RESOLUTION INVESTORS

Resolution Insights

Tipping Points, Feedback Loops and S-Curves

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Your attention is drawn to the disclaimer

In this latest *Resolution Insights Piece*, we explore why optimising risk-adjusted returns requires an investment strategy that is not only quality-focused but also strongly climate-aligned today. We examine the risks of acting too late, the human tendency to favour linear forecasts over likely exponentials, and the importance of tipping points for understanding the climate crisis.

As always, we welcome your thoughts and feedback.

With best wishes,

The Resolution Team

Too late is as good as never

Many investment firms tout their climate credentials, but, in reality, their criteria are often undemanding or based on distant future goals - “By 2035, we aim for up to 75% of fund holdings to align with the Paris Agreement.”

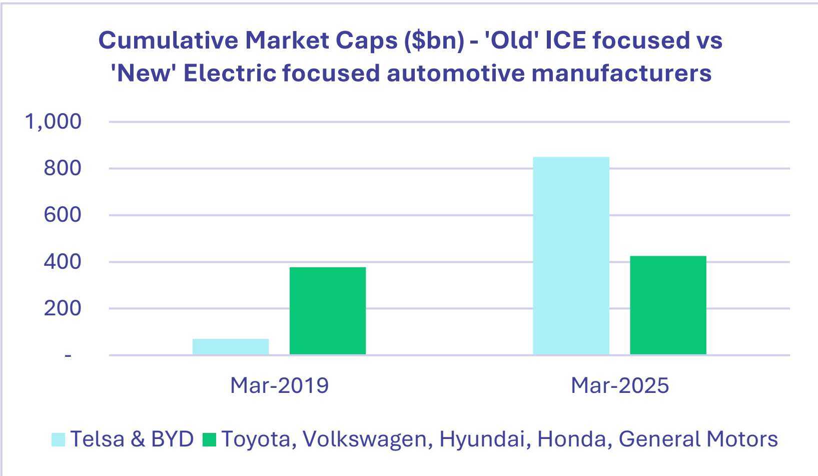
Some claims remind us of election-time political manifestos. Promises are made, yet rarely enforced, and often broken without consequence. Blame cynicism, but we are cautious of placing much weight on commitments with no real accountability.

At Resolution, we take a different approach. Our strategy is designed to be strongly climate-aligned today. We set high hurdles that our investment companies must meet now - for example, requiring all Transition Leader companies[1] to have carbon reduction plans that are material, progressing well, and externally verified by SBTI. Below we explore why this matters.

Our starting point is simple - if a claim is made, it should be true and verifiable. More materially, we want our strategy to be ready today for upcoming legislation, regulation, carbon pricing, consumer shifts, and other market forces - factors we believe will have a far greater impact than the market anticipates.

Predicting the exact timing of new laws is tricky. Similarly, it is hard to know when the market’s attention will shift and focus. But, when investors do wake up, share prices often react sharply. Recently, the market value destruction in response to the DeepSeek announcement, shows how quickly sentiment can change.

Likewise, the two leading global EV companies are now valued at 2x the top five legacy ICE manufacturers, up from just 0.2x six years ago. A fund’s intention to align with the EV transition ‘in a few years time’ would have been of no help. As with much in life, too late is as good as never.

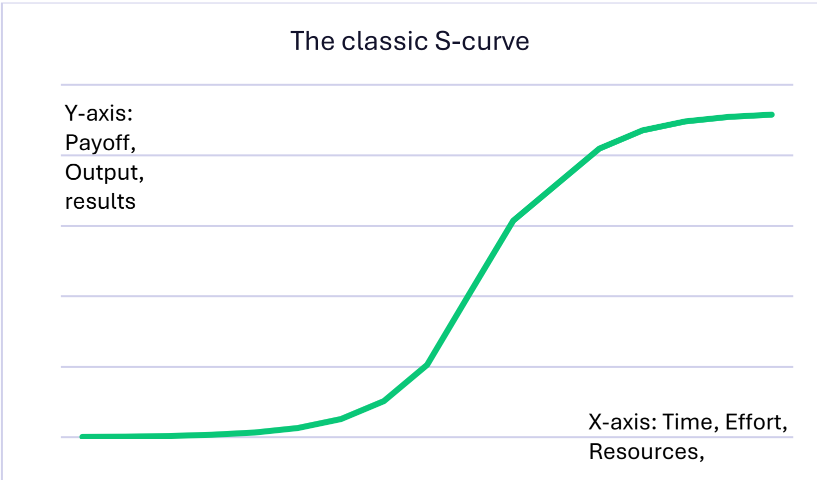


[1] With two exceptions, where we expect formal SBTI verification is coming imminently.

