

**Seeking
Singularity**

Q4 and Full Year Report 2021



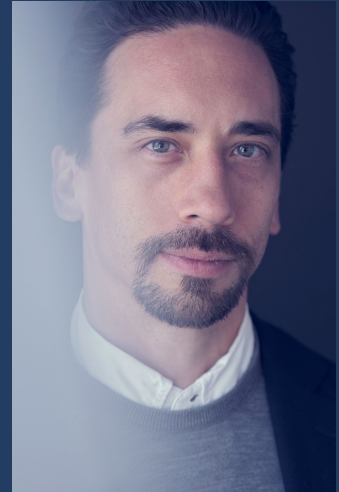
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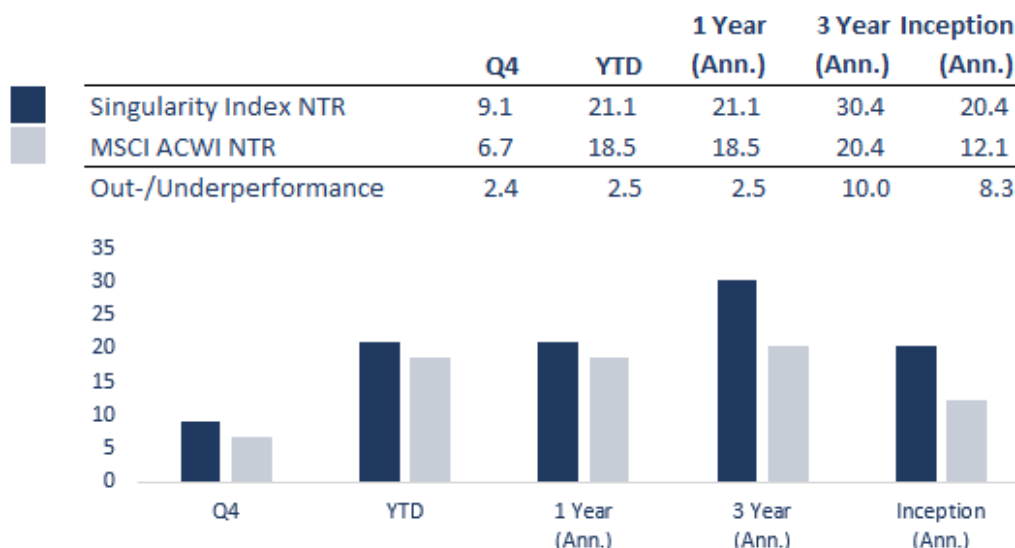


HIGHLIGHTS

- **The Singularity Strategy finished 2021 with AUM exceeding \$100M and a gross return of 21.1%**, an outperformance of 2.5% vs the global benchmark MSCI All Country World Index (MSCI ACWI). Performance attribution was entirely driven by security selection from a factor perspective. Top performing sectors for the year were Virtual Reality, Internet of Things and Artificial Intelligence. As markets continued to trend higher – and value and cyclical sectors made a comeback – our applied innovation approach held up well in comparison, **outperforming both value and growth indices on a global all-country basis over the year.**
- **In the fourth quarter, the Singularity Strategy posted a return of +9.1%** vs the global benchmark which had a performance of +6.8% during the same period. The top performing sectors were New Energy, Internet of Things and Virtual Reality. **Since inception** on Dec 21, 2017, the Singularity Strategy has delivered a cumulative return of **+111% and approximately 20%** on an annualized basis, compared to the MSCI ACWI with a cumulative return of +59% and 12% annualized. Artificial Intelligence, Virtual Reality and Big Data account for the biggest historical contributions to overall returns.
- **Singularity Small & Mid**, which comprises the top 100 innovation companies within the \$1bn to \$25bn market cap range, **posted a gross return of +2.1% for the final quarter of the year and +10.4% since launch on May 10, 2021** (vs +7.8% for the MSCI ACWI). In the backtest based on live data, the strategy is up +106% since inception.
- **On November 19, 2021 the Singularity Index was rebalanced** in accordance with the semi-annual rebalancing cycle. A total of 49 names have been replaced in the index. In terms of portfolio weights, 6% of the index have been replaced with entirely new positions. The weighted Singularity Score increased from 79% to 82%, compared with 29% for the MSCI AC World. **The biggest sectors in the index post rebalancing were Virtual Reality, Artificial Intelligence and Big Data** with allocations of 20.6%, 20.1% and 17.9% respectively. Roughly half of the portfolio is allocated outside of the technology sector. **The rebalanced portfolio continues to exhibit a strong growth and profitability profile, coupled with strong balance sheet and liquidity metrics.**
- **Sector Focus New Energy: New energy systems are at the center of technological convergence.** Looking beyond renewable energy solutions such as wind and solar, we find a host of technologies in the New Energy value chain including sensors, software, storage solutions, control valves and upcycling of waste to energy that enable and support the transition to a sustainable energy future. We uncover some of the leading innovators in this space: VAT Group, SolarEdge, Belimo and Stem.



Historical Performance (%) per December 31, 2021



SINGULARITY IN THE SPOTLIGHT

In the press:

- We've been approached by the press to make statements on the Metaverse once more. [NZZ](#) and [Manager Magazin](#) both quoted our CIO Gregory Hung on the subject.
- [Institutional Money](#) featured our [3-year track record success story](#) – headlined “The Singularity Fund successfully invests in applied innovation” – and also wrote about our [bi-annual rebalancing](#).
- To keep up with current coverage on TSG, please [visit our website](#).

What's next:

- In our next **Seeking Singularity Quarterly Live Webinar**, [Evelyne Pflugi](#) and [Gregory Hung](#) will dive into one of our Singularity Sectors: New Energy. In fact, they will draw your attention away from the obvious and towards the underlying real evolution: the enabling technologies that converge to power the [#energy](#) transition. They'll also take a brief look back on a successful 2021. [Register here](#) and mark January 25th at 3.30 CET in your calendars.
- **Evelyne Pflugi and Gregory Hung will both be panelists at the upcoming Swiss Alternative Investments Forum** on January 27. [All details can be found here](#).
- We are hosting an **exclusive Art & Innovation Breakfast Talk** at our office on February 1, 4 and 11. We limit every event to 5 guests and have very few spots left. If you are interested, please reach out to Dita Bunjaku: db@singularity-group.com.
- We are currently conducting a **global innovation survey**. At this point, we can't reveal much, so stay tuned for more.



