etf partners

20 YEAR ANNIVERSARY

The Environmental Technologies Fund

THE INTELLIGENCE LAYER

Contents

Executive summary

When we launched ETF Partners 20 years ago, a focus on environmental technologies was unprecedented in venture capital. Today it is both urgent and mainstream.

"The past is kind enough to give you lessons. The present is kind enough to give you opportunities. The future is kind enough to give you both"

Matshona Dhliwayo, philosopher, entrepreneur, and author

20 years ago, it was obvious that climate change was real. It was also clear that innovation would be needed for humankind to address it effectively. We saw a huge need for a massive technology-based adjustment to society. In short, we saw both purpose and opportunity.

We founded ETF Partners – The Environmental Technologies Fund – in 2005 with great optimism. We were able to raise our first fund of over £100m because we could demonstrate deep experience in technology venture capital. At the time, the idea of a venture capital fund focused on what we called 'sustainability through innovation' was seen by some as visionary – by others as simply eccentric. Yet we discovered that purpose has power. It provides conviction that others recognise, and which more and more people come to adopt, building support and generating market opportunity.

If the opportunity we saw in 2005 was a mountain range, its sheer size meant we (and others) underestimated our distance from it. 20 years later, we have made it to the foothills and as we ascend, we now see opportunity all around. Today, we still feel that we are just starting out, yet with more experience and undiminished enthusiasm. There is so much to do, and the fundamental pieces – of infrastructure and deep tech – are now sufficiently mature for venture capital to do what it does best: make radical, scalable impact.

The themes of 'sustainability' and 'climate' are rightly attracting significantly more capital today, and yet the urgency is now far greater and much more still needs to be done. In the pages that follow, we wish to encourage others to address these needs with optimistic pragmatism, and, if we can, also add a few insights and provocations that may be helpful.

Fig 1: A mountain of opportunity comes in to view

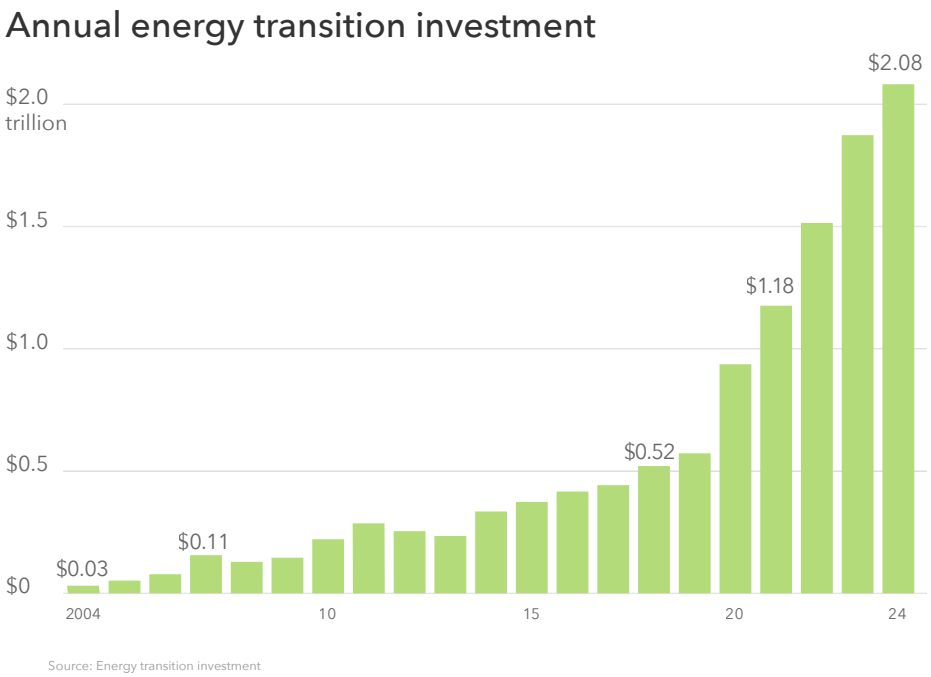
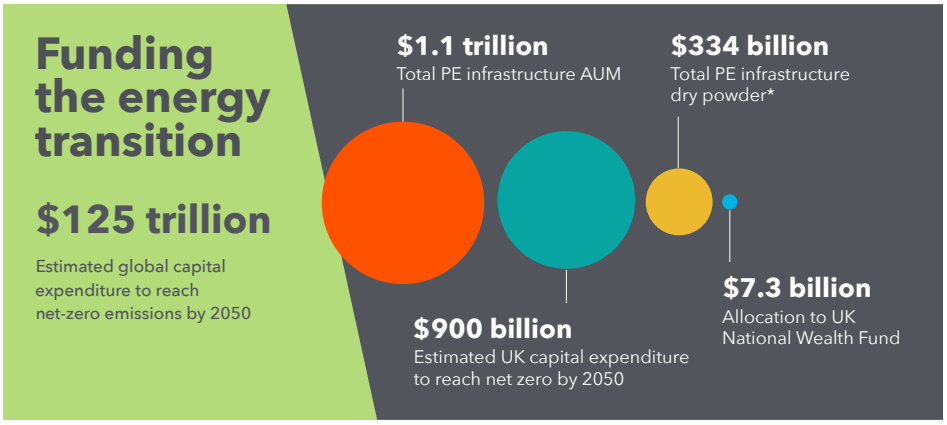


