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The Missing Middle: Capital Imbalances in the Energy Transition

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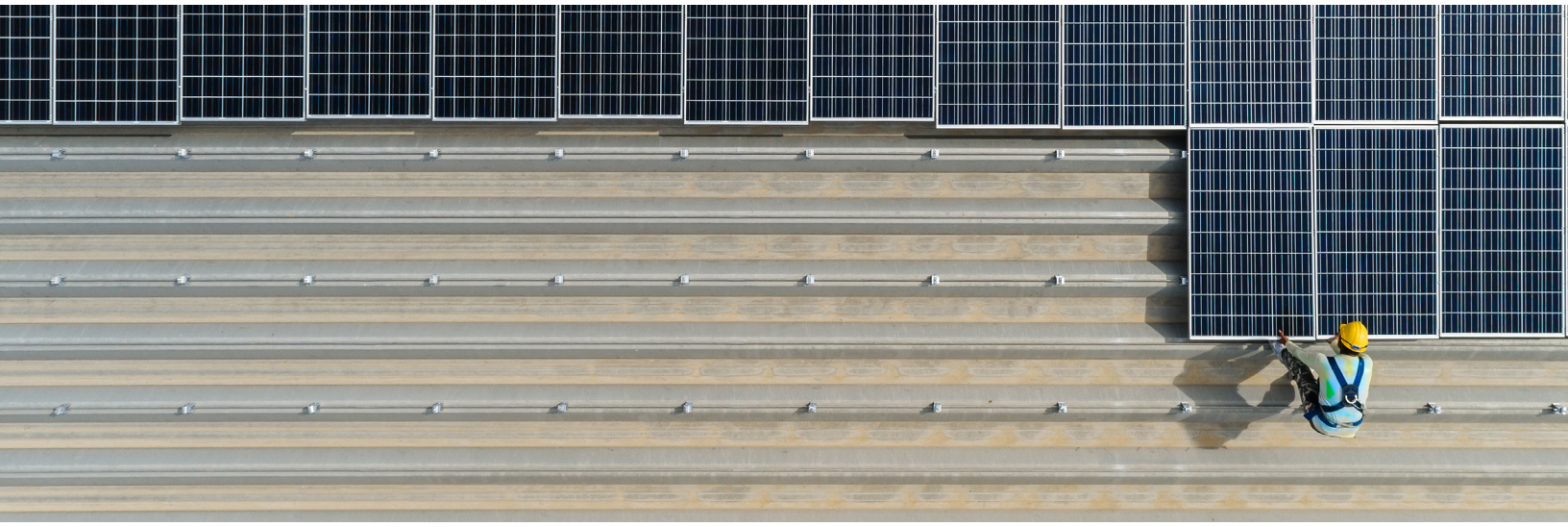
Executive Summary

Achieving economy-wide decarbonization by mid-century is a daunting challenge. It will require technological breakthroughs, the overhaul of long-established and deeply ingrained regulatory and market paradigms, and massive levels of investment across the power sector, transportation, industrial processing, and the built environment. Analysts estimate the cumulative investment required will amount to almost $200 trillion dollars. This translates to an annual investment of more than $6.5 trillion toward the transition each year for the next 30 years,[1] a figure equivalent in scale to the entirety of the current US federal budget ($6.3 trillion in 2022).

On the face of it, it appears that the capital markets have enthusiastically embraced the opportunity presented by decarbonization and have allocated significant resources to tackle the challenge. In recent years, "energy transition" focused investment has grown from $235 billion in 2010 to more than $1.1 trillion[2] as of 2022. This surge in investment has created the perception that the clean energy market is well-capitalized. However, as we will discuss in this paper, the reality surrounding this spending "super-cycle" is more complicated, and headline figures do not capture the nuances of effective, fit-for-purpose capital deployment. Indeed, we will show that in some critical respects, the energy transition faces a significant deficit in capital availability, particularly when it comes to capital targeting difficult to abate sectors.

Achieving real progress on decarbonization requires a massive acceleration in capital deployment over the next decade.

To begin to understand these issues it is important to appreciate that successfully addressing the decarbonization challenge requires more than the deployment of existing clean energy solutions. Economy-wide decarbonization will only be possible through the development and scaled deployment of a broad set of new technologies and commercial models. As such, any discussion related to capital availability to support decarbonization must consider the adequacy of access to such capital across the entire technical and commercial maturity spectrum.



[1]Bloomberg New Energy Finance 2022 Update
[2]Ibid

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At the very heart of the issue is the bifurcation of how capital is deployed across today's energy transition market. At one bookend is "infrastructure" capital. We estimate that across the US and European private markets alone, $75 billion of energy transition-focused infrastructure capital has been raised since 2017, with many multiples of this figure having been raised by public funds during the same period. This capital is looking to be deployed into de-risked clean energy projects at large scale ($100 million+ investments). At the other end of the investing risk spectrum is venture financing. We estimate more than $110 billion of earlier-stage energy transition-focused venture capital has been raised since 2017. It is noteworthy that such enthusiasm exists for this category in the private markets despite previous poor experiences for venture capital in cleantech[3].

While this abundance of venture and infrastructure capital is very welcomed there is also a need for capital focused on supporting companies that have matured out of the venture stage but have not yet scaled and de-risked adequately to access infrastructure-type capital. This growth-stage funding is vital to the successful gestation of those solutions. Unfortunately, despite the more than $50 billion in headline capital raised since 2017 to target this investment stage, the underlying structure of this capital is broadly not fit-for-purpose to support companies entering this critical bridge phase. This issue is further exacerbated by a relative oversupply of early-stage capital and highly concentrated growth and infrastructure pools, with associated implications for company valuations and the broader sectoral focus of capital allocation as a whole.

While the aggregate capital committed to the energy transition today appears impressive, much of this is not aligned to where the market's funding needs are most pressing.

So, while significant quanta of capital are nominally available to support decarbonization efforts, this does not necessarily mean that the practical financing needs of the energy transition are being adequately met. In reality, there is a significant mismatch between the type of capital available in the market and the actual capital needs of the market. The availability of growth equity and first-of-a-kind project capital must be sufficient to support both the technical de-risking and initial scaling of solutions emerging from the venture stage to the point where they are bankable by those deploying infrastructure capital. The deficit of this type of capital in today's market means that critical early-stage technologies will struggle to successfully achieve full-scale deployment. Without sufficient volumes of this vital fit-for-purpose bridging capital in the market, the notion that there is adequate funding available in support of the energy transition is nothing more than a mirage.

[3]Venture Capital and Cleantech: The Wrong Model for Clean Energy Innovation

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The Energy Transition in Context: It's Really a Power Sector Story So Far

Economy-wide decarbonization will require the development, deployment, and scaling of clean energy solutions across a very large number of use cases. However, to date, real progress at-scale has been limited to a few, albeit very important areas. The most important of these being electricity generation and the large-scale deployment of renewables. The availability of cleaner electricity is central to almost every economy-wide decarbonization scenario, and so the wins made there have been heartening and are a key enabler of progress more broadly.

To frame this progress in quantitative terms, reflect on the fact that in 2013 global wind generation capacity stood at ~300GW. Today, a decade later, deployed wind capacity had reached ~900GWs. Achieving a 3X expansion over such a short period in infrastructure-deployment terms is real progress. The story for solar is even more dramatic. Since 2013, global installed solar PV capacity has grown by over 7X, and now stands at just over 1TW. These are big numbers, but still not big enough considering the global coal capacity is more than 2TW and natural gas capacity ~1.75TW, and both technologies typically run at much higher capacity factors than renewables. Fortunately, there is momentum towards further acceleration of renewables. Solar and wind now dominate new generation deployments across the world. In the US, renewables made up 75% of all new capacity deployed over the past decade, and in Europe they accounted for nearly 85%[4]. As such, there is now a feasible path emerging to deep decarbonization of the power sector.

[4]EIA, Bloomberg

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To date, progress on decarbonization has largely been limited to emission reductions in the power sector.

