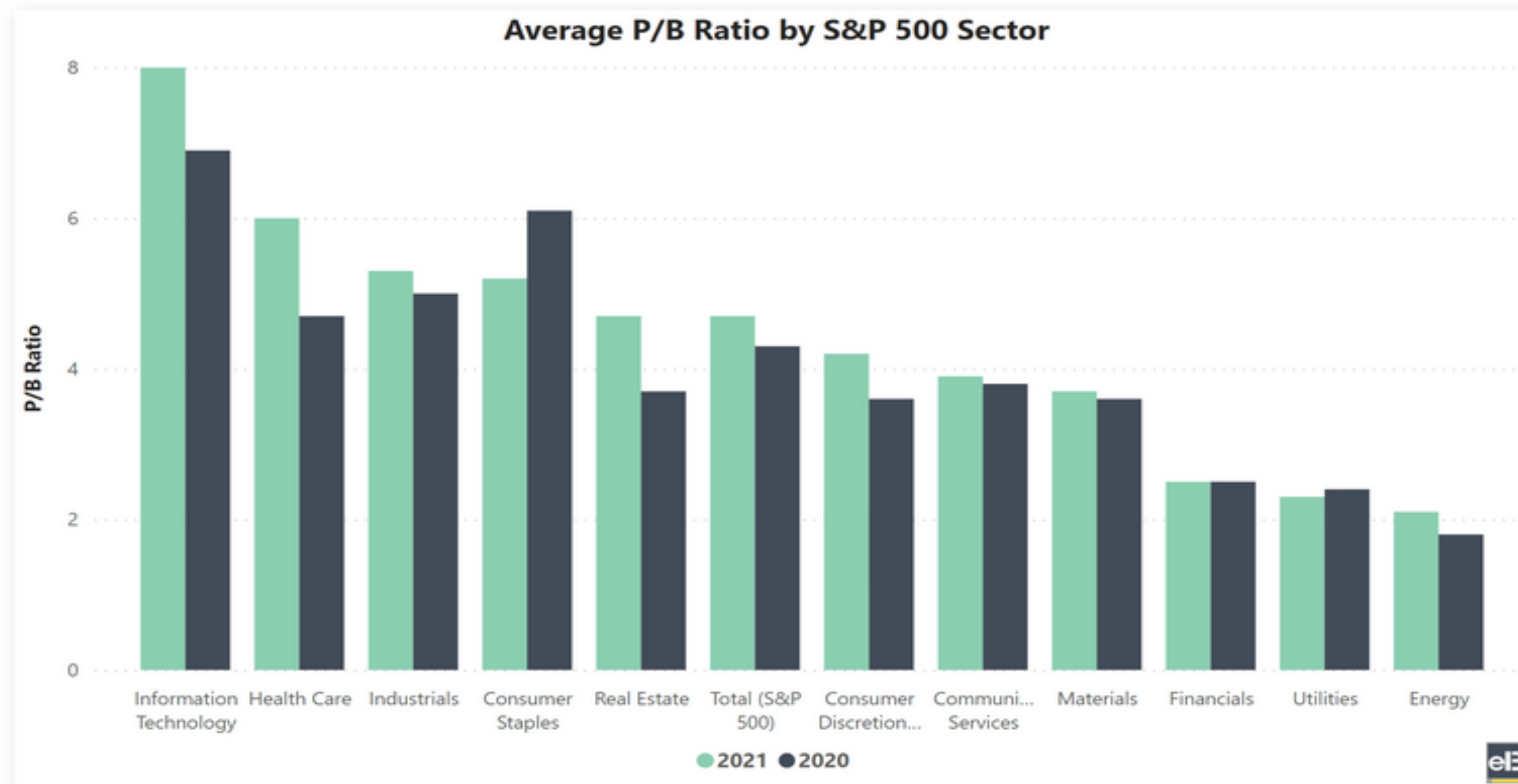
# EMPIRICAL EVIDENCE

- Stock prices reflect present discounted values of earnings.
- Hence P/E ratios are high when future earnings are expected to be high and low otherwise.
- Similarly stock prices reflect forward looking expectations but book values from balance sheets only reflect current or historical values.
- Hence we might expect firms with substantial long run risk to have low P/E and P/B ratios.