Fig 2: Or is it a planet of opportunity?



*Sources: Pitchbook data, Glasgow Financial Alliance for Net Zero, UK Infrastructure Bank

WHAT IS PREDICTABLE?

Most events are fundamentally uncertain or unknowable in advance. So what, if anything, is predictable in what can seem like an increasingly chaotic world? Our experience has shown that, in fact, there is quite a lot!

One example is the reality of environmental deterioration, about which much has been written. Another is the falling costs and performance improvement of technology, particularly in areas such as semiconductors and photovoltaic cells. To us, these trends appeared highly predictable – and still do.

In each case, this is simply because there was already a long-term trend based on hard data, plus a clear underlying logic for why it should be durable. Solar panel costs have been dropping in price by 20% to 24% a year for decades. Since 2005, other new technologies, such as wind turbines, have also demonstrated similar 'cost curves' more strongly than were originally expected. If, once established, these trends offer predictability, then the trick is to imagine their consequences in a decade or so. For example, what is likely to happen in 10 years' time when solar cells cost one tenth what they do now?

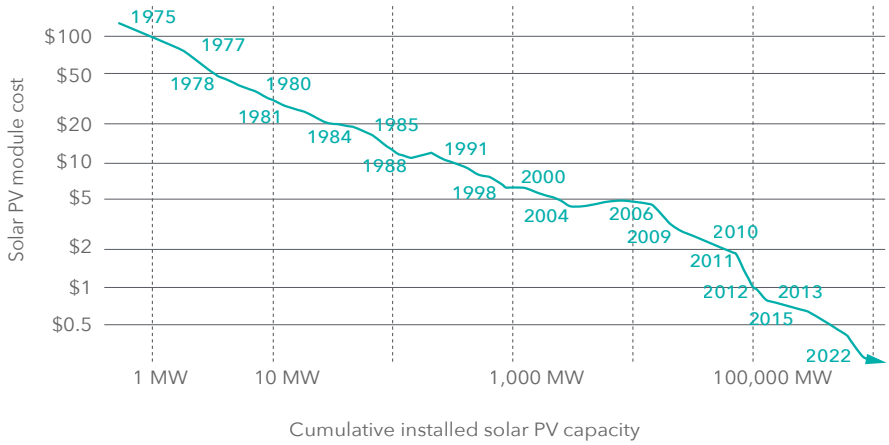
That gives perspective that we think is under-used, yet valuable:

"The trend can be your friend"

Fig 3: Falling towards zero

Solar panel costs have fallen by around 20% for every doubling of global cumulative capacity

Costs are measured in US dollars per Watt, adjusted for inflation.