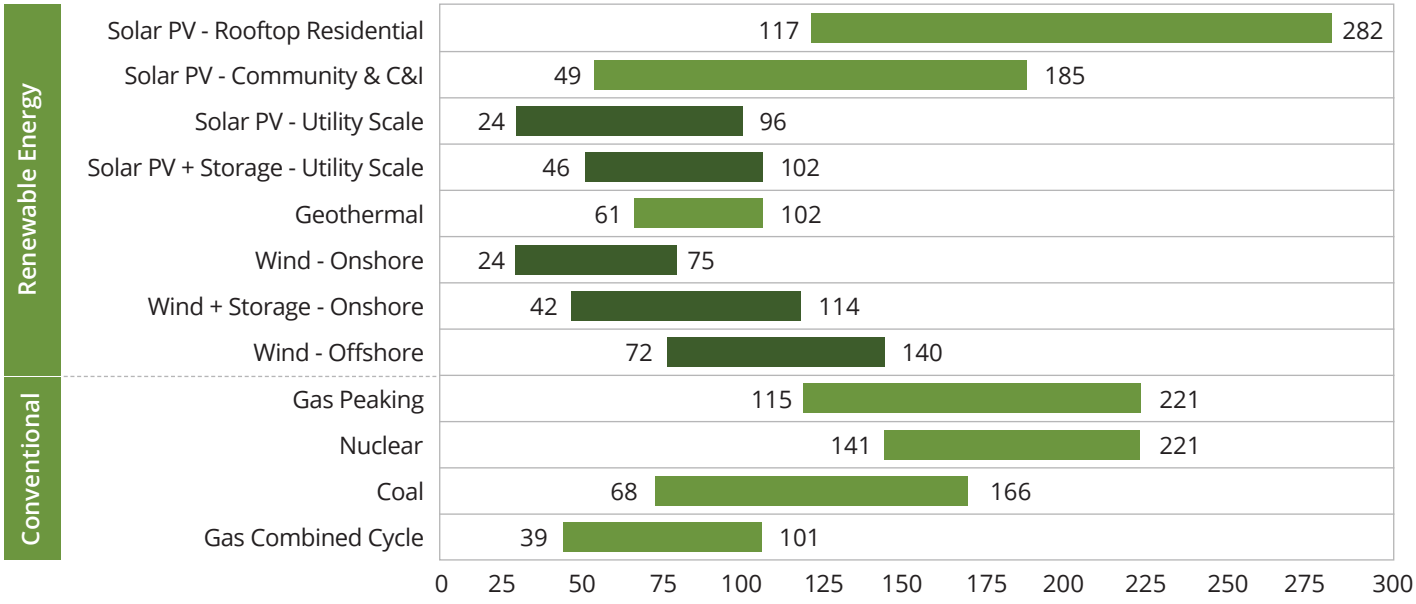
This path to primacy for renewables has been complex; but in large part, the simple reason wind and solar are now so dominant is that they are cost-effective relative to the alternatives. As shown in Figure 1, the unsubsidized levelized cost of energy (LCOE) from onshore wind and utility-scale solar is now equivalent or lower than even the most cost-effective combined-cycle gas plants, making broad decarbonization of power generation economical.

Low-cost capital has been a key enabler of today's very large-scale deployment of renewables. Wind and solar PV have successfully transitioned to become a de-risked, bankable solution, and in doing so they have become a preferred target for those capital allocators tasked with deploying large amounts of infrastructure-type capital seeking secure returns, albeit at lower-yields. In 2022 alone, just under $500 billion was invested into wind and solar PV globally. Approximately $50 billion of this was invested in the US alone, and more than half of this capital came from low cost-of-capital players like pension and infrastructure funds[5]. Consequently, the power sector's energy transition evolution has successfully crossed over from early-stage technology incubation to widespread infrastructure deployment, and we are now on a well-defined glidepath towards large-scale decarbonization.

Wind and solar PV have successfully transitioned to become de-risked bankable solutions that match the investment needs of infrastructure-focused capital.

To date, progress on advancing decarbonization in sectors other than electricity generation has been much more modest and heterogeneous. Major emitting sectors like industrial processing have seen little investment from the private markets relative to their GHG footprint, while other important emitting sectors like transportation have seen investment skew towards certain subsectors. In the case of transport for example, the personal mobility space has been the target of 5X the amount of private market investment than commercial transport since 2017 even though both subsectors account for roughly the same amount of overall emissions (~10% each). Over the same timeframe, private market investors have deployed almost 3X more capital into battery technologies and production compared to upstream mineral production, despite the

Figure 1. Levelized Cost of Power by Energy Source
$/MWh



Source: Lazard 2023 Levelized Cost of Energy+

[5]Bloomberg

latter being a well-documented chokepoint. Understanding all the factors that drive variations in where investment dollars flow is complex; however, investors ultimately focus on where they see value creation opportunities that align with their investing mandates and offer the most attractive risk-return profile. This does not necessarily mean that capital will be deployed where the largest emissions reduction needs are. Indeed, investors will often avoid these sectors owing to their longer-dated, higher-capex, lower-margin characteristics.

The abundance of private market capital nominally focused on the energy transition opportunity is often posited as being a boon for delivering decarbonization. The nuance is that although there is lots of capital available, much of it has little appetite to deploy into the "harder to abate" sectors that hold the key to real progress on decarbonization. Lower-cost infrastructure capital remains largely focused on de-risked power sector opportunities, while earlier-stage venture-orientated investors tend to be focused on areas that are perceived to offer higher-growth, higher-return opportunities. This limits the capital available to solutions where returns are likely to be capped, and technology or business models remain to be de-risked, even when many of these areas are the very ones where the largest emissions reduction potential exists. These dynamics are the result of salient structural features of the contemporary capital markets that we will explore in the following sections of this paper.

Salient features of today's energy transition-focused markets mean that those sectors with the greatest emissions reduction needs are often not the focus of capital deployment.

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The Missing Middle: Issues in Today's Capital Markets

Energy transition opportunities have come into increased focus for the private capital markets, and evidence of this can be seen in the flurry of fund-raising activity over the past number of years. Between 2017 and 2022 almost $300 billion of new energy transition-focused private capital was raised across the United States and Europe. Given this and the very robust energy transition-focused public market activity, it could be reasonably argued that at least a high level the sector is well-capitalized. The reality, however, is somewhat different, and in the following sections we detail features of today's markets that mean they are less than fit-for-purpose for effectively supporting the progress needed to drive the energy transition forward over the coming decade.

The siloed nature of today's capital markets creates a range of barriers to effective progress on the energy transition.

At the heart of the challenge is the siloed nature of capital allocation in contemporary markets. Though we often speak about the energy transition "market" in aggregate, it is a complex collection of funds and capital allocators focused on very different types of opportunities that vary from early-stage venture capital to infrastructure to the public markets themselves. This spectrum of market participants encompasses a wide range in terms of risk appetite and return expectations, investment size, etc. Early-stage energy transition investors tend to focus on unproven technologies and business models that have potential to scale significantly, albeit with a lot of risk.

Infrastructure investors are focused on well-proven assets with stable, albeit low returns. Successful realization of the energy transition requires the ability to support concepts that are successfully gestated in the venture phase and then mature them further to the point where they are adequately de-risked for infrastructure investors. Growth equity investors provide the capital to support this maturation process. Today's energy transition-focused capital markets heavily skew towards either early-stage or infrastructure-focused funds with much less headline capital available for the growth stage. Moreover, the structures surrounding the growth stage funding that is available are not necessarily aligned to the capital needs of companies entering this phase of their businesses. This creates a real funding bottleneck, a "missing middle" so to speak for higher potential, albeit yet-to-be de-risked concepts. Until the markets can better support this growth and de-risking phase, progress on the energy transition will be less than what the scale of the aggregate committed capital would suggest it should be.

