

Climate Scenario Alignment, Net-Zero, and Uncertainty

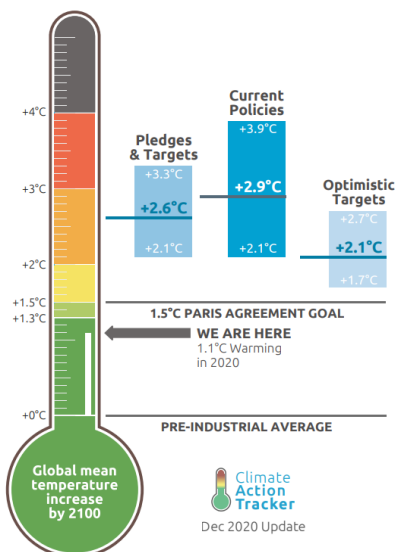
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EXECUTIVE SUMMARY

- Net-zero commitments are starting to receive signatories, with USD 5.7 trillion and USD 37 trillion assets signed up to the Net Zero Asset Owners Alliance and Net Zero Asset Managers initiative, respectively.^{1,2}
- Even optimistic targets show the world falling short of a 1.5°C scenario (see Exhibit 1).
- Scientific consensus suggests a 1.5°C pathway would require net-zero emissions by 2050, while 2°C pathways are closer to 2070-2080.
- Absolute greenhouse gas (GHG) reduction (tracking a specified scenario) is aligned with meeting these goals, while relative GHG reduction (reduction to an underlying index) is better but not necessarily aligned.
- The S&P PACT™ Indices (S&P Paris-Aligned & Climate Transition Indices) are designed to give investors confidence in following absolute decarbonization pathways.

Exhibit 1: Decarbonization Predictions



Source: Climate Action Tracker. Data as of December 2020. Chart is provided for illustrative purposes.

¹ UN Environmental Programme. (2021). *Net Zero Alliance*.

² Net Zero Asset Managers Initiative. (2021).

WHERE ARE WE NOW?

Scientific consensus suggests a 1.5°C pathway would require net-zero emissions by 2050, while 2°C pathways are closer to 2070-2080.

Both the Net Zero Asset Owners Alliance and Net Zero Asset Managers initiative have signed up to target net-zero GHG emissions by 2050 or sooner,^{3,4} binding trillions of dollars to be decarbonized. This raises the question, how can we grasp these climate targets and practically implement them?

Understanding scenario alignment as reductions in GHG emissions (or GHG intensity adjusted for inflation) at the portfolio level, aligned with that required of the global economy, allows the application of conclusions from climate scenario trajectories to broad-market indices. The EU Technical Expert Group on Sustainable Finance (TEG) promotes this philosophy as not simply limited to indices, but applicable to asset owners, asset managers, private investors, etc.⁵ as a method to decarbonize a portfolio.

How can we grasp these climate targets and practically implement them?

We use data from the Integrated Assessment Modeling Consortium's (IAMC's) 1.5°C Scenario Explorer,⁶ used in the Intergovernmental Panel on Climate Change's (IPCC's) Special Report on Global Warming of 1.5°C,⁷ which is a collection of quantitative climate scenario pathways. These enable us to approximate scientific consensus on future climate scenarios. The next sections will discuss relationships among these climate scenario predictions.

Modeling future climate scenarios is tough, even for the world's brightest minds, due to the climatic system being complex in nature. This brings significant potential for error and uncertainty.⁸ Therefore, aiming below predicted trajectories may be prudent to increase confidence in a stable climate.

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WHERE ARE WE HEADING?

While there is uncertainty around the climate scenario we are heading for, Carbon Action Tracker calculates scenario predictions based on current policies, current pledges and targets being met, and more optimistic targets, where any targets agreed on or under discussion are assumed to be achieved.⁹

³ UN Environmental Programme. (2021). *Net Zero Alliance*.

⁴ Net Zero Asset Managers Initiative. (2021).

⁵ EU Technical Expert Group on Sustainable Finance. (2019). *Handbook of Climate Transition Benchmarks, Paris-Aligned Benchmarks and Benchmarks' ESG Disclosures*.