Source: IRENA (2023); Nemet (2009); Farmer and Lafond (2016)

It is this combination of the knowable and unknowable nature of the future that makes venture capital investment both a science and an art. There are few hard-and-fast rules, but there are useful rules of thumb, distillations of experience that appear to hold true. Below, we share some of the other less obvious lessons we have drawn from the past few decades of trial and error. For example:

In innovation, 'weight matters'

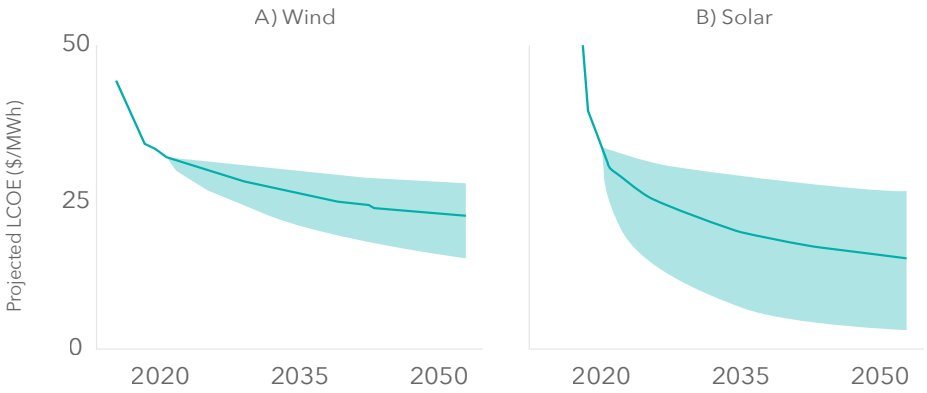
Think of it this way, if you were to buy a plane you would expect it to last far longer than if you were to buy a bike, so the ability to iteratively improve is less, as the singular asset-holding time is so long. Because of the speed of innovation around the bike, electric versions are now cheaply accessible and on demand in many cities…

To take another example: if solar panels reduce in price by 20% every time capacity doubles, whereas for wind the figure has been 6% to 8%, then basically, solar wins out over time – and in fact at that rate of improvement, it wins out over every source of energy over time. This is why we believe that solar will dominate new energy production – within the lifetime of a new venture capital fund – and it will be cheap.

Crudely speaking, heavy things see slow innovation and so are typically less attractive for venture capital investment – 'weight matters'. In fact, we can stretch this point and say that innovations based on electrons have steeper cost curves than those based on molecules. (It is easier and cheaper to control electrons than molecules and so easier to get better at it).

Taking this to an extreme, 'weightless' software and data innovations have the best cost curves!

Fig 4. Projected LCOE based on full-period learning rates. The lines represent point estimates, and the bands represent 95 confidence intervals.



Source: energy.gov

EMERGING THEMES

The rate of technological change has been steadily accelerating over the past 20 years, and we see no reason why it should not continue to do so (moderated only by society's ability to absorb change).

For instance, a profound cost curve is now visible in the satellite industry, and there is even an emerging cost curve in quantum computing developing. AI is evolving so fast it appears to learn in step changes rather than curves, but it will keep evolving and likely at a rate not limited by technological progress as much as by existing infrastructure, energy sources, and governmental legislation. So, look for innovation around these critical constraints!

New technologies will not just co-exist; they will increasingly work together to leverage and improve existing infrastructure, as well as pave the way for new infrastructure growth.

Looking forward, we therefore think that the place to invest that can generate the biggest environmental bang for the buck, fastest, is what we call 'the intelligence layer that enables modern infrastructure'.

Just as we saw today's listed tech giants – the so-called Magnificent Seven – eat the world with their weightless offerings, so we will see deep sustainability-driven technologies eclipse the slick panels and weighty turbines to become the winners and impact drivers of tomorrow.