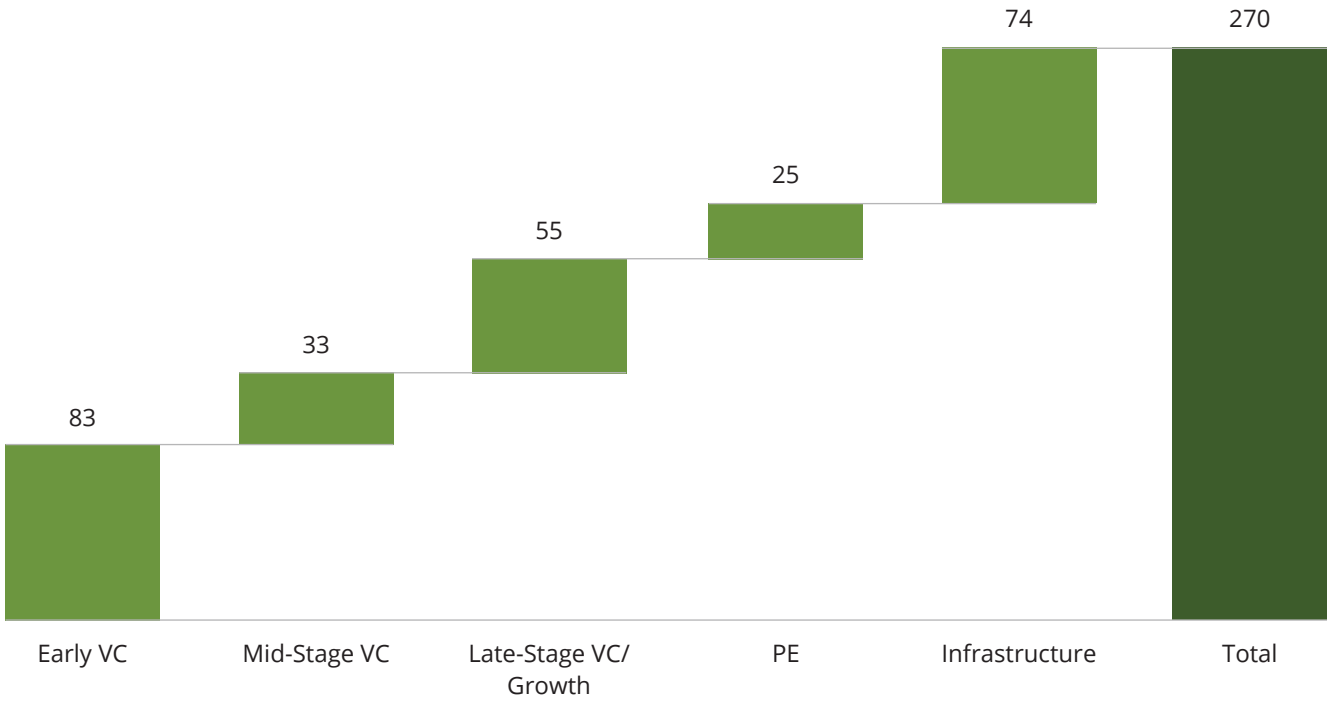
A range of second-order effects flow from this "missing middle" issue, and these only add to the difficulty in successfully maturing concepts from venture through the growth and de-risking phase. These include inflationary impacts on earlier-stage funding round valuations and an over-indexation of capital towards certain segments and business model structures. The following sections will quantitatively address these issues and reflect on how capital market structures must evolve to better support the delivery of the energy transition.

The Well-Capitalized Transition Narrative

Between 2017 and 2022, $270 billion of new energy transition-focused private capital was raised across the United States and Europe. This capital is distributed among funds whose investment mandates span the spectrum from early-stage venture to infrastructure. A breakdown of this capital by target investment stage is shown in Figure 2. Notable in this data is that funds focused on early and mid-stage venture make up the plurality of the capital raised. These funds account for just under $120 billion, or 43% of the total. Infrastructure and private equity funds account for $100 billion, or 37% of the total, while late-stage VC and growth equity orientated funds account for $55 billion or 20% of all the capital raised.

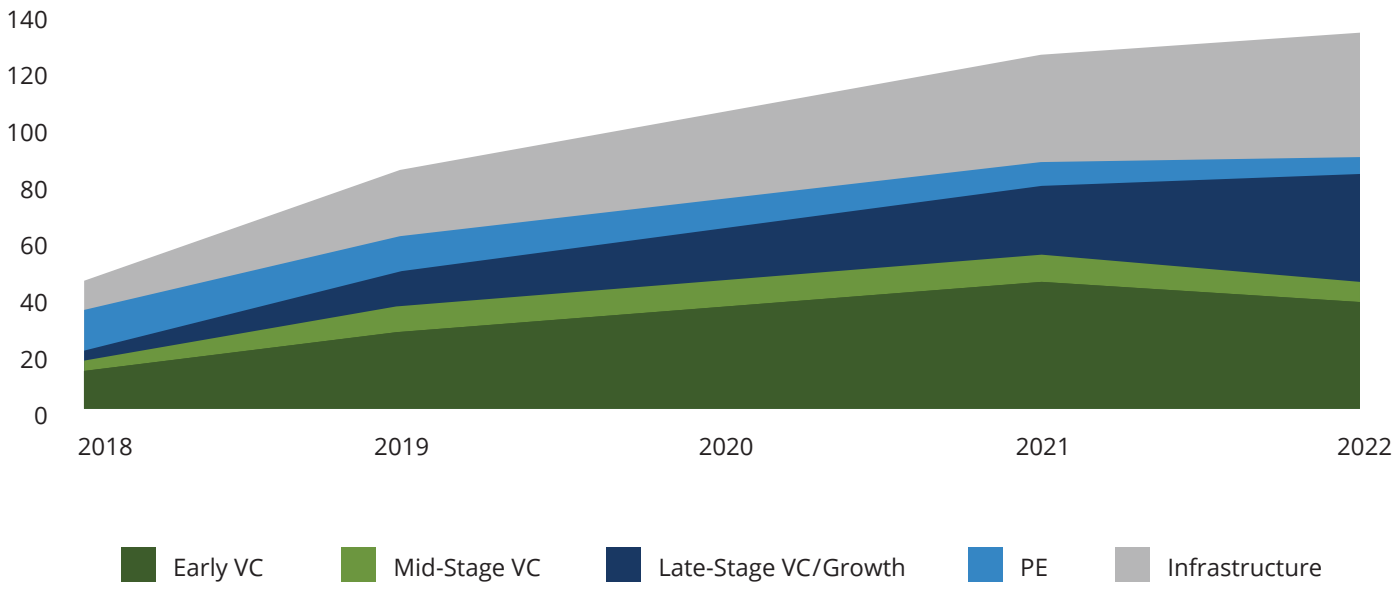
Given the scale of this capital raising activity there remains significant "dry powder" available today for deployment across the market over the next several years. As shown in Figure 3, we estimate that as of the end of 2022 there was at least $140 billion of dry powder available in US and European energy transition-focused private funds. This means that clean energy innovators currently seeking funding should not struggle to find managers with capital to deploy. This could be viewed as a big positive. However, as with the overall mix of capital raised since 2017, this dry powder is largely targeting either early-stage or infrastructure opportunities.

Figure 2. US and EU Energy Transition-Focused Private Capital Raised from 2017-2022 by Investment Stage
$ Billions



Source: S2G Analysis, Pitchbook, Preqin Infrastructure - see appendix for details

Figure 3. Energy Transition Private Capital Available to Deploy Across Stages Annually
$ Billions



Source: S2G Analysis, Pitchbook, Preqin - see appendix for details

Public market interest in the energy transition has mirrored the dynamics seen on the private side. There has been a proliferation of public funds targeting the transition opportunity over the past five years. The number of US-based public market funds with a sustainability focus has quadrupled since 2015, and today these manage over $280 billion[8]. In Europe, where the energy transition opportunity is the subject of even greater attention, there is almost $2 trillion now under management in sustainability-orientated funds across the continent's public markets.