⁶ Huppmann, D., Kriegler, E., Krey, V., Riahi, K., Rogelj, J., Calvin, K., . . . Zhang, R. (2019). *IAMC 1.5°C Scenario Explorer and Data hosted by IIASA*.

⁷ Rogelj et al., J. (2018). *Mitigation pathways compatible with 1.5°C in the context of sustainable development*.

⁸ Pindyck, 2017; Lewandowsky, Ballard, & Pancost, 2015; Freeman, Wagner, & Zeckhauser, 2015

⁹ Climate Action Tracker. (2020). *Paris Agreement Turning Point*.

Even optimistic targets only predict a median temperature increase of 2.1°C above pre-industrial levels by the year 2100 (see Exhibit 1). Even the lower bound of optimistic targets see us fall short of the 1.5°C target the IPCC steers us toward.

The median expected 2100 warming is around 2.6°C when accounting only for those that have made pledges, while current policies would leave us around 2.9°C, but potentially as high as 3.9°C—a high degree of error built in, given we are currently at 1.1°C above pre-industrial levels.

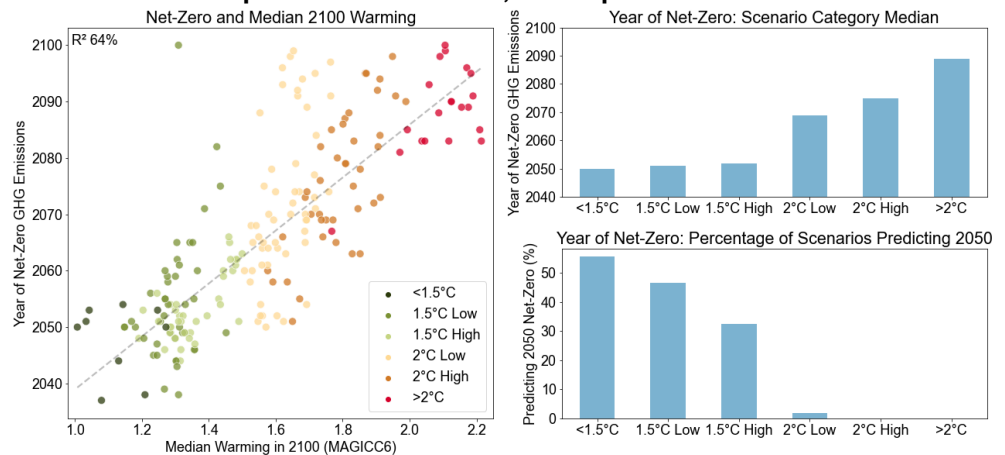
The median expected 2100 warming is around 2.6°C when accounting only for those that have made pledges.

NET-ZERO AND CLIMATE SCENARIO RELATIONSHIP

To help understand the link between net-zero and climate scenario alignment, Exhibit 2 plots predictions of the net-zero year against the median expected warming in 2100, for scenarios in the database predicted to reach net-zero. We observe a fairly strong linear relationship where, unsurprisingly, the sooner the predicted net-zero year, the lower the predicted 2100 warming.

Exhibit 2: 1.5°C Implies ~2050 Net-Zero, 2°C Implies ~2070-2080 Net-Zero

We observe a fairly strong linear relationship; the sooner the predicted net-zero year, the lower the predicted 2100 warming.



Source: S&P Dow Jones Indices LLC, Huppmann, D., Kriegler, E., Krey, V., Riahi, K., Rogelj, J., Calvin, K., . . . Zhang, R., IAMC 1.5°C Scenario Explorer and Data hosted by IIASA. Data as of 2019. Charts are provided for illustrative purposes.

These climate scenarios are categorized (see Appendix A for more detail) based on their climate alignment. For example, those grouped as 1.5°C aligned are categorized into below 1.5°C, 1.5°C low overshoot, and 1.5°C high overshoot. These categories and groups of categories inform on scientific consensus linking climate scenarios and net-zero expectation.

1.5°C alignment indicates reaching net-zero around 2050, while 2°C appears indicative of hitting net-zero much later—around 2070-2080. When studying the percentage of scenarios predicting net-zero before 2050, those 1.5°C scenarios with no or limited overshoot show almost a 50% chance of reaching net-zero by 2050, whereas 2°C scenarios show almost no chance of meeting a 2050 net-zero goal.