Tipping Points, Feedback Loops and S-Curves

We spend a lot of time thinking about tipping points, feedback loops, and s-curves – they are fundamental for understanding 'how change happens', both in societies and in nature.

Analysts across all fields default to forecasting smooth, linear trends. This is partly human nature – just as people are known to struggle with intuiting probabilities; they have an equally hard time grasping exponential growth.

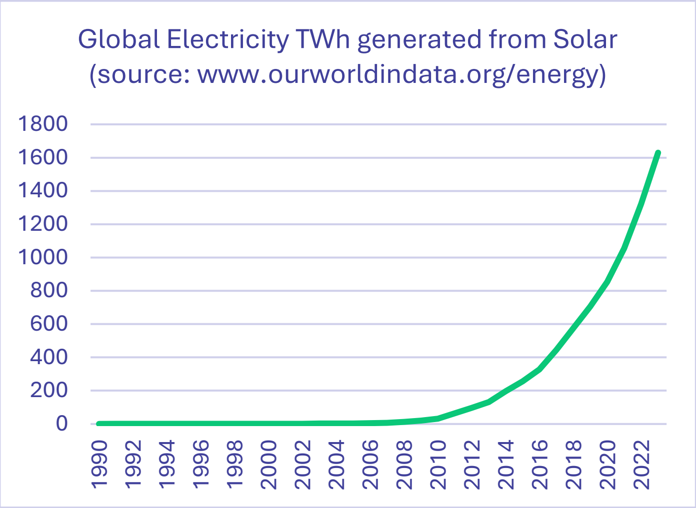


This is the lesson of the Chinese fable of the Emperor's Chessboard. The Emperor agrees to reward a sage for his services - one grain of rice on the first square of a chessboard, two on the second, four on the third, and so on, doubling each time. By the final 64th square, the total is nearly 10 million million million grains of rice. Clearly the Emperor was human after all, at least in his appreciation of exponentials.

This tendency to think linearly is a problem because, in reality, change is often exponential - or at least distinctly non-linear.

In Societies, it is common to see s-curve adoptions of innovations and new technologies.

Rapid 'parabola' adoption can be sparked or accelerated by legislation. Car seatbelts is a case in point – in January 1983 the UK government introduced a new law which made the wearing of seat belts compulsory for all car drivers and front seat passengers. Shortly afterwards, participation jumped to 90%, and there was a 30% reduction in serious and fatal injuries.



A more current example is the rise of solar energy. Here, exponential growth has been driven by a combination of favourable legislation, ongoing efficiency improvements, and big cost downs. As a result, as solar became the cheapest source of energy, adoption surged in certain regions. Once it passed the tipping point, growth has outstripped projections time and time again.

In the physical & natural world, tipping points, feedback loops, and s-curves are also common, though often under-appreciated.

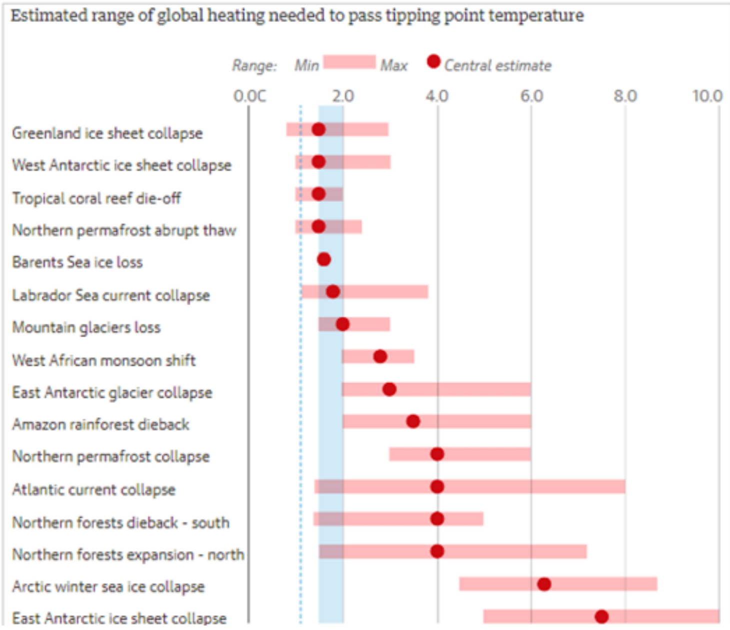
In physics, the concept of latent heat explains how, when heating a glass with water and ice, the temperature of the water is constant until all the ice is melted – at which point, the water warms quickly. Similarly, while systems may appear stable, once a tipping point is crossed, change can be swift and dramatic.