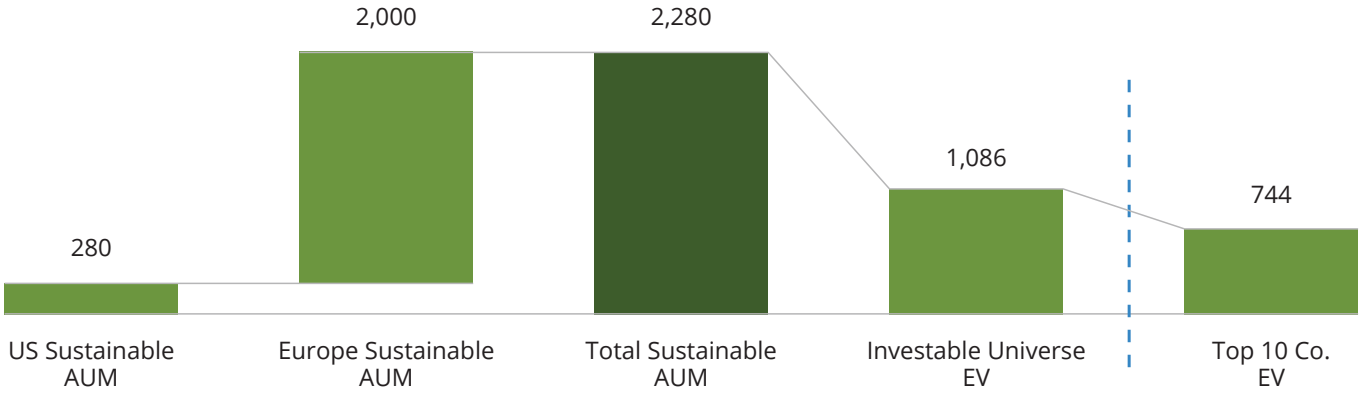
That $2 trillion currently under management in public US and European sustainability-focused funds contrasts with the cumulative $1 trillion enterprise value of the entire S&P North America & Europe Clean Energy Index.

Moreover, the top 10 constituents of this index, typically large-scale electricity utilities, and investment-grade renewables developers, account for 70% of this total. As such there is significant appetite and ample capital capacity in the public markets to invest into new de-risked energy transition companies. The bigger issue, as Figure 4 shows, is that the private markets have to date not proven capable of delivering enough investible opportunities to absorb all the available public capital, which one can argue is a barometer for the capital markets' success in scaling businesses into investable public markets opportunities.

To date, the energy transition-focused private markets have struggled to mature sufficient opportunities to fully unlock the public market's appetite for the category.

[8]Morningstar

Figure 4. Energy Transition-Focused Public Capital Available vs. Market Value of Current Investable Opportunities
$ Billions



Source: S2G Analysis, Morningstar, Bloomberg - see appendix for details

Misalignment Between Capital Availability and Capital Need

As described earlier, perhaps the most significant feature of today's energy transition-focused capital markets that hinder their effectiveness is simply how the aggregate capital is distributed across investment stages. As shown earlier in Figure 2, of the $270 billion clean energy-focused private capital raised between 2017 and 2022, funds targeting early to mid-stage venture accounted for $120 billion, or 43% of the total. Private equity and infrastructure-focused funds raised $100 billion or 37% of the total, while late-stage venture and growth-focused funds accounted for the remaining $55 billion. The bi-modal nature of this distribution means a relative abundance of support is available for early and risky technical innovation and for activity deploying fully de-risked clean energy solutions. However, these two categories do not intersect. Instead, they rely on later-stage venture and growth equity funding to create a commercial bridge between them.

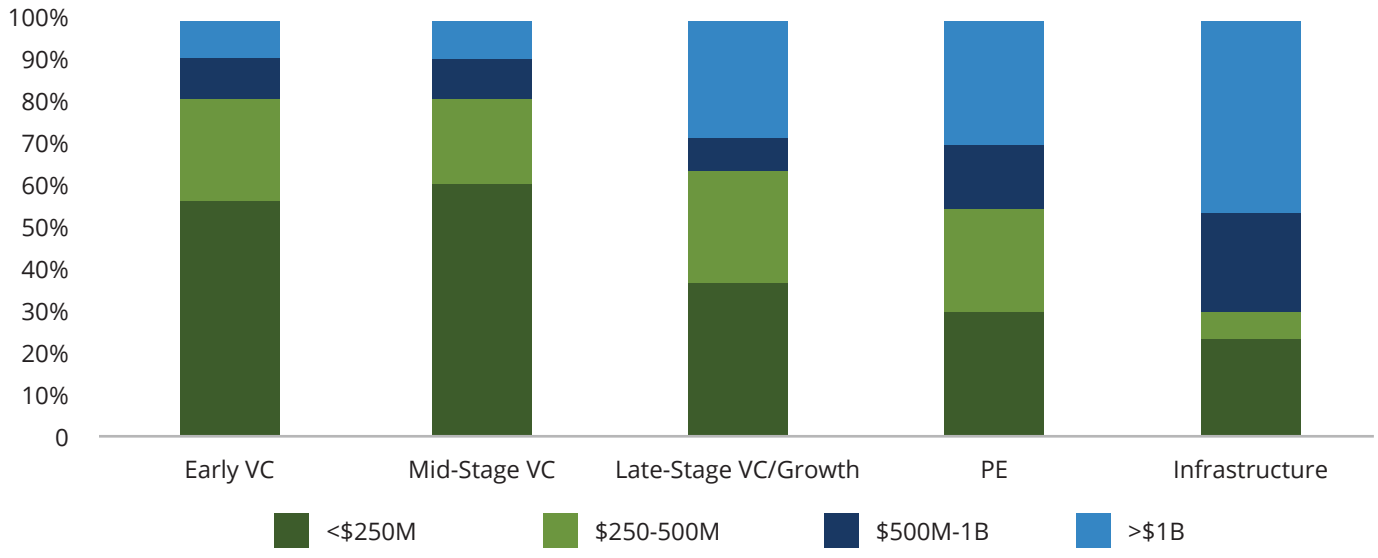
Important insights emerge from reviewing the size of individual funds targeting each stage, and how the aggregate capital is distributed among these. First, regarding the size distribution of each fund, Figure 5 shows that the typical earlier-stage fund tends to be much smaller than a typical infrastructure or private equity fund. In the case of the funds raised since 2017, 80% of all the early and mid-stage venture funds were $500 million or less, and indeed a full 50% were no larger than $250 million. By contrast, significantly more than half of the private equity and infrastructure-focused funds were at least $500 million, and many were greater than $1 billion.

None of this is particularly remarkable, including the fact that the size distribution of growth-orientated funds fell between these two poles. However, re-plotting this same data to illustrate the distribution of total capital controlled by fund size at each stage, as shown in Figure 6, reveals some important added insights. First, it highlights that, except for early-stage ventures, most of the aggregate capital is controlled by funds that are at least $1 billion in size. Again, this is not unexpected for categories like private equity and infrastructure given those funds' business is about scaled capital deployment. However, in the case of the late-stage venture and growth category the concentration of capital in very large funds has important and potentially negative implications. In particular, the dominance of large funds creates practical limitations on the minimum size of checks available to companies at the growth stage. These large growth funds must make larger individual investments to facilitate effective deployment. Given their typical size is more than $1 billion, it can be assumed that these funds have relatively limited appetite for making individual investments of less than $100 million.

This means there is a throttle on capital availability for earlier-stage growth companies that need more modest growth stage checks in today's capital markets. Figure 7 shows an estimate of the aggregate capital available by check size from the total pool of clean energy-focused private capital raised between 2017 and 2022. "Early growth" checks, those in the $25 million to $50 million range, along with those in $50 million to $100 million range, are the least available in today's market despite arguably being the most critical to advancing solutions through early de-risking and initial deployment.