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So how is this applicable to broad-market indices? Many investors have shown intentions to meet a net-zero target by a specific year. If this date is 2080, strategies aligning with either 1.5°C or 2°C appear appropriate. However, if 2050 is the net-zero goal, scientific consensus shows 1.5°C-aligned strategies are likely to increase the chance of meeting that objective. This does, of course, rely on the strategy aligning in practice with the pathway it is marketed as pursuing.

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UNCERTAINTY AROUND RELATIVE AND ABSOLUTE DECARBONIZATION

How can we align our practices with a predicted climate scenario and, by extension, expectations for net-zero? By tracking a specific decarbonization pathway, an absolute approach allows an investor to minimize uncertainty around 1.5°C misalignment. A relative approach could be better than the underlying index, although not necessarily at a desirable level.

Exhibit 3 illustrates the uncertainty we face surrounding the level of future decarbonization. We may have some ideas about how the world will decarbonize (as Exhibit 1 shows, we can make estimates), but in reality, having high confidence in a precise level of decarbonization over a specific time period is difficult, if not impossible.

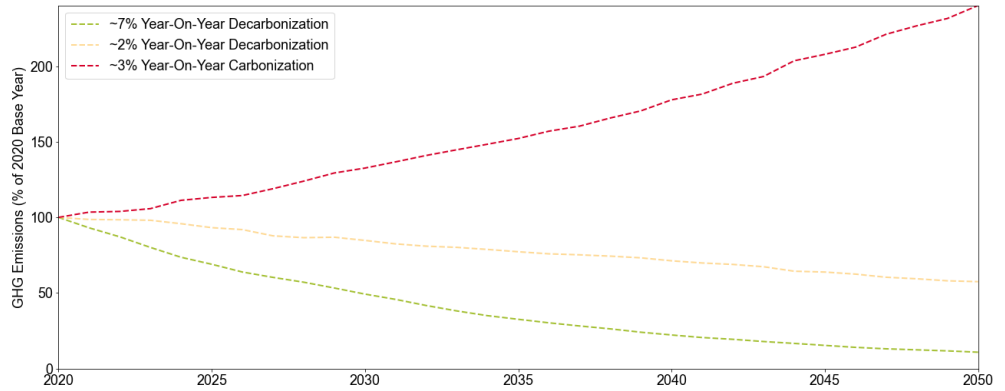
A relative approach could be better than the underlying index, although not necessarily at a level that is desirable.

The dashed green line in Exhibit 3 roughly represents a 7% year-on-year decarbonization trajectory. This is in line with the IPCC 1.5°C scenario, with no or limited overshoot.¹⁰ Using a market-cap-weighted index under this scenario, we would be 1.5°C aligned, albeit with no buffer below the expected trajectory. This would be a fairly nice, attainable outcome. However, the dashed yellow scenario would not meet the 7% year-on-year reduction requirement—with the area between this and the 7% year-on-year curve representing an overshoot of the climate objective. The red line is closer to a business-as-usual scenario, and the area between this and the 7% year-on-year line is large. This goes to show that while it is possible for a diversified market cap index to align with a 1.5°C trajectory, there is a strong chance of far more adverse outcomes.

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¹⁰ EU Technical Expert Group on Sustainable Finance. (2019). *Handbook of Climate Transition Benchmarks, Paris-Aligned Benchmarks and Benchmarks' ESG Disclosures*.

Exhibit 3: Future Decarbonization Uncertainty



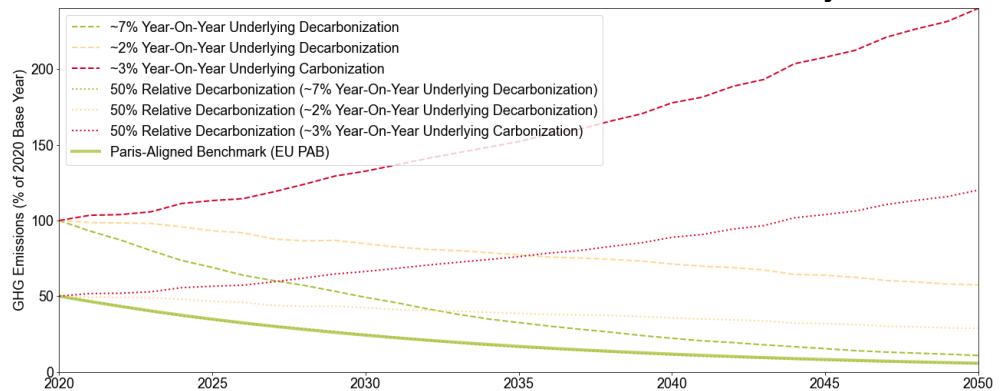
Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes.