Another real-world example is London's Millennium Bridge, which had to be closed shortly after opening. A slight sway caused pedestrians to unconsciously step in unison, amplifying the motion into a much stronger oscillation. This illustrates how small factors can create powerful feedback loops, a core principle of Chaos Theory and Dynamical Systems.

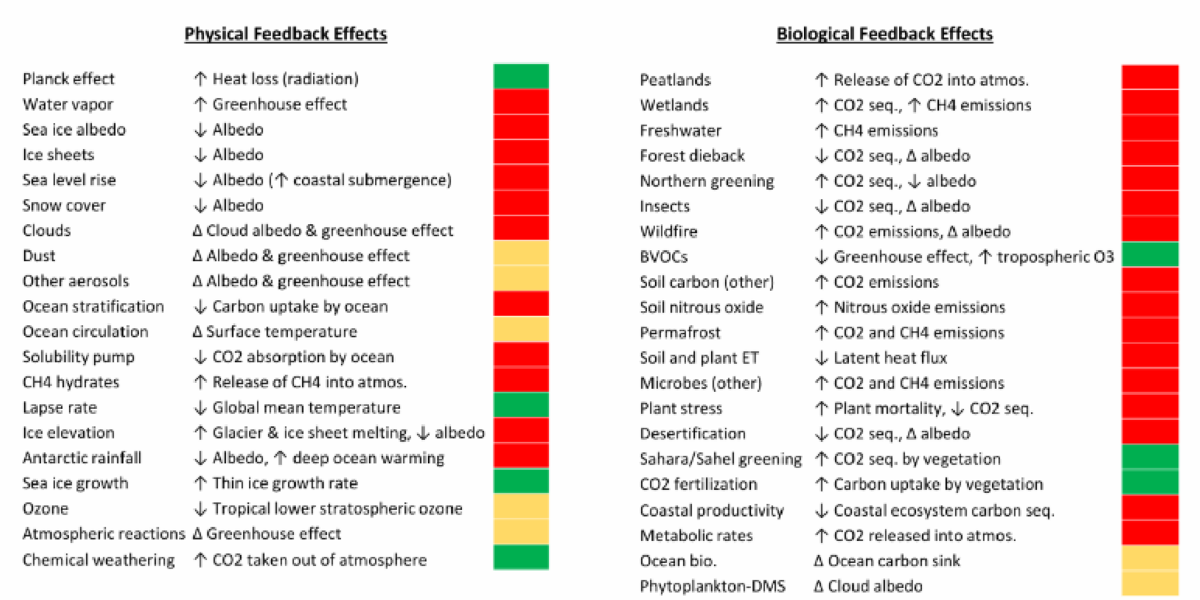
The decline of coral reefs worldwide is a well-documented example of negative domino effects - small changes in water temperature and acidity lead to the demise of entire ecosystems. This highlights their inherent fragility. On a more hopeful note, some coral reefs have shown the ability to adapt to changing conditions, with renewed growth. Here, we remain optimistic about nature's ability to self-renew, but only provided change remains within manageable limits.

Unfortunately, the global climate crisis presents numerous tipping points that, once crossed, can accelerate further disruptions. A clear example is Arctic ice melt - as ice disappears, the exposed darker ground absorbs more heat, preventing refreezing.

The chart to the right (source: Armstrong McKay et al, 2022) outlines a number of key tipping points and the global temperature increase level at which they are expected to occur.



Duncan Austin (www.bothbrainsrequired.com) identifies that of the 41 physical and biological feedback loops assessed - 27 are 'reinforcing' and will accelerate heating (in red below), 7 are 'balancing' and will moderate heating (green), while 7 have mixed or unknown effects (yellow).