What happened:

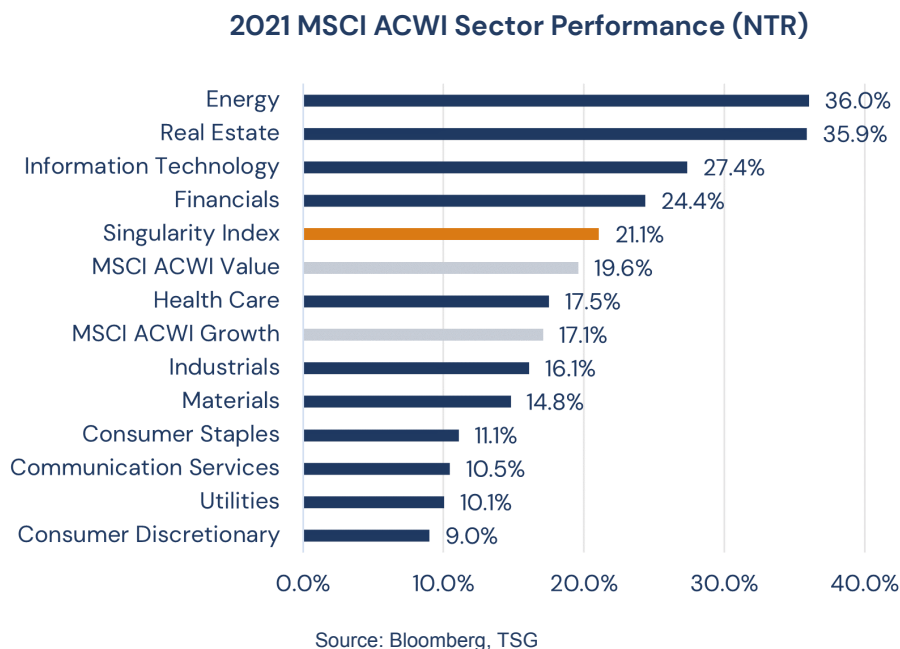
- We **exceeded the 100mm AUM milestone** at the turn of the year.
- Evelyne Pflugi and Gregory Hung have been busy speaking. Greg participated in Swissquote's Trading Day and Evelyne spoke at the **Richmond PIMS Forum** in Bad Ragaz and **at Zurich's first Noah Conference**.
- Our latest **blog posts** created quite some attention:
 - "The Metaverse is Flat. Not."
 - "How Innovative are Global Equity Indices?"
- Our **monthly Greg Cast** continues to be a popular video format that we distribute once a month. You can find all episodes also on our YouTube channel.





SINGULARITY PERFORMANCE – 2021 REVIEW

The last twelve months were to some extent a continuation of the preceding year. We continued to grapple with the coronavirus and its variants and their effect on the economy, society, and the way we work and live. Fiscal and monetary policy remained supportive, global GDP continued to recover and stock markets trended upwards to new all-time highs in most major markets driven by earnings growth, the big exception being China. But whereas in 2020 growth and stay-at-home stocks clearly had the upper hand, 2021 turned out to be more balanced with both growth and value stocks ending the year around very similar levels albeit with very different trajectories. Especially during the first quarter, an inflation scare sent the former stocks lower. As long-term bond yields eased subsequently, so did value's outperformance.



Some cyclical sectors, in particular energy and financials, posted respectable returns for the year on the back of higher yields and rising energy and commodity prices. At the same time the tech sector continued to do rather well throughout the year underpinned by continued solid earnings dynamics. **The big laggards in 2021 were largely unprofitable hyper-growth stocks which had experienced an unprecedented run-up during the previous year as some investors sought risk in tech and biotech.** A good illustration of this cohort is given by the Goldman Sachs Non-Profitable Tech Index, which consists of non-profitable US listed companies in tech and new economy companies across GICS industry groups. It more than doubled in 2020 but was down by -21% last year with a drawdown of close to -40% at the end of the year.



Goldman Sachs Non-Profitable Tech Index



Source: Bloomberg, TSG

A more consistent way to profit from innovation: With a focus on applied innovation, the Singularity Strategy seeks out innovation leaders that successfully harness technological innovations in their product and service offering. As such, companies in our portfolios are not only at the forefront of today's value-driving innovation and well-positioned to take advantage of future opportunities, they are also highly profitable. The degree of innovation, also known as the Singularity Score (SC), measures companies' revenues from innovative products and services. **By design, companies in the Singularity Strategy have higher Singularity Scores compared to ones in the global benchmark.** The average weighted Singularity Score for the Singularity Strategy at the end of 2021 was 82% – an increase of 17 percentage points compared to 1 year ago. This compares to 29% (+7pp) for the MSCI ACWI.

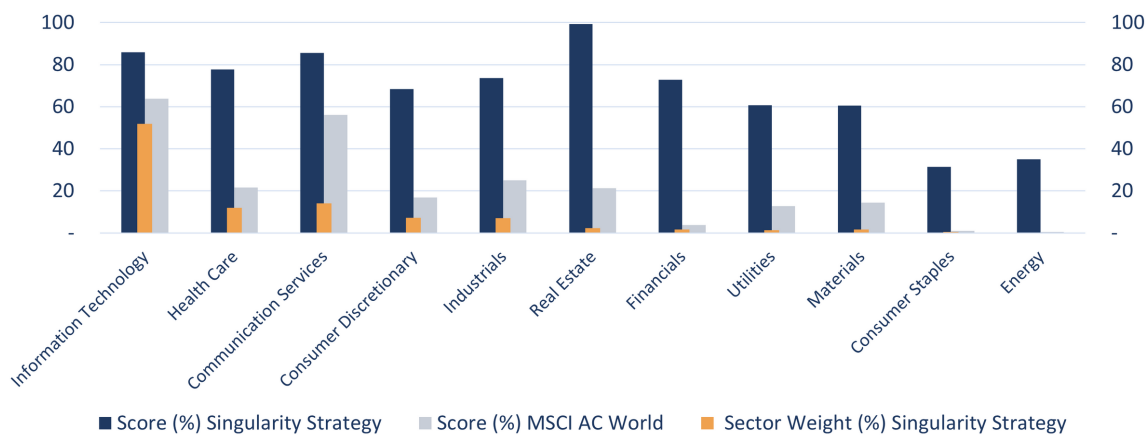
The Singularity Score



A company's Singularity Score represents the percentage of its revenues associated with innovation. It is a reflection of a company's ability to create innovation vs base/commoditized business and cash flows, and its ability to participate in technological evolution. Changes in the Singularity Score are just as important as the absolute value. A Company's Singularity Score **relative to its overall GICS sector Singularity Score** can say a lot about the companies competitive standing and ability to gain and maintain market share. **Regional Singularity Scores** can be used to evaluate the innovation power of markets as well as gauge companies' standing in different regions.