These sustainability champions will play into the following emerging growth themes, as we seek to deliver:

- Optimisation
- Adaptation
- Abundance

The climate crisis is upon us. Existing technologies will only get us so far. The innovations we see in the market will enable us to do so much more than we have ever imagined. This is what we still mean, after 20 years, by delivering 'sustainability through innovation'. Its time has come, and we are excited to be on this part of the journey with you.

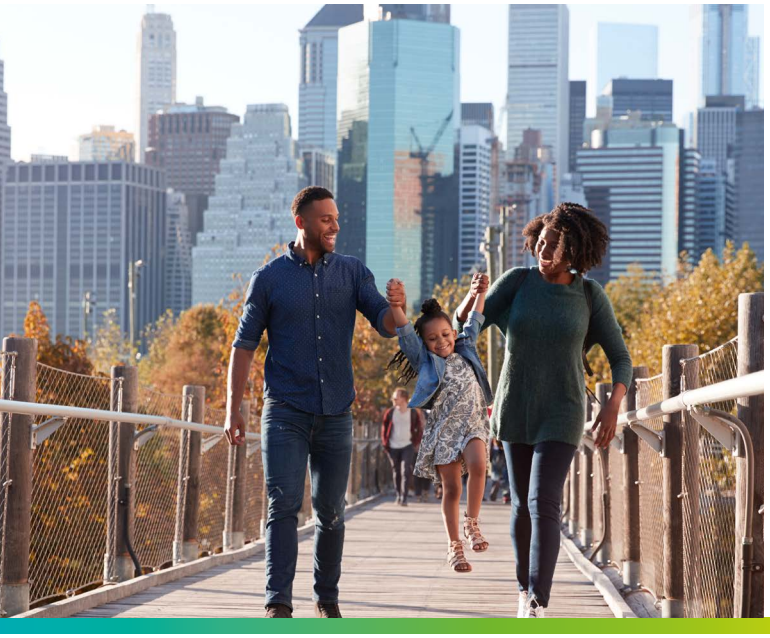
Pleased but not satisfied

The Intelligence Layer

2005: THIS IS GOING TO BE HUGE

Why did we start The Environmental Technologies Fund?

In 2005, Patrick Sheehan was already a 20-year veteran of venture capital and had returned to Europe from Silicon Valley, where he had set up 3i's US operations. It had been an adventure, and he was eager for another, but in an area where he could make a difference. He saw climate change as a threat, but the venture capital industry at the time was not addressing it. It was Peter Horsburgh who first proposed the idea of an environmental technologies fund. For Peter, Patrick, and their soon-to-be third colleague, Henrik Olsen, the problem was that all the big recent successes in venture capital had been very different: mainly digital, consumer plays. It may not seem it now, but to pan out from eBay, Google, Facebook, etc., to safeguarding the state of the planet was quite the intellectual reframing. 'Cleantech' was yet to be coined as a term. Protecting the environment just wasn't on the radar of people investing in venture capital.



If anything, we were a little too early.

In the aftermath of the dot-com bubble, the venture capital market had lost its mojo and few people were thinking big. When we launched The Environmental Technologies Fund, there were just two other small outfits in Europe with a similar thesis. Even in the US, climate investing was at best embryonic.

What was 'the pitch' that raised a £100m fund for a market that barely existed? It was brutally simple and involved no jargon.

There is a massive need for innovation that addresses climate change and protects the environment. As well as being fundamentally important, it is going to be a huge opportunity. Europe's environmental focus gives it a leadership position.

We then explained that serious long-term investment institutions should invest in the most experienced team they could find in this new area, except of course, there weren't any experienced teams! So we created one for them: The Environmental Technologies Fund. In the words of Robert Genieser, who subsequently joined as the fourth partner, the challenge for the team would be to demonstrate that the fund's portfolio companies could help solve some of the world's most pressing environmental problems, while delivering commercial success.

Our positive lesson here, in addition to the ever important one of addressing a critical need, is relevant for all start-ups:

Be clear about what you are best in your world at

THE FIRST WAVE, 'CLEANTECH' AND THE FINANCIAL CRISIS

By 2007, cleantech was now a 'thing' – and it was rapidly propelled by, first, a light breeze, then a wind, and then a gale. A year later, there were half a dozen cleantech funds operating just in the UK alone. While it felt great to be part of something with a good tailwind, we were wary of aligning ourselves with what felt increasingly like dot-com euphoria.