Physical Feedback Effects

Planck effect	↑ Heat loss (radiation)
Water vapor	↑ Greenhouse effect
Sea ice albedo	↓ Albedo
Ice sheets	↓ Albedo
Sea level rise	↓ Albedo (↑ coastal submergence)
Snow cover	↓ Albedo
Clouds	Δ Cloud albedo & greenhouse effect
Dust	Δ Albedo & greenhouse effect
Other aerosols	Δ Albedo & greenhouse effect
Ocean stratification	↓ Carbon uptake by ocean
Ocean circulation	Δ Surface temperature
Solubility pump	↓ CO2 absorption by ocean
CH4 hydrates	↑ Release of CH4 into atmos.
Lapse rate	↓ Global mean temperature
Ice elevation	↑ Glacier & ice sheet melting, ↓ albedo
Antarctic rainfall	↓ Albedo, ↑ deep ocean warming
Sea ice growth	↑ Thin ice growth rate
Ozone	↓ Tropical lower stratospheric ozone
Atmospheric reactions	Δ Greenhouse effect
Chemical weathering	↑ CO2 taken out of atmosphere

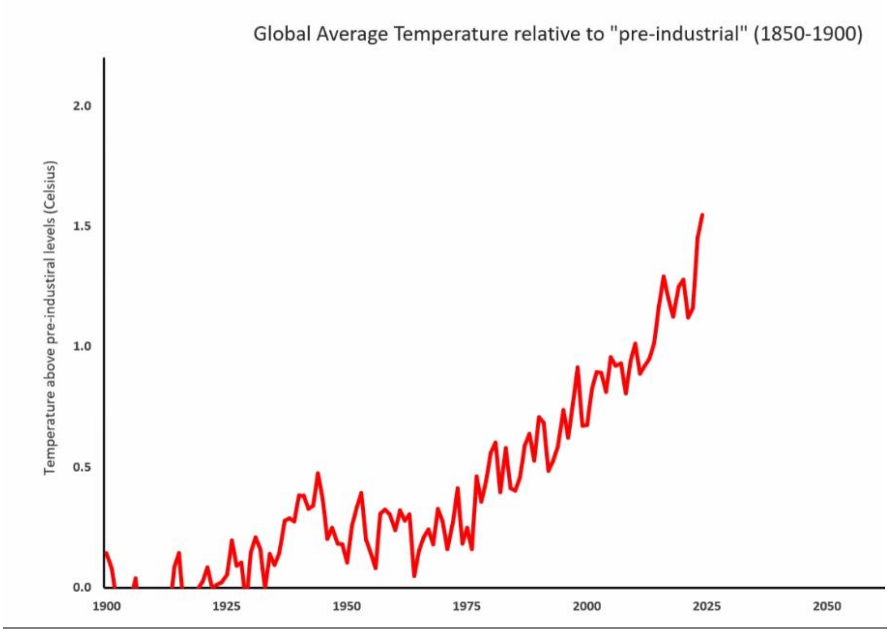
Biological Feedback Effects

Peatlands	↑ Release of CO2 into atmos.
Wetlands	↑ CO2 seq., ↑ CH4 emissions
Freshwater	↑ CH4 emissions
Forest dieback	↓ CO2 seq., Δ albedo
Northern greening	↑ CO2 seq., ↓ albedo
Insects	↓ CO2 seq., Δ albedo
Wildfire	↑ CO2 emissions, Δ albedo
BVOCs	↓ Greenhouse effect, ↑ tropospheric O3
Soil carbon (other)	↑ CO2 emissions
Soil nitrous oxide	↑ Nitrous oxide emissions
Permafrost	↑ CO2 and CH4 emissions
Soil and plant ET	↓ Latent heat flux
Microbes (other)	↑ CO2 and CH4 emissions
Plant stress	↑ Plant mortality, ↓ CO2 seq.
Desertification	↓ CO2 seq., Δ albedo
Sahara/Sahel greening	↑ CO2 seq. by vegetation
CO2 fertilization	↑ Carbon uptake by vegetation
Coastal productivity	↓ Coastal ecosystem carbon seq.
Metabolic rates	↑ CO2 released into atmos.
Ocean bio.	Δ Ocean carbon sink
Phytoplankton-DMS	Δ Cloud albedo

How to manage a global crisis

Regrettably, several tipping points have already been crossed. They have likely contributed to the global temperature rise already hitting 1.5 degrees in 2024 - a chunk earlier than expected.

Amongst the climate science community, the very real fear is of a domino effect, where one tipping point triggers another, leading to a dangerous downward spiral. As the recent Los Angeles wildfires testify, the consequences are severe and non-linear.



Fortunately, most governments and regulators are increasingly aware and engaged.

The COVID-19 pandemic - another natural exponential initially seen as linear - offered a blueprint for managing global crises. It revealed the extent to which governments can impose restrictions, how swiftly new rules can be enacted, and also peoples' willingness to adapt to new ways.

Regardless of U.S. political shifts (which we will address separately), à la King Canute, the waves of action against the climate crisis are unstoppable. When we look back in 10 to 15 years, we expect to see regulations in place that today seem almost unthinkable.