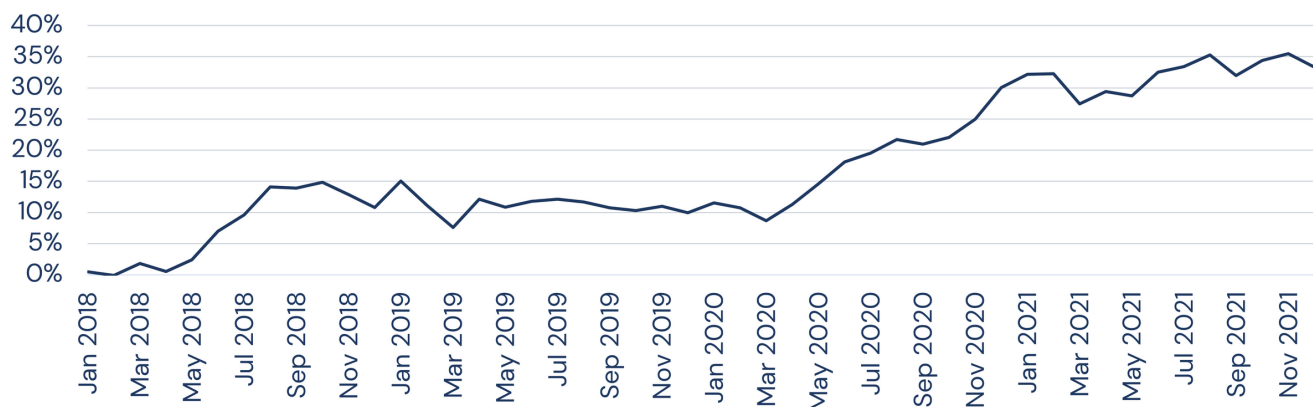
Singularity Score by Sector per end December 2021



Source: Bloomberg, TSG

Investing with innovation winners has provided handsome payoffs in the past. While innovation's outperformance is certainly not a linear affair, it is our firm belief that over time innovative companies will continue to win. In 2020 innovation leaders, as measured by our Singularity Score, strongly outperformed the market. In 2021 the trend continued though was less pronounced as some cyclical industries experienced relative strength on a 'recovery trade'. That said, **on a sector-neutralized basis, companies with higher Singularity Scores have historically outperformed those with lower ones.** The below chart shows the outperformance of the top 2 Singularity Score quintiles vs the bottom 2 quintiles based on a broad global equity universe. Score quintiles are determined on a sector-neutralized basis so as to compare apples with apples. For the purpose of this analysis, portfolios are equally weighted and rebalanced monthly. Since inception of our investment methodology more than 4 years ago, higher rated companies have outperformed lower rated ones by nearly 35%.

Outperformance (%) of Top 2 Quintiles Singularity Scores Minus Bottom 2 Quintiles Singularity Scores (Sector-Neutral)



Source: Bloomberg, TSG



Singularity Index vs. benchmark: In 2021 the Singularity Strategy posted a net total return of +21.1%, outperforming the MSCI AC World Index (MSCI ACWI) which was up by 18.5%. **Importantly, strategy assets exceeded \$100M at the end of the year.**

During the first quarter, a spike in bond yields on the back of improved reopening prospects coupled with inflation angst led to relatively strong performance of previously weak value names and cyclicals resulting in an underperformance of the portfolio vs the benchmark. In the second and third quarter, continued strong portfolio company earnings and a shift in the bond market's perception of longer-term inflation to a more benign outcome fueled portfolio returns.

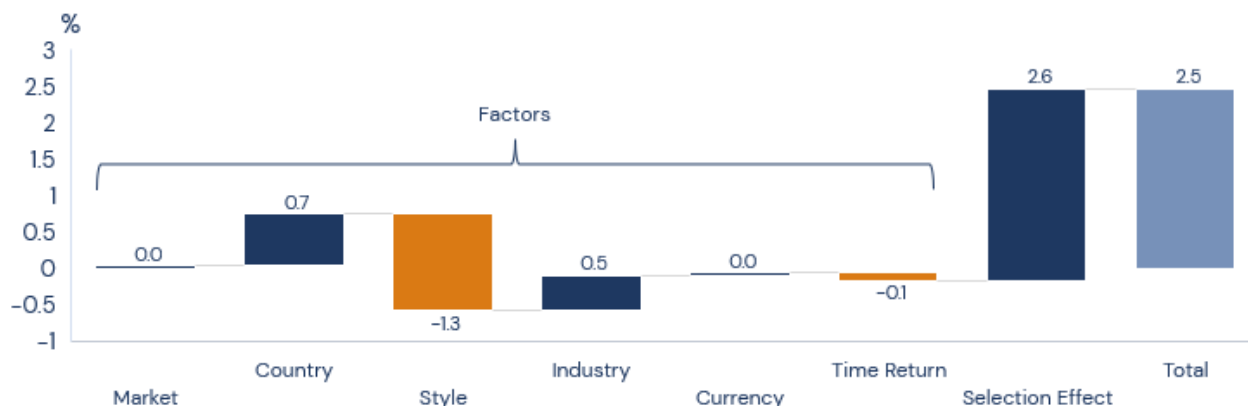
As fundamentals were more appropriately weighed by markets, high quality and healthy businesses with strong cash flows and growth outlooks were rewarded. By the end of the third quarter the portfolio had levelled its slight initial underperformance. During the fourth quarter it built a lead vs the benchmark to close out the year with an outperformance of 2.6%. This occurred against the backdrop of a bear-flattening yield curve in the US as the Fed began to taper its monthly bond purchase program in December.

Singularity Sectors: The top performing Singularity Sectors for the year were Virtual Reality (+42.2%), Internet of Things (+24.9%) and Artificial Intelligence (+23.4%). Blockchain (-13.5%) and Neuroscience (-5.3%) were the only two sectors that finished the year in negative territory.

Top Contributors: Nvidia (NVDA US, Singularity Score [SC]: 100) was the second best performing stock in the portfolio for the year and the biggest contributor with a contribution to return of 3.6%. Tesla (TSLA US, SC: 89) had the second highest contribution (+2.5%), followed by Alphabet (+2.3%, GOOGL US, SC: 87), Microsoft (1.9%, MSFT US, SC: 61) and ASML (+1.9%, ASML NA, SC: 100). The largest detractors from performance were Tencent (-0.5%, 700 HK, SC:), Orsted (-0.3%, ORSTED DC, SC: 67), and Alibaba (-0.3%, 9988 HK, SC: 13).

Performance Attribution: The Singularity Strategy generated a gross outperformance of 2.5% for the year driven by security selection effects. Factor attribution was flat overall: country and industry factors had positive effects while equity style factors had negative impacts on the active return. In terms of style factors, it was mostly underweights in value, dividend yield and leverage that proved detrimental to last year's performance. While the overweights in profitability, growth and momentum contributed positively they were not able to offset the former effects. In terms of country factors, relative overweights in the US, Netherlands and Taiwan contributed positively while the overweight in China detracted from performance.