For example, at the height of cleantech, there were 84 thin-film solar companies in the world backed by VCs. We invested in none of them because it reminded us of the computer memory chip market (the DRAM market), which had rapidly become a commodity market. We were proved right, as none of them succeeded. Put simply, some markets are a race to the bottom.

Avoid commodity markets

We also recognised that major industrial transformations typically undergo three phases of change. The first two phases tend to be capital intensive and offer relatively poor returns, at least for venture capital. We therefore focused on what we called 'tertiary change', or what we then thought of as the knowledge intensive companies that become invaluable. (For example, after early electric vehicles hit the road, and then charging infrastructure is gradually deployed, new knowledge-based innovation is needed to enable the system to work, with these solutions having a big impact on improving the efficacy of the underlying infrastructure and serving to accelerate adoption).

While our prior experience meant we dodged many bullets, we still stopped a few the hard way. We were sometimes investing in very difficult technologies and sectors, or in pre-revenue and first-of-a-kind technologies. When the global financial crisis came unexpectedly, conditions proved too challenging for these businesses, and disastrous for cleantech. That storm capsized all the boats.

What is the lesson we took from this? Among other things, we learned that, in contrast to the technology sector itself with which we were very familiar and that was always innovating, much of the rest of the industrial world was resistant to change. In the words of the CTO of one of the world's largest paper mill companies – when we were discussing a startup company that produced fuel from forestry waste – "you don't understand; our industry doesn't innovate". The reason, on reflection, is simple. Low margin industries don't have the capital to speculate, and their managers are not paid to take risks. If there is no capex budget, innovation is just not an option. Such industries aren't merely late adopters or laggards; they are structurally resistant to change. Even today, investors entering 'climate tech' frequently under-appreciate this.

So, another lesson we share internally is:

Be careful of old intuition in new markets

"Everyone got caught up with the idea that climate change was a big problem and therefore there was a big market," says Sheehan. "The prevailing sentiment was that climate solutions deserved to succeed and therefore they would. It was an intellectual trap."

"There was a false belief that if you built it, they would come. Sadly, for many companies in the 2000s, the market was just not there," Genieser adds.

In essence, no matter how important the problem or compelling the solution, the end-market must want to embrace innovation. So, we now say something different:

"Great customers make great companies"

Clean-tech, historically

INNOVATION BY INCUMBENTS	CAPITAL INTENSIVE INNOVATION	KNOWLEDGE BASED INNOVATION
Change/Disruption in Industry	**Change/Disruption in Infrastructure**	**Change/Disruption in Networks**
Improved/Alternative Drive Trains	Alternative Fuel Battery Technology	Software and IT development
Hybrid Cars Electric Cars Fuel Cell Cars	Charging Station	Internet of Things & Connected Devices
		New "Asset Free" business model
Impact Measured Traditional ESG	Impact Measured Traditional ESG Forward projections	Impact measured (but not captured) by forward projections
PRIMARY CHANGE	SECONDARY CHANGE	TERTIARY CHANGE

ETF2 and ETF3 focus

WHERE IS VENTURE CAPITAL TRULY EFFECTIVE?

After the financial crisis, we reviewed our investment thesis.

The planetary risks of climate change were continuing to grow unabated, and innovation was still the answer, but we realised we needed to think more acutely about the constraints of venture capital as a medium for that innovation, and where it could be most effectively deployed. In particular, we looked harder at where we could make a measurable impact within the time horizon of a normal 10-year fixed-life venture capital fund.