Beyond policymakers, funds should prepare for transformative shifts in consumer behaviour. The history of the world could be written as the history of social movements:

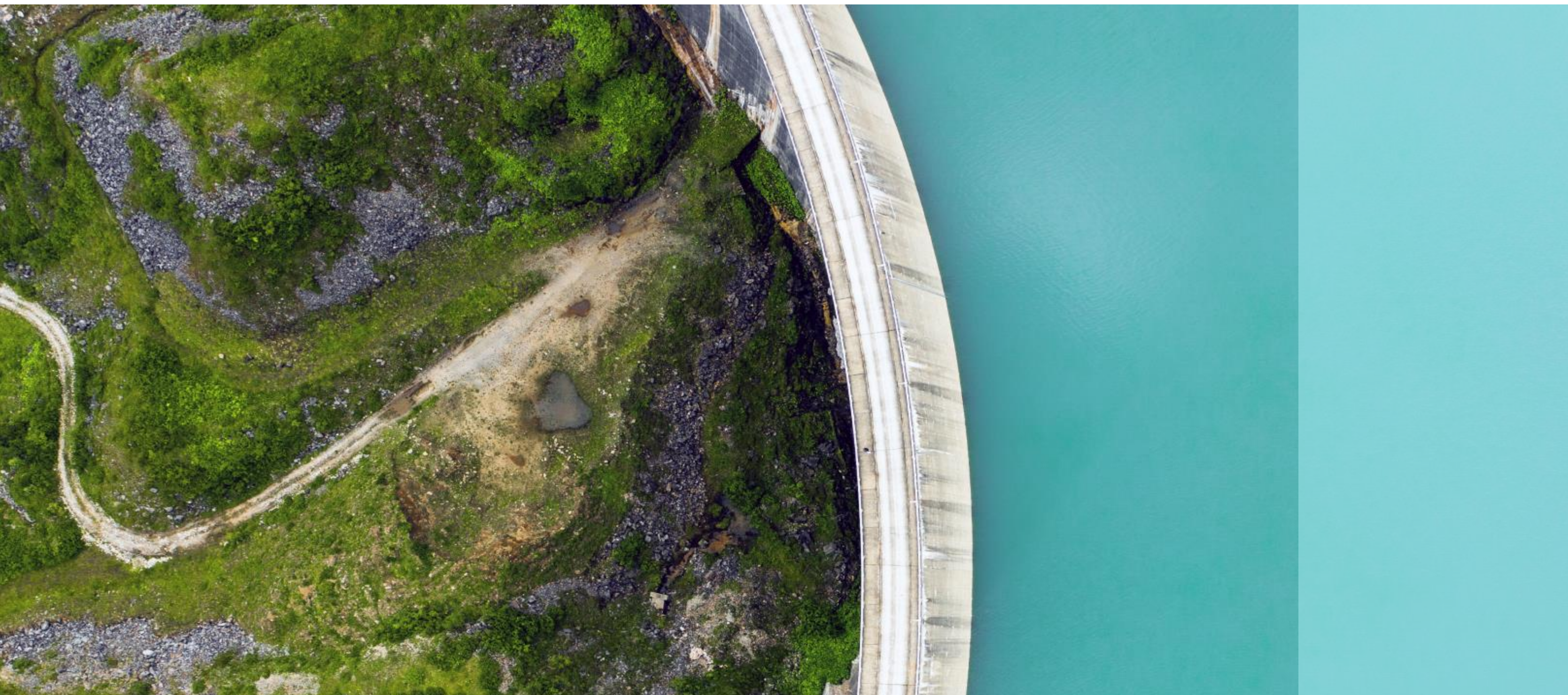
- The Women's Suffrage Movement led to women gaining the right to vote in many countries, and sparked broader gender equality reforms.
- The Civil Rights Movement in the USA in the 1950s and 1960s led to the landmark Civil Rights Act aimed at ending racial segregation and discrimination.
- The Indian Independence Movement led to the end of British colonial rule and India gained independence in 1947. This inspired other anti-colonial movements worldwide.

The climate crisis has arguably yet to see its defining 'social movement moment' – but when it does, history shows that when people rally to a cause, sweeping change will follow.

Conclusion

These thoughts bring us back to our core point - change often happens faster than expected. From an investment strategy and risk-adjusted returns perspective, it is crucial to be well positioned now, or risk being too late. At Resolution, we offer an investment strategy that, as well as being quality-focused, is strongly climate-aligned today.

The Resolution Team



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