A relative decarbonization approach can help 1.5°C/2050 net-zero-aligned investors get closer to their desired outcome.

As a solution, a relative decarbonization approach can help 1.5°C/2050 net-zero-aligned investors get closer to their desired outcome. Exhibit 4 shows how the relative decarbonization approach had better outcomes than the market cap benchmark; however, the level of alignment is still dependent on the underlying index. A relative decarbonization approach is generally better than the underlying index, but it does not explicitly control for a specified decarbonization pathway.

This leaves us requiring an absolute decarbonization path to give confidence in meeting absolute decarbonization goals (either scenario alignment or a meaningful net-zero target) if these are the targets. The S&P PACT Indices trajectory allows for controlled GHG exposure dynamically over time, below the rate the IPCC states as necessary in order to meet a 1.5°C/2050 net-zero alignment, due to the large buffer (the 50% initial decarbonization). This further reduction of cumulative emissions, below the 7% year-on-year reduction, increases confidence of meeting these climate objectives.

Exhibit 4: Absolute Decarbonization Controls for a 1.5°C Pathway



Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes.

DYNAMICALLY CONTROLLING CARBON EXPOSURE WITH THE S&P PACT INDICES

Predictions of cumulative emissions between 2020-2050 better explain the median warming in 2100 than the year of net-zero.

Theoretically, cumulative emissions adequately approximate the climate challenge,¹¹ as it's the cumulative emissions that will burn through our 1.5°C GHG budget, rather than a level reached at a specific point in time. In practice, we see this baked into scientific consensus too; predictions of cumulative emissions between 2020-2050 better explain the median warming in 2100 than the year of net-zero (Exhibit 5), and better than the year of net-zero explains the median 2100 warming (Exhibit 2), according to the r-squared values.

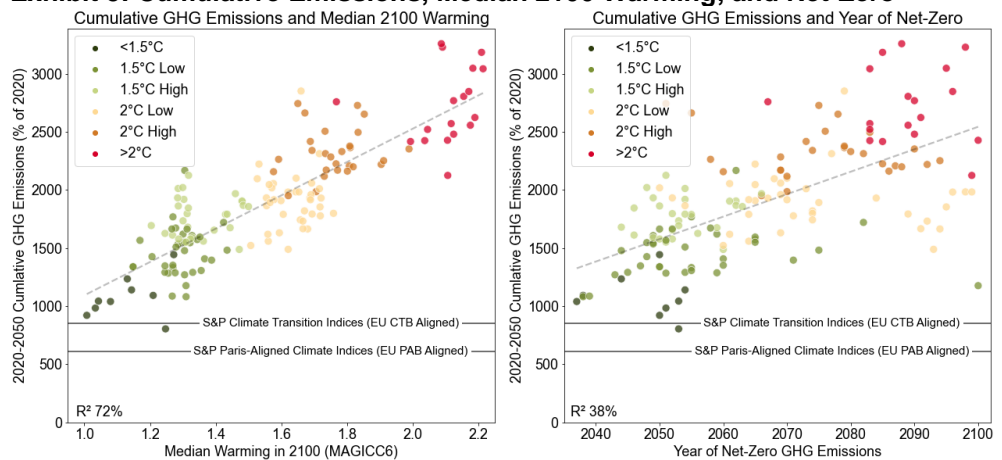
The expected cumulative emissions of the S&P Climate Transition Indices are lower than emissions for all but one scenario in the database (and in turn potential scenarios the underlying market cap index could take), while the S&P Paris-Aligned Climate Indices are lower than all the others.