We decided to put greater focus on post-revenue companies. There were three simple reasons for this. Firstly, it had become obvious that it was extraordinarily hard to predict how long some new innovations took to become commercial. Materials companies, for example, seemed to take forever to go from being 99% market ready within an R&D lab, to actually being produced at scale and finding global customers. Unlike software, where early customers are used to purveyors working through 'bugs', industrial customers (rightly) expected new material-based products to immediately be of durable high quality ('to work!') and demanded guarantees! Secondly, within the huge range of technologies that we see, revenue was the simplest filter, demonstrating practical demand. Thirdly, we wanted to see and measure real impact and achieve outcomes for our investors within the timescale of our funds. What better way than seeing what was actually happening at customers?

The other refinement was to focus more on digital technology companies. Digital companies are typically more rapidly scalable, and their customers are normally more keen and tolerant adopters of innovation. Finally, the digital sector has the budgets, profitability and familiarity with M&A.

TECH-PUSH VS MARKET-PULL

There is, of course, a place for materials investment, we just think that often pre-revenue materials companies are in the business of 'technology push', whereas venture capital works well in 'market pull'.

We think venture capital is about carrots – about incentives (as well of course as funding) that work well when there is market demand for an offering. Under those circumstances, it can produce great results. To use venture capital to push technology on a market – no matter how logical and slick that innovation may be – is like trying to hammer a good idea into solid oak using a carrot. You can do it, but you'll need an awful lot of them.

This is the classic error of many new funds in 'climate tech', to mistake the general need for a climate solution with actual market pull from customers, and to end up hammering solutions into a market using carrots.

We know, because in fact, our overall market only really became demand-pull in around 2019, as we were raising our third fund.

We said at the start that we were early.

We also began focusing more determinedly on sectors that were facing the greatest change and largest market pull. Phrases like 'energy transition' and 'smart mobility' did not exist when we were raising our second fund in 2012. Indeed, ten years earlier, the received wisdom in venture capital was that you never do automotive – it changes too slowly – and you never do energy – it's too regulated.

Venture capital is about carrots

The impact on our wallets

From the start, we have been purpose-driven, and we expect the financial returns we deliver to be a strong validation of our impact in the world. But we are also keen to demonstrate the mission-driven nature of our investments, and to measure and report on the real-world impact that our investments have.

Venture capital is all about alignment of interests (carrots, remember!). So we have gone further and made our own teams' rewards (some of the carried interest) contingent on the attainment of impact.

Our approach to this is based on the concept of a 'minimal viable impact'; the achievement needed for an individual investment to have delivered worthwhile impact. Because we only invest in companies whose success is predicated on extremely positive environmental outcomes, we don't expect there to be a conflict between a company's impact success and its financial success, but we do think it is good to be clear and to walk the talk.

In 2024, we led an influential paper on how venture capital firms can measure their impact. You can read it at bit.ly/etfimpactguide

EUROPE: THE GREAT EARLY ADOPTER MARKET

It might sound odd for a venture capital firm to praise intervention and legislation – and to be sure, it's not always a positive – but in our field, there is no question that the political and social zeitgeist across Europe has provided a positive backdrop. Europe has had the regulatory and thought leadership that together has created the market pull from customers that in turn has made it a great place for environmentally focused startups to emerge.

THE INTELLIGENCE-LAYER AND HYPER-IMPACT

We have focused increasingly over time on sectors where we saw the most 'market pull' and dived into detail in many themes within energy transition, mobility and smart cities. We have realised that we need to understand all these adjacent themes to some degree to understand any one of them properly. Within them, the most highly scalable companies have all tended to be digital. So more recently, we are focusing very much on the underlying unifying pattern in what we find most interesting; 'the intelligence layer' that enables modern infrastructure.

This 'intelligence layer' can in practise be a mix of hardware and software, or more often pure software. Based on experience, it is where we can deliver the biggest return on investment, fastest. And that speed is important, not just because our investors rightly want great returns within a venture capital funds lifespan, but also because environmental impact is urgent, and we can't just wait for technologies such as nuclear fusion to become commercially scalable. Simply put, worthwhile endeavours such as that will take decades, and we also need impact now.