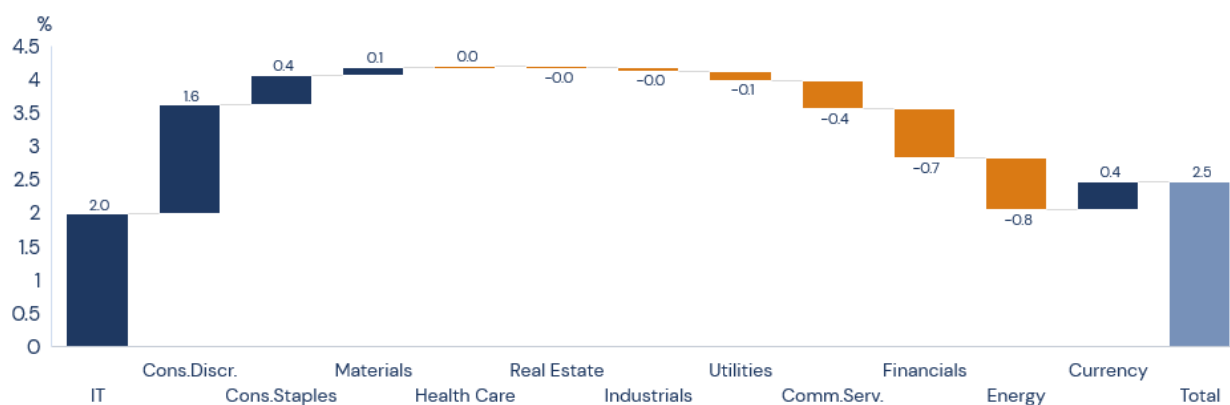
2021 Performance Attribution by Factor



Source: Bloomberg, TSG

From a GICS sector perspective, sector allocation (+3.1%) and currency (+0.4%) contributed positively, while security selection (-1.1%) was slightly negative. Approximately half of the GICS sectors contributed positively to the outperformance, namely Information Technology (+1.9%), Consumer Discretionary (1.5%), Consumer Staples (+0.4%), Materials (+0.1%) and Health Care (+0.02%). The largest negative contribution came from Energy (-0.7%) and Financials (-0.7%), two sectors which are underrepresented in the portfolio vs the benchmark. The strategy outperformed in North America and Europe with attributions of +1.9% and +0.6% respectively, and slightly underperformed in Asia Pacific with a small negative attribution of -0.2%. Security selection was positive in all major regions.

2021 Performance Attribution by Factor



Source: Bloomberg, TSG

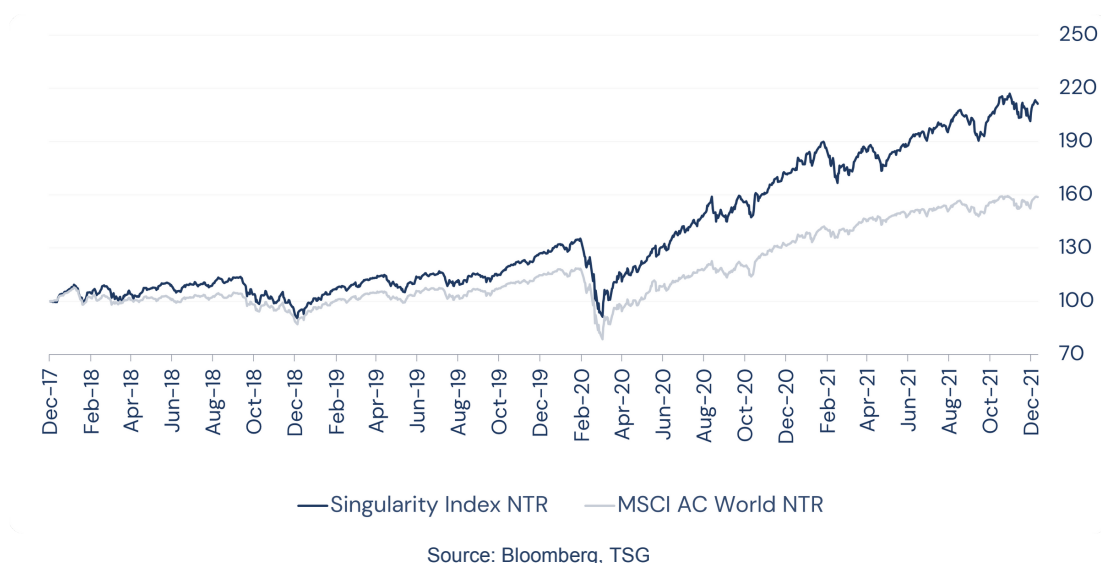
Singularity Stocks: The top performing stocks for the year in terms of absolute performance were Fortinet (+142%, FTNT US, SC: 100), Nvidia (+125%, NVDA US, SC: 100), Gartner (+109%, IT US, SC: 88), Arista Networks (+98%, ANET US, SC: 100) and Lasertec (+89%, 6920 JT, SC: 100). The latter two companies have been top holdings in our Singularity Small & Mid Strategy.



SINGULARITY PERFORMANCE – SINCE INCEPTION

Since inception on December 21, 2017 the Singularity Strategy is up by 111.3%, an outperformance of +52.6% vs the benchmark.

Performance Since Inception: Singularity Index vs. MSCI ACWI per end of December 2021 (indexed)



Singularity Sectors: The top performing Singularity Sectors since inception were New Energy (+405.5%), Virtual Reality (+221.7%) and Artificial Intelligence (+165.4%). Blockchain (-4.8%), Space (+20.7%) and Neuroscience (+26.8%) recorded the smallest total return. The biggest contributions to total return over the last 4 years came from Artificial Intelligence, Virtual Reality, and Big Data.

Singularity Sector Performance and Contribution Since Inception

		Average Weight (%)	Performance (%)	Contribution (%)
AI	Artificial Intelligence	20.0	165.4	27.8
VR	Virtual Reality	5.7	221.7	16.9
BD	Big Data	8.9	100.5	15.6
IOT	Internet of Things	8.1	103.4	12.5
NE	New Energy	3.5	405.5	12.1
BI	Bioinformatics	7.6	83.0	8.4
RO	Robotics	7.7	65.1	6.0
3DP	3D Printing	4.6	74.7	4.0
AM	Advanced Materials	2.9	40.5	1.9
NS	Neuroscience	2.5	26.8	1.0
BC	Blockchain	0.2	-4.8	-0.1
SP	Space	4.1	20.7	-2.9
Total		100.0		103.2

Legend: AI (Artificial Intelligence), VR (Virtual Reality), NE (New Energy), BD (Big Data), IOT (Internet of Things), RO (Robotics), BI (Bioinformatics), 3DP (3D Printing), AM (Advanced Materials), BC (Blockchain), NS (Neuroscience), SP (Space)