Again, if we understand scenario alignment as GHG emission reductions at the portfolio level, aligned with that required of the global economy, we can apply climate scenario trajectories to broad indices. If we assume a broad market-cap-weighted underlying index to take on the GHG intensity of predicted climate scenarios, these can be compared with the S&P PACT Indices. The expected cumulative emissions of the S&P Climate Transition Indices¹² are lower than emissions for all but one scenario in the database (and in turn potential scenarios the underlying market cap index could take), while the S&P Paris-Aligned Climate Indices are lower than all the others.

Even under the most ambitious pathways the underlying index may take, the S&P PACT Indices would give increased confidence of meeting the 1.5°C scenario alignment.

...while the S&P Paris-Aligned Climate Indices are lower than all the others.

Exhibit 5: Cumulative Emissions, Median 2100 Warming, and Net-Zero



Source: S&P Dow Jones Indices LLC, Huppmann, D., Kriegler, E., Krey, V., Riahi, K., Rogelj, J., Calvin, K., . . . Zhang, R., IAMC 1.5°C Scenario Explorer and Data hosted by IIASA. Data as of 2019. Charts are provided for illustrative purposes.

¹¹ Matthews, H. D., Zickfeld, K., Knutti, R., & Allen, M. R. (2018). Focus on Cumulative Emissions, Global Carbon Budgets and the Implications for Climate Mitigation Targets.

¹² This expectation is based on the indices cumulative emissions being aligned with the targeted trajectory, which is 5% below the 7% year-on-year trajectory outlined by the EU Low Carbon Benchmark Regulation.

How do the absolute trajectories of the S&P PACT Indices compare with a relative decarbonization strategy, under these various predicted climate scenarios?

While looking at lower climate change scenarios, there appears to be a linear relationship between cumulative emissions and median 2100 warming...

First, in Exhibit 6 we have added back all scenarios in the database that do not meet the net-zero before 2100 goal. While looking at lower climate change scenarios, there appears to be a linear relationship between cumulative emissions and median 2100 warming, and when we extend this to higher climate change scenarios, this expected relationship appears non-linear. This is unsurprising, as earth system dynamics include non-linear interactions, processes, and feedbacks,¹³ which appear baked into these models at higher temperatures, to some degree.

By reducing the cumulative emissions each year by 30% and 50% for the respective strategies, we can replicate the expected GHG emissions pathways a relative decarbonization strategy could take under each scenario in the database.

...and when we extend this to higher climate change scenarios, this expected relationship becomes non-linear.

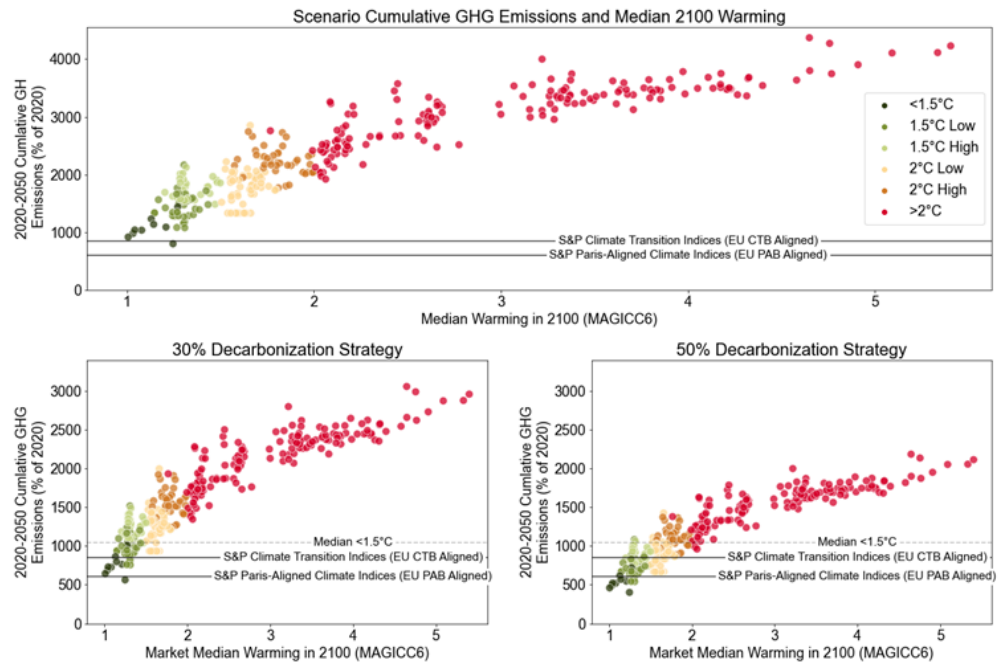
If the market decarbonizes at a rate aligned with a 2°C pathway, a 50% relative decarbonization strategy still may not align with 1.5°C, while a 30% relative decarbonization strategy would likely require the market to decarbonize in line with a 1.5°C trajectory to elicit cumulative emissions below 1.5°C. Both S&P PACT Indices demonstrate cumulative GHG emissions beneath a median below-1.5°C scenario.