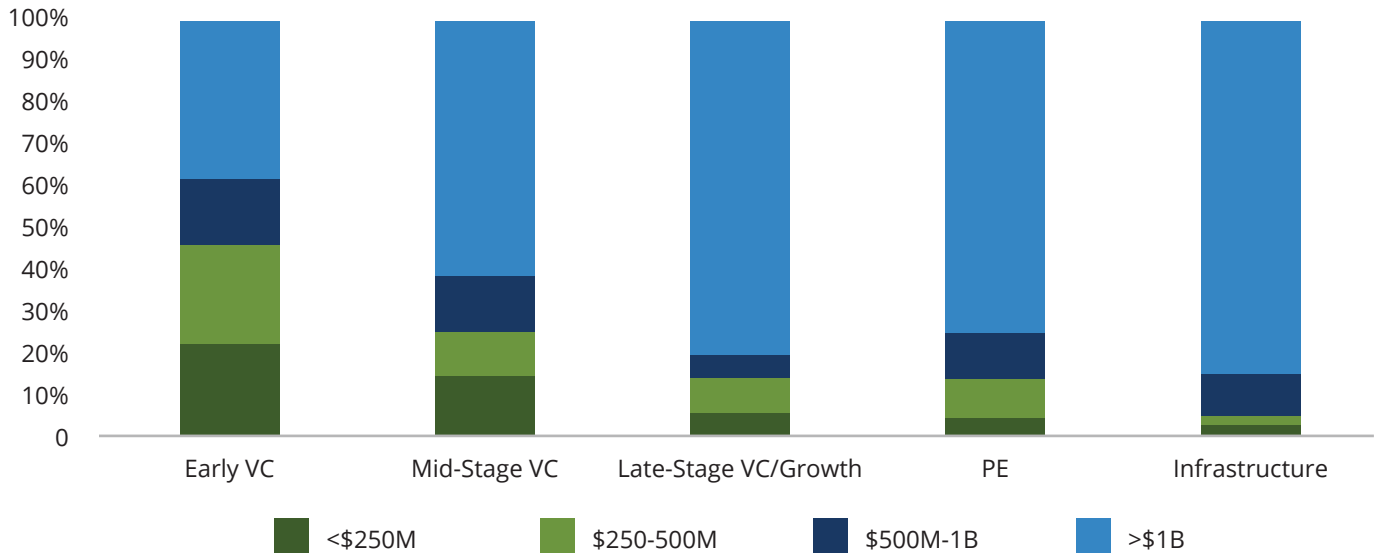
The headline figures on the total number of funds in the energy transition market mask a concentration of capital across a smaller cohort of large funds who need to write larger checks at every investment stage.

Figure 5. Breakdown of US and EU Private Capital Funding by Stage and Size
Percent of Funds by Fund Size Bucket



Source: S2G Analysis, Pitchbook - see appendix for details. Stages as defined in Figure 2

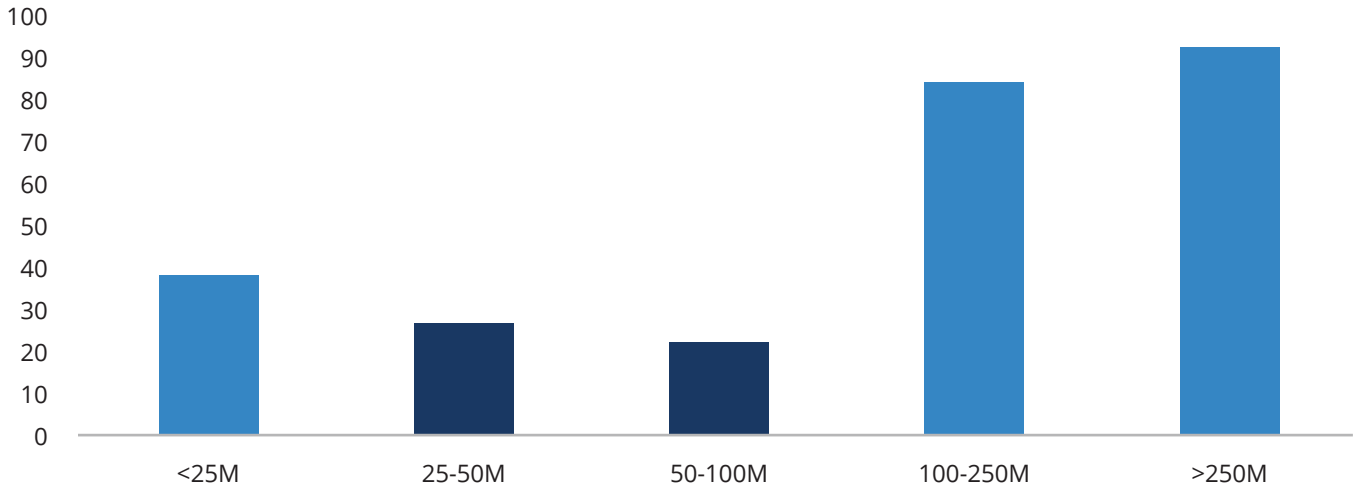
Figure 6. Breakdown of US and EU Private Capital Funding by Stage and Size
Percent of Dollars by Fund Size Bucket



Source: S2G Analysis, Pitchbook - see appendix for details. Stages as defined in Figure 2

We expand on this analysis in Figure 8 which compares the number of available checks with projected demand based on the number of companies expected to seek new private capital investment over the coming three years. This analysis highlights just how significant the "missing middle" issue is. While the analysis highlights a potential surplus of earlier-stage checks, the growth stage (checks in the $25 million to $100 million range) is projected to see a significant deficit in available funding relative to demand.

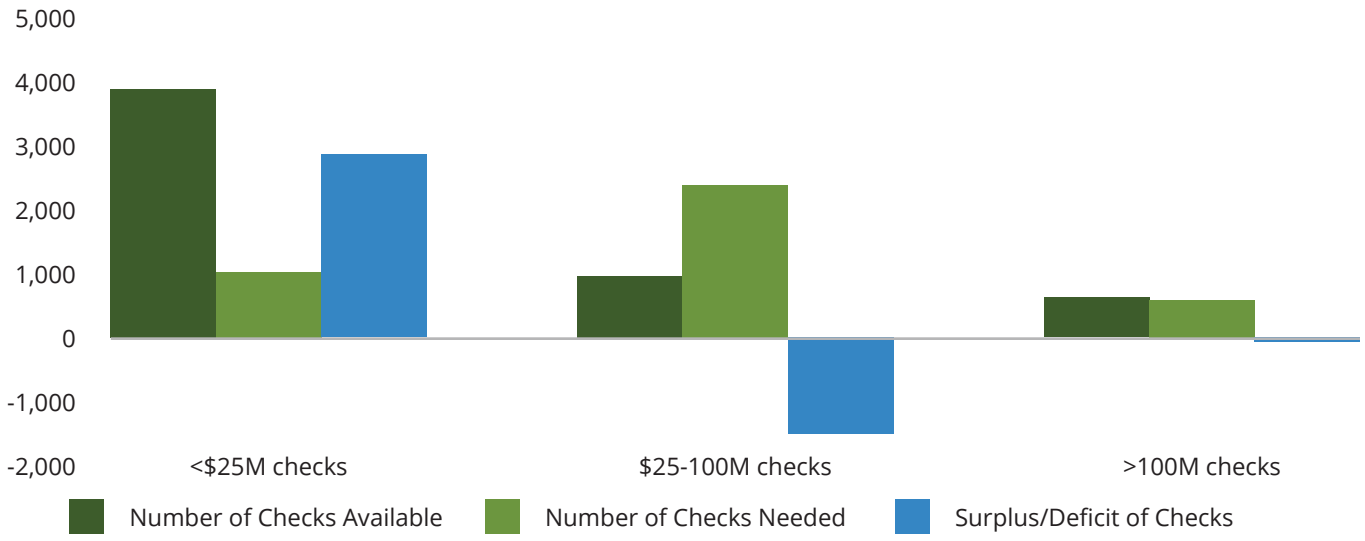
Figure 7. Capital Breakdown by Expected Average Check Size Based on Fund Size
$ Billions; Aggregate Capital Available at Different Check Sizes



Source: S2G Analysis, Pitchbook, Preqin - see appendix for details

As described earlier, realizing the energy transition at scale is both capital intensive and time consuming. We have observed a clear bifurcation in the market where capital is disproportionately distributed to the venture and infrastructure stages to the market. The middle-market "growth" stage, while critical to a company's success, has been relatively overlooked by private market investors to the detriment of true technological progress. Without adequate funding at this stage, many higher-potential innovations, particularly those transitioned from technical development to piloting and first-of-a-kind project deployment, find themselves in a funding "no man's land" between risk-on focused venture funds and infrastructure investors seeking fully de-risked opportunities. No matter how much capital is available to support early-stage innovation, or how much infrastructure investing appetite is out there to deploy de-risked solutions at scale, today's lack of adequate, fit-for-purpose growth equity is a fundamental barrier to realizing the energy transition.