# EMPIRICAL EVIDENCE

## S&P 500: Average P/B Ratio by Sector (Fiscal Years 2020-2021)

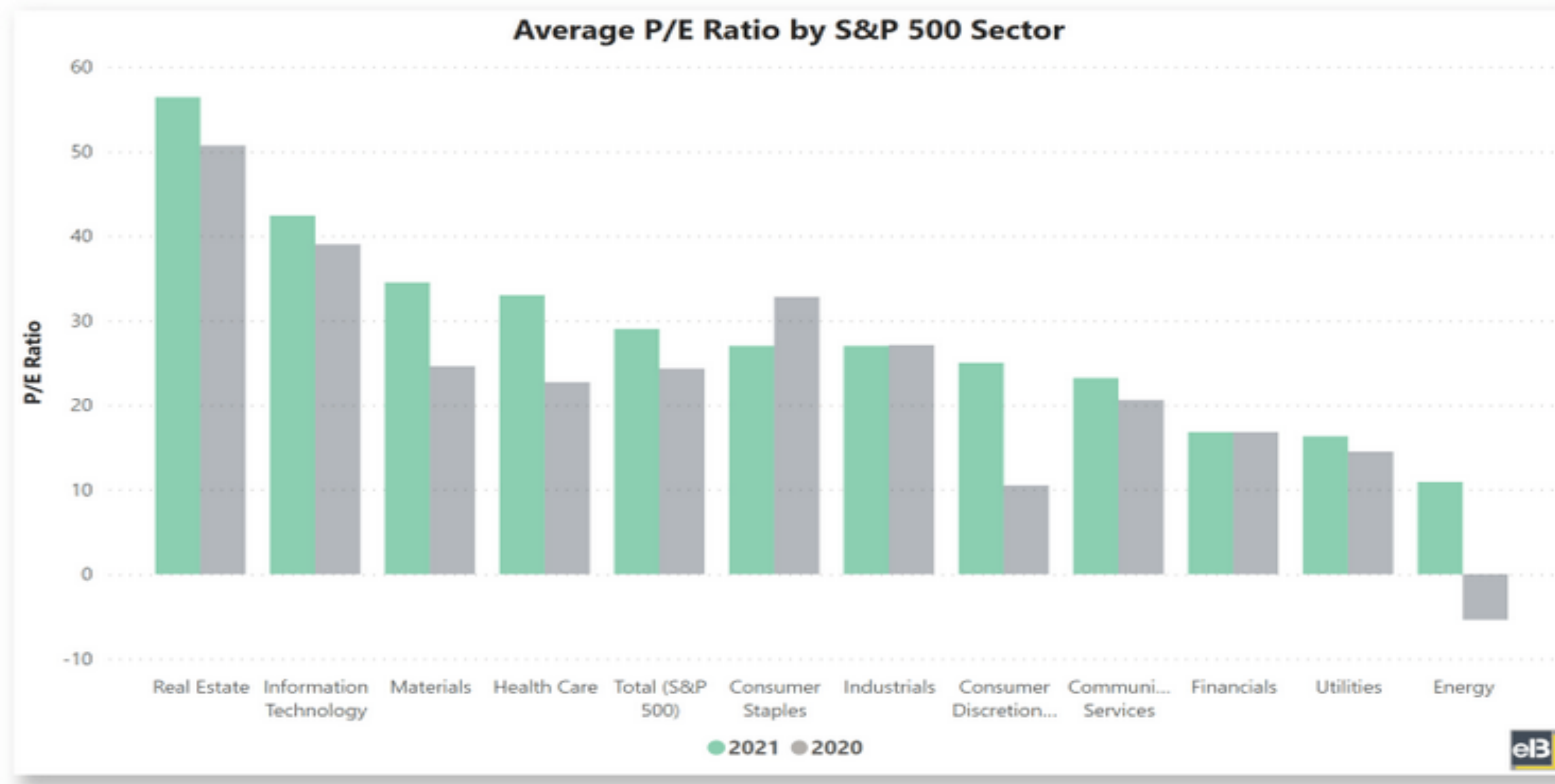
The average P/B ratio of the S&P 500 was 4.7 in 2021, and 4.3 in 2020.



# EMPIRICAL EVIDENCE

## Average P/E Ratio by Sector (FY 2020-2021)

The average P/E ratio of the S&P 500 was 29.0 in 2021, and 24.3 in 2020.