The problem investors may face is that even with optimistic targets, which includes those targets being met that have not even been agreed to by countries, the median expectation is for a 2.1°C alignment. Simply put, if investors want strategies to align with 1.5°C or a 2050 net-zero, this is an exposure they can, and will likely need to, control for explicitly.

Even with optimistic targets, which includes those targets being met that have not even been agreed to by countries, the median expectation is for a 2.1°C alignment.

¹³ Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., . . . Schellnhuber, H. J. (2018). Trajectories of the Earth System in the Anthropocene.

Exhibit 6: Relative Decarbonization Strategies Scenario Alignment Depends on Market Decarbonization



The S&P PACT Indices can step in and provide investors with confidence in an emission-reduction strategy.

Source: S&P Dow Jones Indices LLC, Huppmann, D., Kriegler, E., Krey, V., Riahi, K., Rogelj, J., Calvin, K., . . . Zhang, R., IAMC 1.5°C Scenario Explorer and Data hosted by IIASA. Data as of 2019. Charts are provided for illustrative purposes.

SUMMING UP

With many investors aligning their allocations with a 1.5°C scenario or a specific year of net-zero, understanding the interactions between these goals can be beneficial in understanding the types of strategies that may help. 1.5°C alignment indicates a year of net-zero around 2050, while 2°C appears indicative of hitting net-zero much later—around 2070-2080.

To aid these GHG emission reduction claims, GHG reduction strategies often take one of two forms: absolute or relative. Relative strategies tend to have a lower carbon intensity than the underlying index, but do not control for specific climate decarbonization pathways or a net-zero target year.

The S&P PACT Indices can step in and provide investors with confidence in an emission-reduction strategy that will go beyond the IPCC 1.5°C scenario, with no or limited overshoot, and is aligned with a 2050 net-zero.

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APPENDIX

Pathways and Summary Statistics					
PATHWAY GROUP	PATHWAY CATEGORY	PATHWAY SELECTION CRITERIA AND DESCRIPTION	NUMBER OF SCENARIOS	NUMBER OF SCENARIOS MEETING NET-ZERO BEFORE 2100	ABBREVIATION
1.5°C or 1.5°C consistent	Below 1.5°C	Pathways limiting peak warming to below 1.5°C during the entire 21 st century with 50%-66% likelihood	9	9	<1.5°C
	1.5°C low overshoot	Pathways limiting median warming to below 1.5°C in 2100 and with a 50%-67% probability of temporarily overshooting that level earlier, generally implying less than 0.1°C higher peak warming than below-1.5°C pathways	44	43	1.5°C Low
	1.5°C high overshoot	Pathways limiting median warming to below 1.5°C in 2100 and with a greater than 67% probability of temporarily overshooting that level earlier, generally implying 0.1-0.4°C higher peak warming than below-1.5°C pathways	37	37	1.5°C High
2°C or 2°C consistent	Lower 2°C	Pathways limiting peak warming to below 2°C during the entire 21 st century with greater than 66% likelihood	74	55	2°C Low
	Higher 2°C	Pathways assessed to keep peak warming to below 2°C during the entire 21 st century with 50%-66% likelihood	58	41	2°C High
Above 2°C	Above 2°C	Pathways above 2°C	189	20	>2°C

Source: S&P Dow Jones Indices LLC, Rogelj, J. et al. (2018). Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. Table is provided for illustrative purposes.

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