Source: Bloomberg, TSG

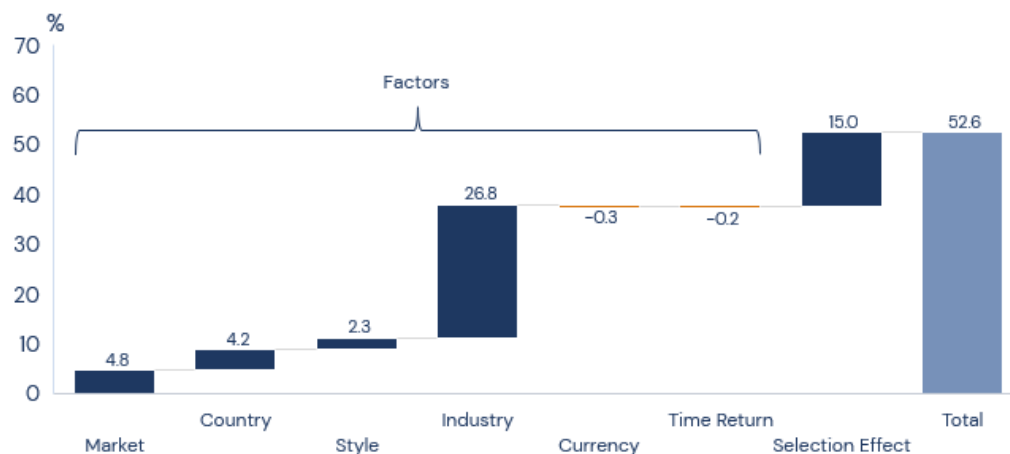
Top Contributors:

The portfolio was generally well-diversified. The largest position over the period was Microsoft with an average weight of 3.2% and a contribution of +7.3%. The second largest position was NVIDIA (3.0%), also the second best contributor (+10.9%). **Tesla accounted for the biggest performance contribution (+13.7%) on an average weight of 2.4% with a performance of +1493%.** A bit more than half of the top 20 contributions came from the tech sector, approximately a quarter from consumer discretionary, and the rest from communications services and healthcare.

Performance Attribution:

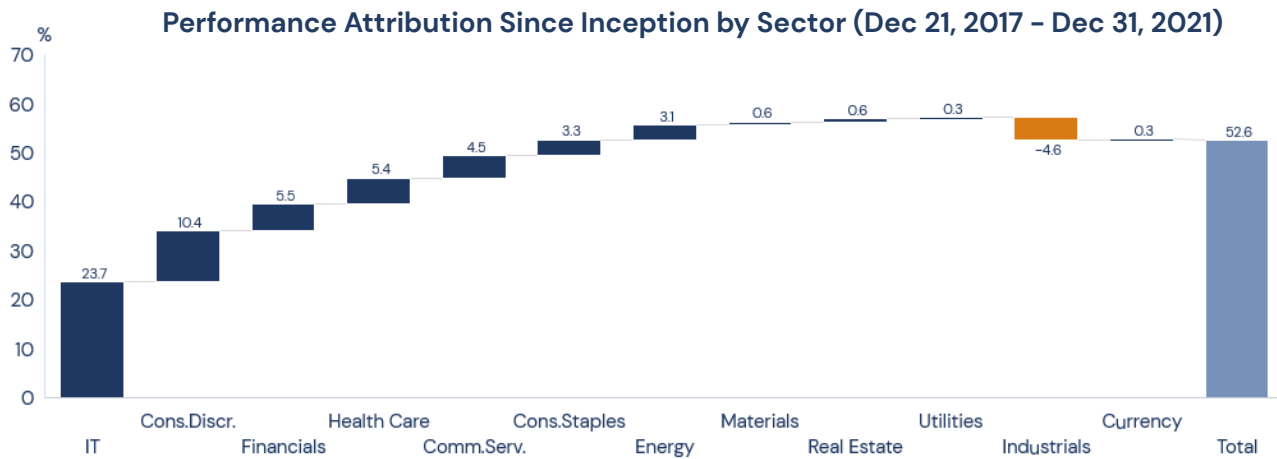
Since inception the strategy generated a gross total return of 111.3% (vs 58.7% for the MSCI AC World Index) resulting in an outperformance of 52.6%. From a factor perspective, security selection effects account for nearly a third of the active return. Industry effects generated 26.8% of the outperformance and were mainly due to overweights in semiconductors, software, medical equipment, as well as underweights in banks, insurance companies and integrated oil firms.

Performance Attribution Since Inception by Sector (Dec 21, 2017 – Dec 31, 2021)



Source: Bloomberg, TSG

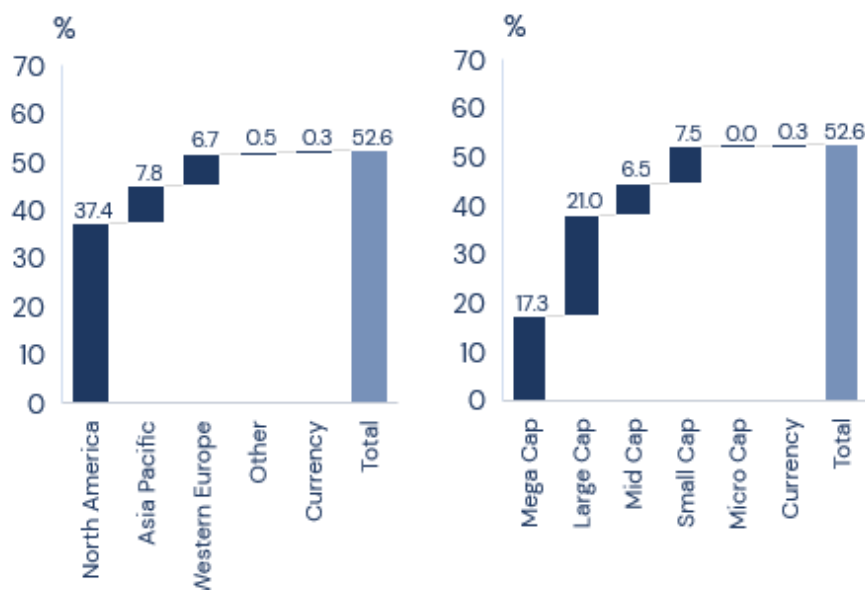
Breaking down the active return into its components by GICS sectors, we see strong contributions from security selection (30.5%) and sector allocation (21.9%), while the currency effect was negligible (0.3%). **All sectors, with the exception of Industrials, contributed positively to the outperformance.** Commensurate with its average historical weight of 42%, Information Technology contributed nearly half to the overall outperformance of 52.6%. More than half of the active return was generated outside of the technology sector, spearheaded by Consumer Discretionary, followed by Financials and Health Care. In the case of Financials, a combination of sector underweight and strong security selection contributed to a strong relative result. Industrials was the weakest complex since inception. The negative attribution is mainly a result of a reduction in sector weight during the May 2020 rebalancing following the introduction of the ESG exclusion filter which eliminated various aerospace & defence-related names from the portfolio. Excluding these dropouts, overall sector attribution was positive.