Figure 8. Estimate of Available Investment Checks vs. Checks Needed in the Private Markets
Number of Checks



Source: S2G Analysis, Pitchbook

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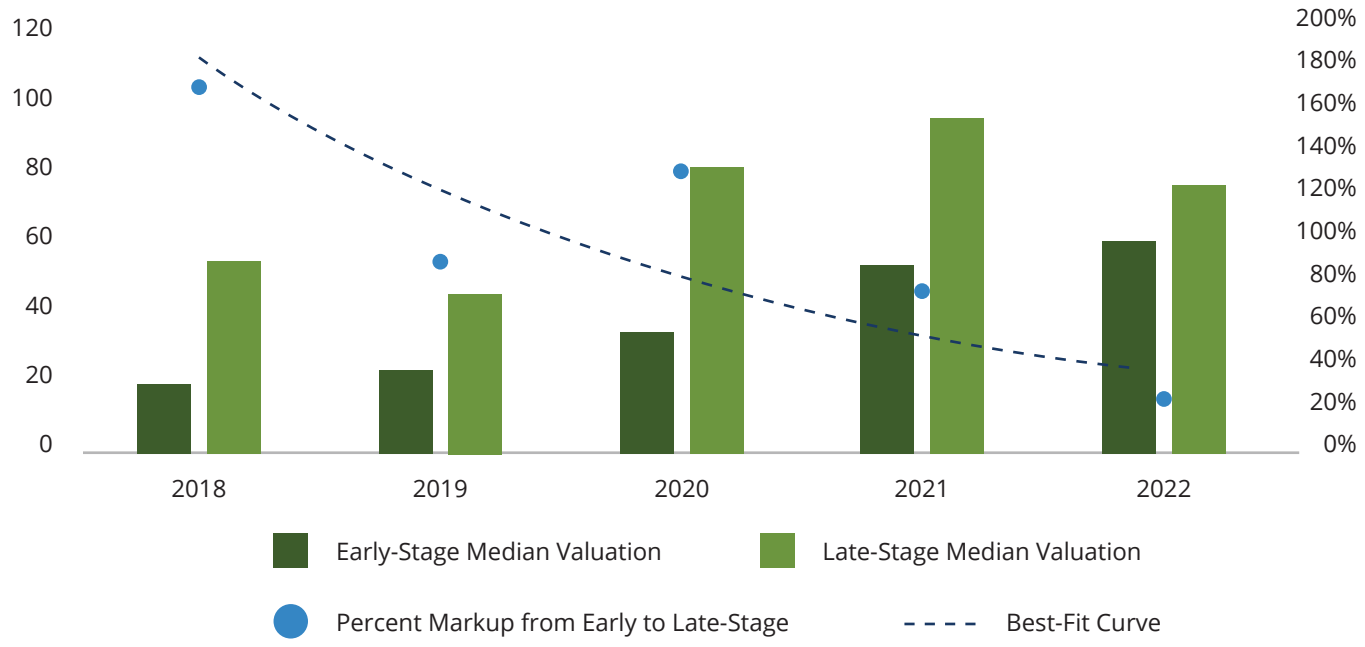
Inflated Early-Stage Valuations Drive Longer-Term Challenges

The lack of growth-stage orientated capital leads to further issues when coupled to the relatively over-funded early-stage and infrastructure segments of the market. For example, the markets' over-indexation towards early-stage venture over the past several years generated significant competition for deals and this has seen the relative valuations of early-stage companies increase dramatically since 2017. Recall that even within early-stage venture, almost 40% of the aggregate capital is controlled by funds greater than $1 billion in size, amplifying the need to deploy capital at scale into new technological innovation.

Over the recent past, the over-capitalization of the early-stage market has yielded valuations that exceed levels that can be supported by long-term fundamentals governing a mature energy market.

As shown in Figure 9, this inflation of early-stage valuations has been most prominent in the past two years, and, as a result, many of these companies have not yet come to raise their growth rounds. Given the bearish market conditions that have emerged across the private markets recently, it is likely that as these companies come to market for their growth rounds, they will struggle to achieve the valuation step-ups that they would have experienced during their earlier venture financings. Moreover, unlike other sectors like technology or consumer, energy transition-focused companies often require multiple growth capital rounds given the capital-intensive nature of their businesses. As such the need to go back to the capital market cannot be avoided and this makes through-cycle valuation management even more important.

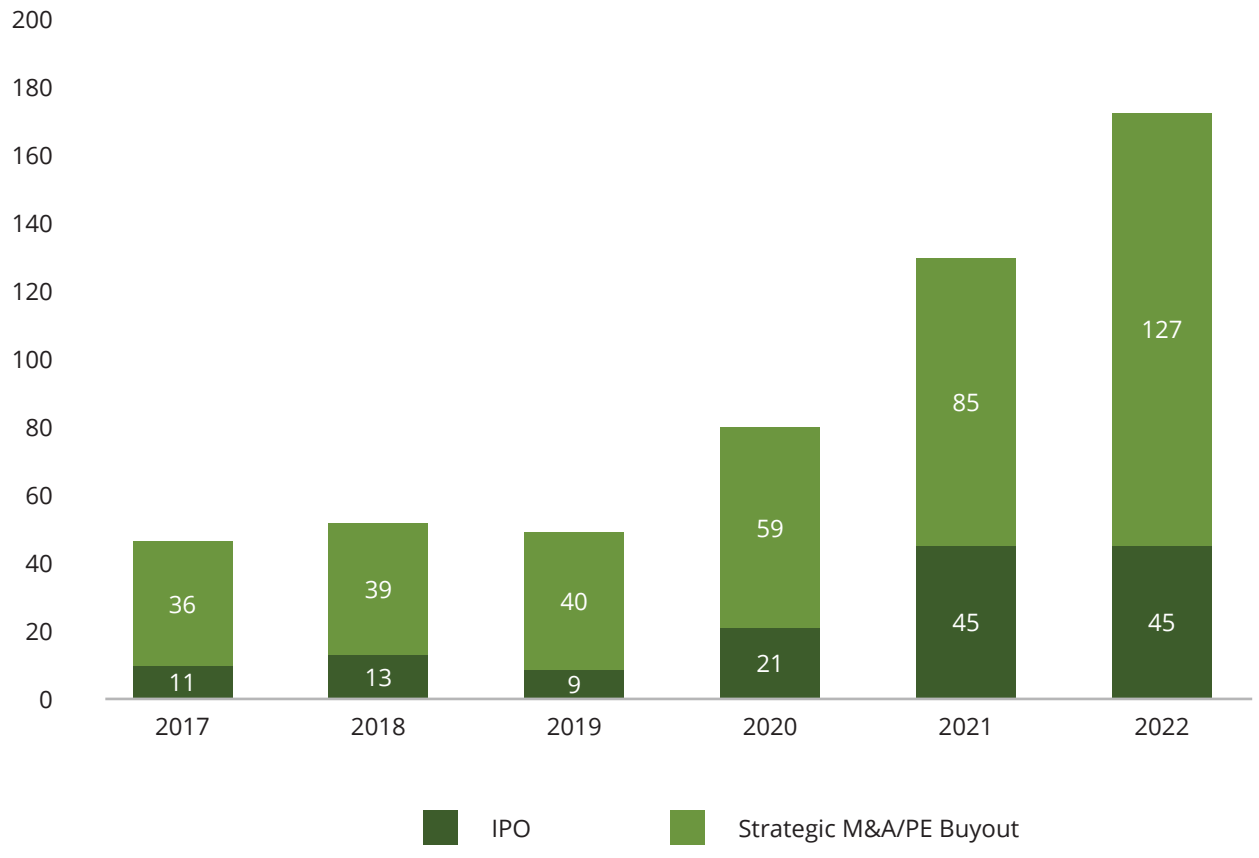
Figure 9. Early vs. Late-Stage Private Market Valuations in the Energy Transition
Pre-Money Valuation ($M) Left-Hand Side; Percentage Markup Right-Hand Side