Today we can clearly see 'the intelligence layer' as an enabler of profound advances in mobility and the energy transition. We also see it manifesting in the practical application of AI and even in the beginnings of practical applications of quantum computing. As these and other 'deep technologies' become commercial, we expect to see an abundance of opportunity for positive environmental impact.

Intelligence is leverage

How our portfolio companies are leveraging intelligence to protect the environment

Quantum computing

RIVERLANE

Quantum error correction

One of our investee companies, Riverlane, is helping make quantum computing a practical reality. Quantum computers are inherently 'noisy' and error-prone, so Riverlane is leading the world in providing quantum error correction.

The potential environmental impacts of then being able to apply quantum computers to complex real world problems (such as designing new materials or properly modelling global climate) are simply huge.

IntellSpace and satellites

OPEN COSMOS

Satellite-powered insights

We invested in UK-based Open Cosmos in 2023 because we recognised the huge potential impact that this satellite company could have on our understanding of planet Earth. In essence, it helps to be able to see the Earth clearly! Without the data inputs and insights that satellites can give us, it would be much harder to know where to allocate our sustainability efforts and to know how well they are working. As well as Earth observation, the company builds and operates satellites for telecommunications, navigation and scientific missions.

For instance, one of its satellites, called Menut, delivers images that monitor deforestation, wildfire impact, flooding and coastal erosion. The amount of effort and energy, down here on Earth, that can be saved and optimised, by such eagle-eye insights is a great example of the scalable impact venture capital investment can achieve.

Thoughts for sustainability investment

By the way, we have not listed the obvious, such as "it's about great people", in favour of the less known or appreciated.

"The trend can be your friend"

Long-term trends with clear causes are lenses that allow us to see and imagine the future

Go weightless

Innovations based on electrons have steeper and more predictable learning curves than those based on molecules, and speed matters

Be clear about what you are best in your world at

Success requires focus. No one should buy from a startup if they have a good alternative

Avoid commodity markets

Some markets are a race to the bottom – they are simply a tough place to be

Be careful of old intuition in new markets

Intuition is a summary of experience. New markets are a new experience, so be alive to their differences

"Great customers make great companies"

No matter how important the problem or compelling the solution, the end-market must really want it

Venture capital is about carrots

It is about incentives and alignment, so is well-adapted to responding to demand, but not good at forcing technological adoption

Intelligence is leverage

Venture capital returns are found primarily in knowledge-based innovation, not mature technology or infrastructure

Glimpses of the future

We said at the start that 'events' are unpredictable, and this can be disconcerting. But some things are predictable, for instance, where there is a clear trend and underlying rationale for that trend; specifically, both climate change and technology cost-reduction curves fall into this category. We also said that the trick then is to imagine the consequences of such trends persisting for a decade or so.

So, we are highlighting three consequences we see from these trends.

Optimisation Adaption Abundance

OPTIMISATION

This may sound obvious, but bear with us, because the impact of AI really will drive significant efficiency and sustainability gains right across real world industries. In most fields of human endeavour where people are managing complex systems, optimisation is difficult. AI is good at that. Our own experience from talking with many companies suggests that there is typically at least a 10% improvement in the efficiency of management of complex industrial and corporate systems using AI, sometimes up to an improvement of a third. (Indeed, we wonder if there is a 'hidden 10% rule'!). If you think of sustainability as the more efficient use of resources, then you see the potential for significant and rapid environmental benefit.

Below are a couple of examples of truly amazing businesses that are making a world-sized dent in sustainability problems that were previously considered all but insoluble.

Addressing hard-to-abate sectors with intelligence

DEEPSEA

Maritime AI efficiency

NODES & LINKS

Smart project delivery

The global maritime industry contributes 3% to 4% of total global emissions and it is often used as a prime example of a 'hard-to-abate' sector. McKinsey, in 2022, estimated that it would cost around $50 billion a year for 20 years to transition to net zero.

In light of this, we invested €5m in Greece-based **DeepSea**, an AI-based optimisation technology for ships that saves 10-15% of fuel consumption, immediately. If 10% to 15% doesn't sound like much, think of it as 0.3% to 0.6% of global CO_2 emissions, cut rapidly while saving customers money. We sold DeepSea to Japan-based Nabtesco in 2023, a leader in maritime infrastructure technology.