Source: Bloomberg, TSG

On a regional basis, the Singularity Fund generated value across the board with strong selection effects in all major regions. For instance, in Asia Pacific the fund generated an attribution of 7.8% on an average weight of ca. 16% corresponding to an outperformance of close to 50% on a normalized basis. The strongest attributions came from Japan, South Korea, Taiwan, Australia and Hong Kong. In Western Europe, the fund also generated a healthy outperformance where UK, Netherlands, France and Switzerland recorded the most significant attributions. Equally, **from a market capitalization perspective the strategy generated positive total attributions for all segments.**

Performance Attribution by Region and Market Cap (Dec 21, 2017 – Dec 31, 2021)



Source: Bloomberg, TSG



PERFORMANCE COMMENTARY Q4 2021

In the fourth quarter the strategy registered a gross return of +9.1% vs the benchmark's return of +6.8% with both security selection (+1.3%) and sector allocation (+1.0%) contributing positively. Top contributors were Tesla (+2.0%), Nvidia (+1.7%) and Microsoft (+0.8%). Bottom contributors were Paypal (-0.4%), Block (-0.2%) and Snap (-0.2%). On a relative basis vs the MSCI ACWI, the strongest positive contributors were Tesla, Nvidia, Broadcom, AMD, Qualcomm, Microsoft and Micron Technology.

Singularity Sectors: All sectors with the exception of Blockchain were positive for the quarter. Top performing Singularity Sectors in Q4 were **New Energy (+21.0%)**, **IOT (+16.8%)** and **VR (+16.4%)** with strong returns from Tesla (TSLA US, +36.3%, SC: 89), XPeng (XPEV US, 32.0%, SC: 95), Nextera Energy (NEE US, +19.4%, SC: 64), Arista Networks (ANET US, +67.3%, SC: 100), Marvell Technology (MRVL US, +45.2%, SC: 61), Qualcomm (QCOM US, +42.3%, SC: 98), Teradyne (TER US, +49.9%, SC: 81), Nvidia (NVDA US, 42.0%, SC: 100) and Roblox (RBLX US, +36.6%, SC: 100). **Blockchain (-15.8%)** and **3D Printing (+2.9%)** were the bottom performers for the quarter.

Top Q4 Contributors by Singularity Sector

Sector	Company	Perf (%)	Contr (%)
New Energy	Tesla	21.0	1.99
Virtual Reality	Nvidia	42.0	1.70
Big Data	Microsoft	19.5	0.80
Artificial Intelligence	Apple	25.7	0.58
Internet of Things	Broadcom	38.1	0.55
Bioinformatics	Thermo Fisher Scientific	16.8	0.18
Advanced Materials	Sika	31.2	0.10
Robotics	Intuitive Surgical	8.4	0.08
3D Printing	Daussault Systemes	12.9	0.07
Space	Eaton	16.3	0.02

Source: Bloomberg, TSG

Singularity Stocks: Best performing stocks for the quarter in terms of absolute performance were Arista Networks (ANET US, +67.3%, SC: 100), Teradyne (TC US, 49.9%, SC: 81), Marvell Technology (MRVL US, +45.2%), Qualcomm (QCOM US, +42.2%, SC: 98), Nvidia (NVDA US, +42.0%, SC: 100), AMD (AMD US, SC: 100), Broadcom (AVGO US, +38.1%, SC: 100), Roblox (RBLX US, +36.6%, SC: 100) and Tesla (TSLA US, +36.3%, SC: 89), Lasertec (6920 JT, +33.8%, SC: 100) and Cerner (CERN US, +32.1%, SC: 100).



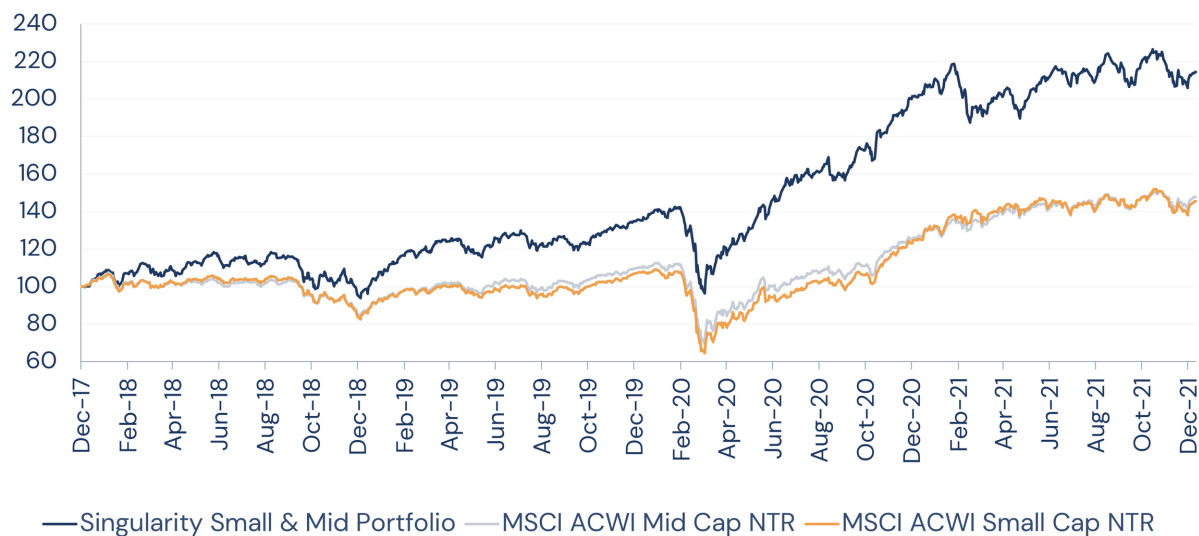
Singularity Small & Mid Performance Q4 2021

The Singularity Small & Mid strategy posted a gross return of +2.1% during the fourth quarter, compared to +2.2% and +5.0% for the MSCI AC Small Cap Index and MSCI AC Mid Cap Index respectively. Since launch of the certificate on May 10 2021, the strategy is up by +10.4%, outperforming the above indices by +8.4% and +5.4%. **Since strategy inception (Dec 21, 2021) cumulative gross performance is +114%.**

The biggest portfolio contributors for the quarter were Arista Networks (ANET US, +1.0%, SC: 100), Hubspot (HUBS US, +0.6%, SC: 100), Lasertec (6920 JT, +0.6%, SC: 100), Xpeng (XPEV US, +0.5%, SC: 95), Albemarle (ALB US, +0.4%, SC: 56), Montage Technology (688008 CH, +0.4%, SC: 100), MongoDB (MDB US, +0.4%, SC: 100) and Cerner (CERN US, +0.3%, SC: 100).