Source: S2G Analysis, Pitchbook

The negative implications of inflated early-stage values are not just limited to difficulties in achieving a near-term valuation step-up. Many investors seem to overlook the fact that the businesses they are investing in are often much more capex-intensive compared to the broader market, and for the most part compete in margin-constrained, returns-limited, commodity markets without established "high-multiple" exit paths. As shown in Figure 10, despite the popularity of public exit pathways over the past 2-3 years, the primary through-cycle historical exit option for many of these companies is acquisition by an incumbent in the energy sector. These incumbents tend to trade at modest EBITDA-based multiples, and as such their ability to use their stock as currency to make strategic acquisitions is limited. Companies with private market valuations that significantly deviate from the underlying fundamentals that publicly traded energy companies are valued on will likely struggle to secure an exit and may even struggle to secure another round of capital, as the growth stage pool is already limited.

Figure 10. Energy Transition Private Company Exit Paths
Number of Exits



Source: S2G Analysis, Pitchbook

Fund-Level Considerations Shaping Capital Deployment

The energy transition market is a big church and interpreting exactly what is and is not in scope can be difficult. One thing that is clear though is that certain sectors are of greater interest to investors than others and the scale of emissions from these sectors is not necessarily the key determinant of this focus. The $5 billion deployed by private market investors into climate tech software investments from 2020 is a good case study on this dynamic. Software has grown rapidly as a proportion of total energy transition-focused investment in recent years. This is unsurprising – investor experience from Cleantech 1.0 highlighted the attractiveness of higher-growth, asset-light software-based business models relative to capex-heavy, hardware-focused companies with longer development timelines.

Whether or not this focus serves to best advance the urgent need for progress on decarbonization could be the subject of some debate. Of the $5 billion deployed by earlier-stage energy transition investors since 2020, much of the funding flowed to companies developing "mission-critical" software solutions that actively serve to support efficiency and decarbonization across sectors like industrial processing, the built environment, transmission grid optimization, transportation, and critical minerals to name a few. However, other companies receiving very significant funding from these investors might be better described as decarbonization adjacent. The $1 billion invested in emissions monitoring and accounting services likely falls into this category. While these types of products are useful and important, they are not linear vectors for decarbonization. Rather they serve an ancillary purpose within the broader energy transition itself.

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Energy transition-focused investors must grapple with the fact that many of the opportunities they see with the largest emissions reduction potential are also often the most difficult to underwrite. In this world, software solutions with their proven value proposition across industries, their lower barriers to adoption, and their faster sales cycles are often just a more attractive risk-return proposition for an investor. However, software can only do so much to drive progress on decarbonization, and at some point, it will become necessary to ask whether all these opportunities are really moving the needle for the overall effort.

It is also important to acknowledge that investors are often deploying capital based on constrained mandates that are shaped by their limited partners. Many larger generalist investors must manage diversified LP bases with varying time horizons for value realization. To prove the investment case for the energy transition, these funds need to show liquidity events in limited fund cycles to garner additional assets. As asset allocators, pension funds, municipalities, and other LPs are under increasing pressure to show liquidity to their own shareholders; the recent expansion of LP-driven secondary transactions in the current market supports this. This pressure is becoming ever more apparent and may explain investor over-indexation to certain investments categories regardless of their emission reduction potential. While this is a complex topic, we would venture to say that these structural features may be fundamentally "at odds" with the nature of the energy transition writ large, which is, by nature, a long-dated investment cycle.

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Conclusion

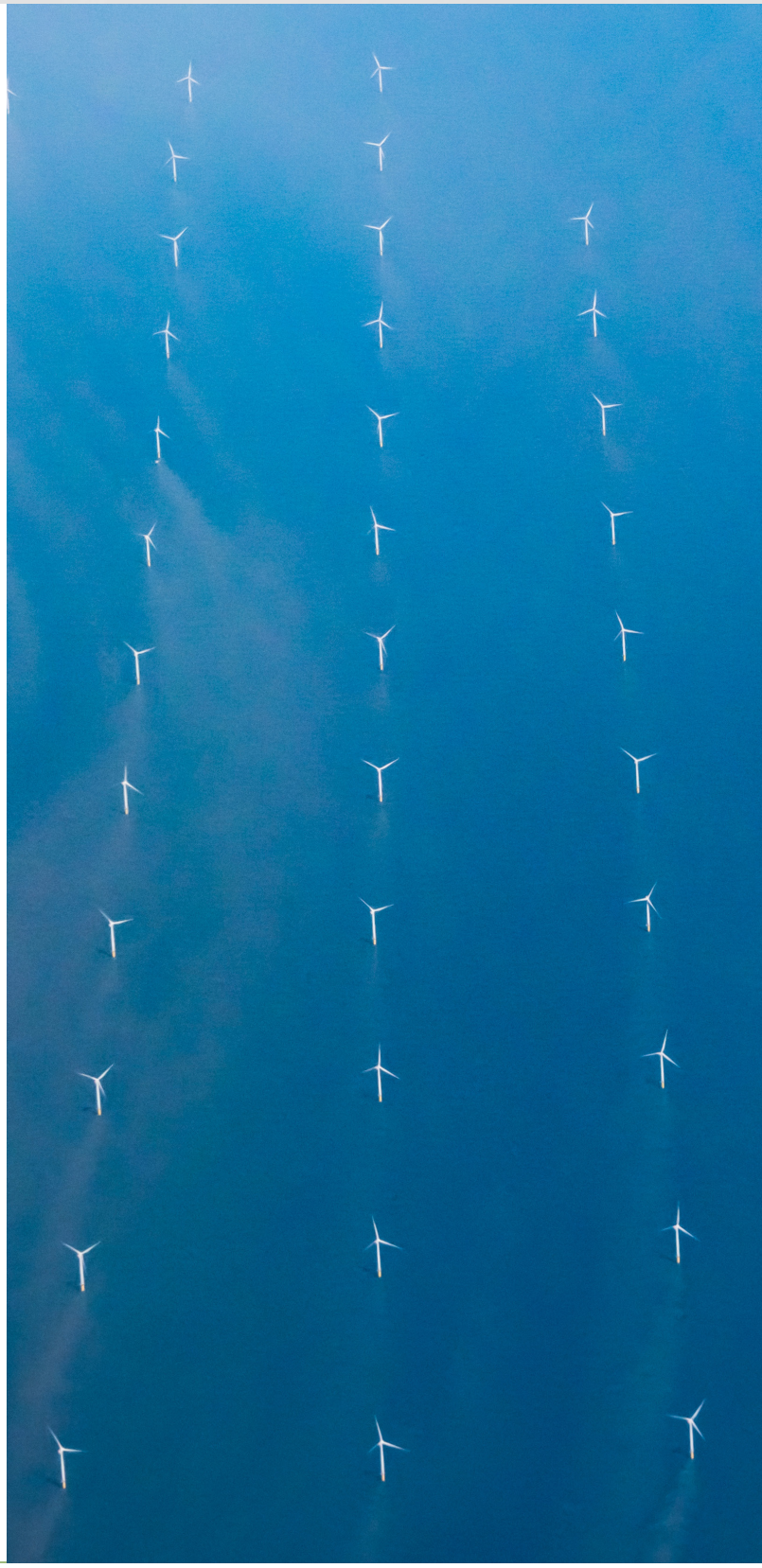
The energy transition is a profound undertaking, and realizing it will require a massive, long-dated, spending "super-cycle." Power systems globally will have to be decarbonized and expanded significantly, and transportation, the built environment, and the industrial sectors will all have to embrace new low and no-carbon solutions. While much more will be needed, some real progress on the delivery of clean electricity has been made over the past decade. Unfortunately, progress to date across other sectors has been much more limited. A major factor in this regard is today's relative dearth of de-risked and cost-effective decarbonization solutions outside of the power sector that can be adequately supported at-scale by lower cost of capital solutions.