So, AI today can often generate 10% or more savings in typical real-work situations. That percentage is only going to increase, to the point where AI becomes used pretty much everywhere, very rapidly driving large improvements in the way we use our resources.

Nodes & Links is another example in our portfolio of how a so-called hard-to-abate sector – in this case big project construction – can be radically optimised with the application of the right AI solutions to drive disproportionately large and positive environmental impact. In this case, as largescale construction projects slip, or undergo change orders, Nodes & Links can update and automate the new workflows, notifying all involved. Through the application of targeted AI, the software can identify the best path forward to save time and money, and eliminate any potential waste.

ADAPTION

The founding father of Singapore, Lee Kuan Yew, famously said that air conditioning 'changed the nature of civilisation' (by making development possible in the tropics). It is becoming clear that we will need to adapt across the world now to a changing warmer climate. The promotion of 'Adaptation technology', is not really a 'thing' today – perhaps because many live in a period of deniability as to the consequences of the climate change, or perhaps because many of its early victims can be found in the global south. However, solutions will be urgently needed, and it will be a growing area for investment during the next decade. 'Air conditioning tech' and other solutions designed to address the fallout from a warming planet will be in demand. Some sectors, such as insurance, may have to do some significant rethinking as they adapt to a more volatile climate.

HELLAS DIRECT

Climate risk insurance innovation

Insurers sit at the centre of an ecosystem that could make a more resilient, adaptable and sustainable world.

We recently led a €30m investment in Athens-based Hellas Direct, an insurer that covers not only seasonal threats but actively incentivises policyholders to take action to mitigate their exposure to climate catastrophe.

ABUNDANCE

We said that the price of solar cells had been consistently falling by 20% to 24% a year. Extrapolating this (which it is reasonable to do) means that in a decade, solar will be by far the cheapest energy source. It will be only 10% or less of what it costs today. So, the production of energy from solar will be pretty much free. But will it then be abundant?

The cost of transmission, of getting the energy to the place it is needed, will probably rise, (assuming the costs of land, labour and regulation rise). We might all then just pay a fixed price for our energy infrastructure (transmission and balancing) regardless of how much we really use. If we make and use our own, then it will be really cheap – so we should expect to see some interesting business model innovations and far more 'local energy' around this notion of energy abundance!

DEXTER

Grid balancing AI

AMBER ELECTRIC

Smart home energy

Management of the emerging new electricity grids should certainly be different.

Another great example of the power of knowledge-based optimisation is Dexter. For all the impressive achievements of the renewable energy industry, it has also created a very real challenge: how to balance the grid when it is increasingly being powered by more variable renewable energy sources.

Dexter addresses this by providing renewable energy forecasting and trade optimisation to energy companies, so they can balance their costs and manage risk.

We also recently led a €26m investment into Amber Electric, a company that helps the customers of energy utilities to optimise and monetise their home energy by managing their batteries and EVs. (We've come a long way from the old venture capital maxim of never investing in the regulated energy sector!)

These are just three areas of prediction – do chat with us if you would like to know more! Of course a lot will surprise us, after all "we can predict everything except the future". However, we can glimpse enough to be excited about the possibilities and alive to the possibilities.

Conclusion

In the evolution of any market, there is a 'right time' for venture capital. It is typically when much of the infrastructure has been built but has not yet been optimised. It is when deep technologies begin to mature and converge to solve a problem. It is when the physical heavy-lifting has been largely done, but the brain-work has only just begun.

We believe that now is such a time for environmental technology.

In the world of buyouts, they talk of leverage. Venture capital also has leverage, but of a very different kind. It leverages intelligence, and there is no more powerful kind of lever. We have already been impressed at the environmental impact that our recent portfolio companies have had – especially relative to the size of our investment – and it is very clear to us that there is much more to come.

etf partners

Sustainability through innovation

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