The largest detractors for the quarter were Huaneng Lancang River Hydropower (60025 C1, -0.6%, removed), Umicore (UMI BB, -0.3%, SC: 100), Asana (ASAN US, -0.3%, SC: 100), SolarEdge Technologies (SEDG US, -0.3%, SC: 87), Bentley Systems (BSY US, -0.3%, SC: 100) and DraftKings (DKNG US, -0.3%, SC: 100).

Live Performance and Backtest: Singularity Small & Mid vs. MSCI AC Small & Mid Cap Indices per end of December 2021 (indexed)

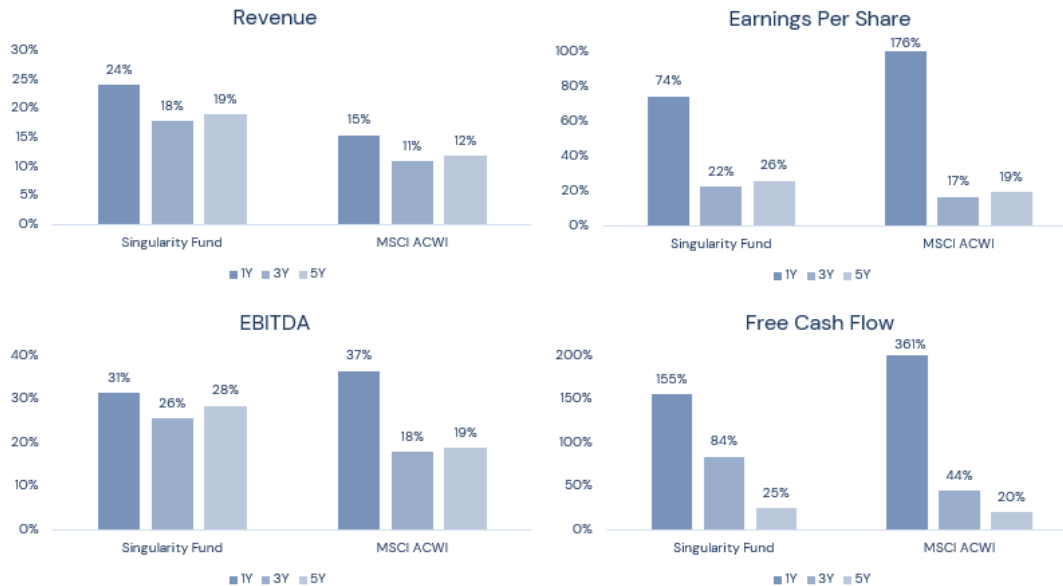


Source: Bloomberg, TSG

PORTFOLIO CHARACTERISTICS

The Singularity Portfolio's strong return over the last 4 years is grounded in a strong set of portfolio characteristics. Revenue grew at a compound annual growth rate (CAGR) of 18% over 3 years and 19% over 5 years. The 3-year CAGRs for EBITDA, EPS, and Free Cash Flow were 15%, 22% and 84%. These growth rates compare very favorably to the global equity benchmark.

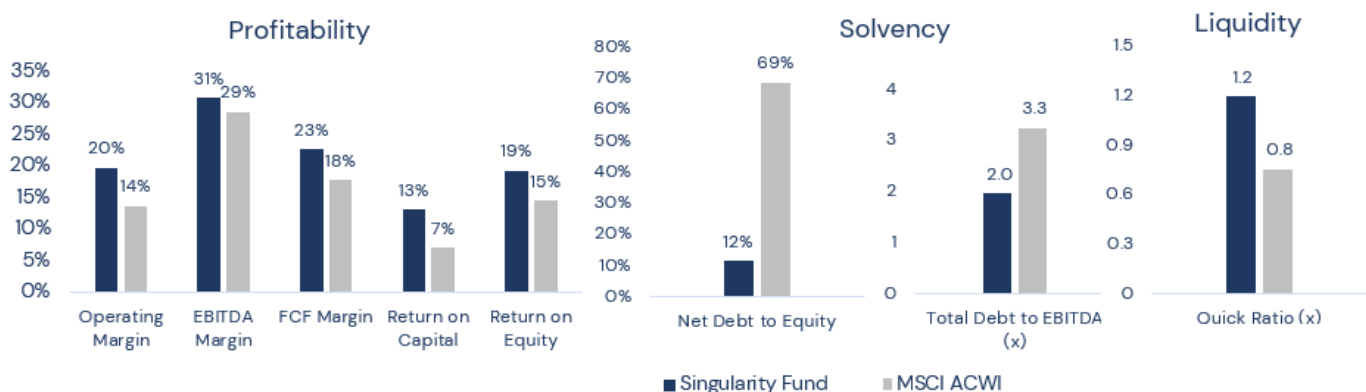
Compound Annual Growth Rates per end of December 2021



Source: TSG, Bloomberg

The current portfolio continues to be highly profitable with an operating margin of 20%, EBITDA and free cash flow margins of 31% and 23%, as well as strong returns on capital (13%) and equity (19%). The balance sheet is healthy with low debt ratios (12% net debt to equity) and a solid liquidity position with a quick ratio of 1.2x.