Developing and deploying these solutions represents a unique economic opportunity and has spurred enormous interest among investors across the private and public markets. Private markets have a particularly important role to play given their flexibility and capacity to support earlier-stage innovation. Over the past several years, large amounts of capital have flowed into energy transition-focused private market funds targeting this opportunity. At a zero-order level, this is a very positive development. It provides the capital needed to support the innovation, de-risking and scaling of the clean energy solutions that are necessary for the transition to be realized. However, structural features of the private capital markets mean that the full potential of this capital may not be realized. Indeed, today a real risk exists for significant under-delivery on this potential despite the strong headline figures.

The core of the issue with the effectiveness of today's energy transition-focused private capital markets relates to how capital is distributed. Today's market is awash with capital targeting either early higher-risk or late-stage de-risked opportunities. However, the vital growth equity funding needed to bridge these two stages is lacking. Furthermore, of the growth-focused capital that is available, the vast majority sits in very large individual funds whose preferred check size is often much larger than what companies at that stage need. This lack of access to right-sized growth-stage funding is a fundamental risk to progress on the energy transition. It compromises the ability of companies emerging from the venture-backed phase of their development to secure the growth capital needed to scale and de-risk their products to the point where they become attractive to the lower-risk longer-term capital providers that support energy solutions deployment at scale.

Several other features of today's markets further exacerbate the lack of balance in capital availability in today's markets and create an added drag on the energy transition. Across stages, the capital invested in the transition is increasingly concentrated in very large investment fund vehicles. The larger scale of these funds creates a need to deploy larger average check sizes at every stage. One impact of this is the inflation of earlier-stage valuations across the energy transition market over the past several years. Higher early-stage valuations may appear attractive on paper and are certainly positive for the short-term markups for investors, but in practice it can make securing subsequent funding more difficult and can limit exit pathway options. This is especially true in the energy sector which is ultimately a commodity-based market with public-entity valuations being capped by modest EBITDA multiples. Many of today's investors have also deployed heavily into areas that offer more limited absolute emission reduction potential in favor of business models that are asset-light and easier to underwrite. The potential for higher returns and shorter development cycles makes software an attractive category, however, software alone cannot deliver the scale of absolute emissions reductions needed, and if the private market cannot support the gestation of the vital tough tech hardware solutions needed to drive economy-wide decarbonization, some other source of funding will have to be found.

So, to conclude. An assessment of today's energy transition-focused private capital markets highlights a structure that is far from fit-for-purpose. Though capital availability at an aggregate level is not an issue, there are fundamental misalignments across the markets in terms of what that capital is available for and where the capital needs are. This situation creates a set of salient barriers to the acceleration and effective delivery of economy-wide decarbonization. Given the critical juncture the energy transition is now at, prompt action to remedy the limitations of today's market structures is vital. It is feasible that the barriers that currently exist can be significantly lowered or eliminated. However, achieving this will not be trivial. It will require significant investor education, changes to long-standing conventions on how capital is allocated to managers and asset classes, changes to how policy supports for the energy transition are designed, and indeed it may even require changes to how investors are compensated. Ultimately, delivering the energy transition represents a generational investment challenge, and it is one that we must get right to avoid the repetition of past cycles. As a result, fundamental change is needed to build a fit-for-purpose capital markets system to support this transition.



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Appendix/Methodology

Key Data Sources/Methodology for Figure 2

1. Private markets raw data sourced from Pitchbook and Preqin data sets.
2. Pitchbook and Preqin data taken for funds based in the US, Canada, and Europe.
3. We extract the associated fund name, size, number, and vintage associated with these pools of capital and assign based on the pre-determined capital pool name.
4. For generalist infrastructure funds, we assume 15% of all capital will be directed towards energy transition investments.
5. We categorize the data based on a combination of Pitchbook designated stages and our own proprietary analysis.

Key Data Sources/Methodology for Figure 3

1. Private markets data sourced from Pitchbook and Preqin with the same data and categorization used for Figure 2.
2. Dry powder estimates based on a 4-year investment deployment timeline by fund post-initial fund formation.

Key Data Sources/Methodology for Figure 4

1. US Sustainable AUM sourced from Sustainable Funds U.S. Landscape Report 2023 – *Morningstar.*
2. European Sustainable AUM sourced from European Sustainable Investment Funds Study 2022 – *Morningstar.*
3. Cumulative enterprise value taken from all constituents in the S&P North America & Europe Clean Energy Index.
4. Top 10 constituents taken from the largest 10 companies in the S&P North America & Europe Clean Energy Index by current enterprise value as of July 2023.

Key Data Sources/Methodology for Figure 5, 6

1. We use the same classified data set as Figures 2 and 3 for funds raised between 2017-2022.
2. We classify based on sizing (if available) and stage based on our categorization in Figures 2 and 3.
3. For Figure 5, we take the absolute number of funds by category to calculate distribution to show the number of active funds per sizing bucket across each stage.
4. For Figure 10, we take cumulative amount of capital raised per designated stage and calculate distribution by size to show aggregate capital controlled by each sizing bucket across each stage.

Key Data Sources/Methodology for Figure 7

1. Same underlying data set as Figures 2 and 3 for funds raised between 2017-2022.
2. We assume size of funds correspond to average check size written based on existing empirical knowledge of private markets investing.
3. For example, we deduce that <$250mm funds write checks <$25mm, $250-500mm write checks of $25-50mm, and so on through the sizing buckets.
4. We then pool capital based on this to show how many funds are writing check sizes in each designated bucket.

Key Data Sources/Methodology for Figure 8

1. We take energy transition companies in US, Canada, and Europe that have raised private capital over the last 3 years from Pitchbook.
2. We then assume these same companies will be re-entering the private markets for funding in the future unless they are no longer active companies.
3. Based on their previous round, we then calculate what implied "stage" of check they are likely to be needing in their current/upcoming funding round.
4. For example, a company who raised a Series pre-seed, seed, or A will likely raise another early-stageround and so on through the designated stages of capital We assume these stages are correlated with overall check size needed.

Key Data Sources/Methodology for Figure 9

1. Data from Pitchbook on early-stage and late-stage VC investments in energy transition using the "climate tech" filter available on the database. We then review the output of this dataset and cleans it as needed.
2. Median pre-money valuations taken from data set and "markup" taken as the percentage difference between the two medians.

Key Data Sources/Methodology for Figure 10

1. Data from Pitchbook on "climate tech" exits by year, categorized between strategic M&A and private equity buyout versus public market offering. We then review the output of this dataset and cleans it as needed.

About S2G Ventures

S2G Ventures, partners with entrepreneurs working on solutions to some of the world's greatest challenges across the food, agriculture, oceans, and clean energy markets. We provide capital, mentorship, and value-added resources to companies pursuing innovative market-based solutions that generate positive social, environmental, and financial returns. S2G provides our partners with flexible capital solutions ranging from seed and venture funding through growth equity to debt and infrastructure financing.

To discuss the Clean Energy Transition further, contact us at s2gventures.com/contact-us.