# EMPIRICAL EVIDENCE: 3/21/23

No.	Name	Market Cap	P/E	Fwd P/E	PEG	P/S	P/B	P/C	P/FCF	EPS past 5Y	EPS next 5Y	Sales past 5Y	Change	Volume
1	Energy	3323.87B	6.44	7.94	0.68	0.71	1.47	9.62	8.43	41.34%	9.46%	13.75%	3.14%	423.38M
2	Basic Materials	1932.26B	10.93	15.52	3.01	1.33	1.84	11.16	20.88	19.47%	3.63%	12.04%	0.52%	314.97M
3	Financial	8595.37B	14.31	11.25	1.65	2.31	1.45	0.52	11.10	10.92%	8.65%	7.93%	2.58%	1.41B
4	Industrials	4624.38B	19.89	16.16	1.66	1.68	3.70	14.47	29.17	11.97%	12.01%	6.55%	1.28%	400.83M
5	Utilities	1406.36B	21.65	3.34	2.61	1.69	1.24	34.19	64.67	5.43%	8.28%	6.28%	-1.79%	109.87M
6	Consumer Cyclical	6003.02B	22.73	20.27	1.75	1.41	3.77	8.98	41.73	12.91%	13.00%	21.47%	2.44%	1.26B
7	Communication Services	5675.20B	22.92	16.26	1.57	2.33	2.47	13.40	34.76	13.95%	14.62%	15.20%	2.31%	461.49M
8	Consumer Defensive	3618.13B	23.36	20.46	3.23	1.19	4.20	22.99	74.28	6.31%	7.23%	5.70%	-0.02%	208.08M
9	Healthcare	7245.85B	25.18	17.03	2.81	1.92	3.93	12.39	30.34	10.78%	8.97%	14.44%	0.65%	838.99M
10	Real Estate	1405.29B	25.74	26.78	2.69	4.02	1.96	22.65	40.76	13.91%	9.58%	12.32%	-0.24%	251.42M
11	Technology	12285.77B	29.49	20.86	2.29	4.16	4.96	16.37	37.43	20.24%	12.87%	15.72%	1.09%	1.19B

# IMPACT ON COUNTRIES

- Countries that are heavily dependent on fossil energy production face termination risk too.
- Countries however do not terminate and hence they would naturally restrict investment and use the excess profits to diversify the industrial base.
- We see this in the Middle East from Saudi Arabia, Abu Dhabi and others that are investing in other industries.
- OPEC+ has reduced supply and prices have risen as inventories fall. This could be just monopoly power or it could be a response to termination risk.
- What about Russia?

# RUSSIA

- A major reduction of energy supply is due to the Russian invasion of Ukraine. The supply reductions from sanctions are in addition to reductions made with OPEC+ and reductions to Europe.
- He has reduced supply and is trying to diversify his economy with a catastrophic war. He knows his resources will be worth less in 10 years and the demand curve will be more elastic because of European renewable energy.
- He is selling fossil energy at elevated prices and the ruble has more than recovered.
- Putin is acting like a climate believer.

# CLIMATE MITIGATION EFFECTS

- It has always been clear that decarbonization would require consumers and businesses shifting from high emitting products to low emitting products. High fossil energy prices are part of this process and therefore the high prices are consistent with climate goals. As consumers add insulation, buy electric cars and reduce driving, they are helping to mitigate climate change.
- High energy prices stimulate the investment in renewable energy.
- Insofar as high energy prices also lead to new fossil energy supply, this will delay decarbonization. When faced with termination risk, these elasticities may be low.

# WHAT WOULD BE DIFFERENT WITH A CARBON TAX?

- If instead, the government set a carbon price, then the profits would flow to the government rather than the fossil energy companies, and the stock market would punish rather than reward these companies.
- The fossil energy prices would still rise but revenue could be used to reduce other taxes and achieve better climate justice.
- Climate hedge portfolios such as the Stranded Asset Portfolio would be performing well.
- Inflation would be lower if the revenue were directed at either subsidizing renewable energy or from a monetarist perspective, reducing the deficit.



# FUTURE PERFORMANCE OF HEDGE PORTFOLIOS

- In a net-zero world, ultimately fossil energy stocks go to zero.
- Hedge portfolios are likely to out-perform if decarbonization continues.
- Putin has accelerated decarbonization. So has the Biden climate bill. So has the EU Green Deal.
- Maybe this will end up moving us in a climate friendly direction.

What kind of world will  
we inherit?





But if we can  
tell them that  
we have it  
solved, ....