Portfolio Characteristics per end of December 2021



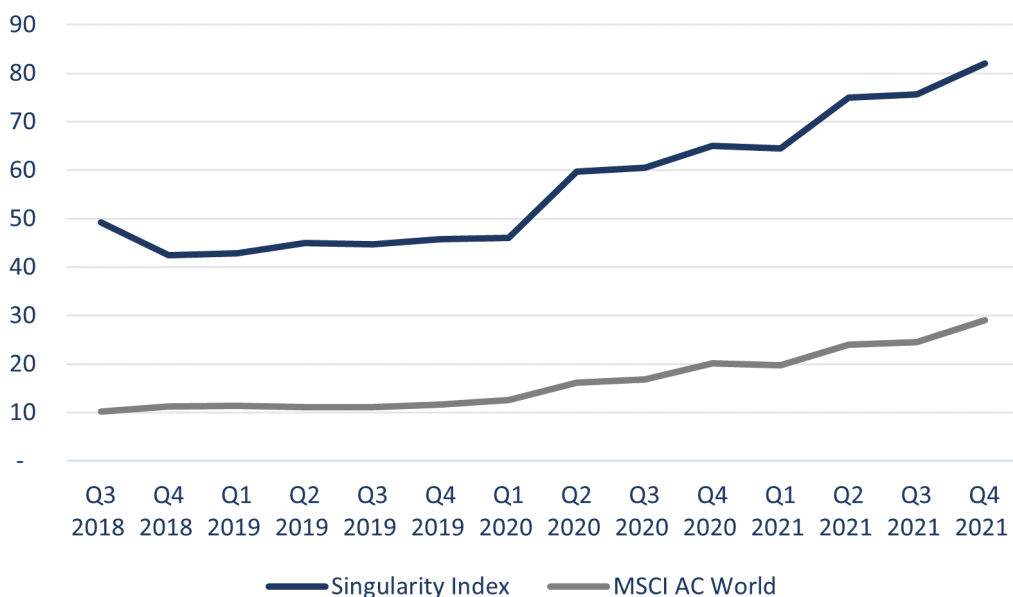
Source: TSG, Bloomberg



SINGULARITY REBALANCING H2 2021

On November 19, 2021 the Singularity Index was rebalanced in accordance with the semi-annual rebalancing cycle. A total of 49 names have been replaced in the index. In terms of portfolio weights, 6% of the index have been replaced with entirely new positions. The total portfolio turnover (two-sided) was 28%. The weighted Singularity Score increased from 79% to 82%, compared with 29% for the MSCI AC World.

Historical Development of Singularity Scores

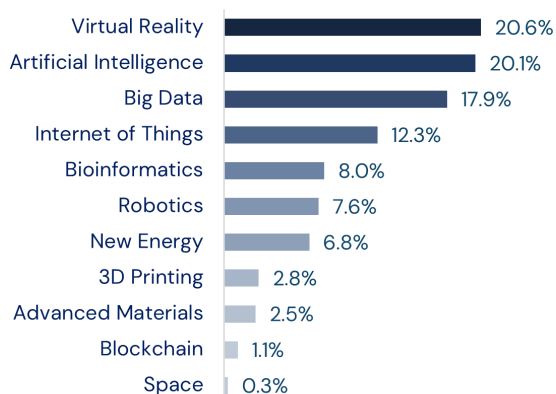


Source: Bloomberg, TSG

The biggest sectors in the index post rebalancing were Virtual Reality (VR), Artificial Intelligence (AI) and Big Data (BD) with allocations of 20.6%, 20.1% and 17.9% respectively. VR saw the biggest weight increase by nearly 4 percentage points. Roughly half of the portfolio is allocated outside of the technology sector. In terms of portfolio concentration, top 5 positions sum up to 20.4%, for the top 10 it's 32.7%, and the weight of the top 20 holdings is 44.7%. **The rebalanced portfolio continues to exhibit a strong growth and profitability profile, coupled with strong balance sheet and liquidity metrics.**



Singularity Index Sector Composition as of November 19, 2021



Source: Bloomberg, TSG

The Singularity Small & Mid portfolio, which focuses on the top two Singularity Score quintile firms per GICS sector within the \$1bn and \$25bn market cap range, was rebalanced on the same day as the Singularity Index. **A total of 50 out of 100 names were replaced in the portfolio representing 45% of the overall weight. Total portfolio turnover (two-sided) was 103%. The weighted Singularity Score increased from 83% to 94%.** Please find the full report [here](#).

NEW ENERGY SYSTEMS AT THE CENTER OF TECHNOLOGICAL CONVERGENCE

It is no news that the energy transition is underway. In aiming to bring your investment portfolio closer to where it comes to fruition, in this note, we counterintuitively draw your attention away from the energy topic and towards the underlying enablers and the real evolution: **robotic sensor technologies, artificial intelligence, and advanced material processing** capabilities are changing the way energy is sourced, created, distributed, monitored, as well as stored and saved. This report describes a pattern that keeps repeating itself globally and across industries: **key enabling technologies keep re-combining and applying themselves to form new eras and infrastructures that create value for our planet as well as our investment portfolios.**

The past decade has seen transformative changes across the energy system. Costs and performance of solar, wind and batteries have improved exponentially on the back of Wright's Law, which observes that for most technologies each increase in cumulative production volume results in a fixed percentage decline in associated cost.¹ Global investment in the low-carbon energy transition rose from less than \$300 billion per annum in 2011 to almost \$500 billion by 2020.² Eight out of the world's 10 largest economies have committed to achieve net-zero emissions by mid-century.³ Where is this money going?

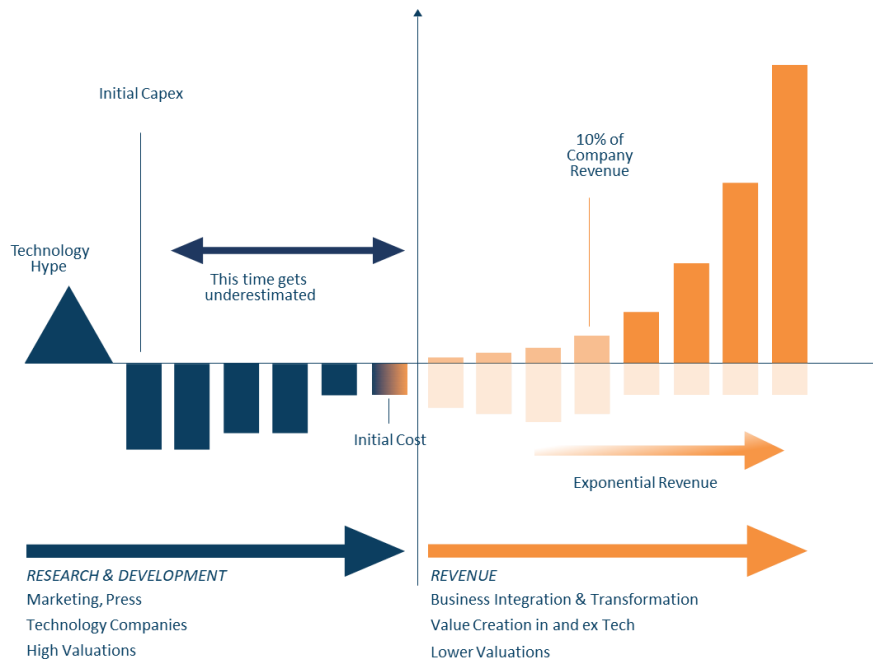
¹Cf. for example Quan Bui et al., "Statistical Basis for Predicting Technological Progress", *Santa Fe Institute*, 2012 <https://sfi-edu.s3.amazonaws.com/sfi-edu/production/uploads/sfi-com/dev/uploads/filer/c2/a5/c2a50ab2-0efb-4742-86ce-7065938c40c8/12-07-008.pdf>

²Bloomberg New Energy Finance, *Energy Transition Investment Trends*, 19 January 2021, <https://assets.bbhub.io/professional/sites/24/Energy-Transition-Investment-Trends-Free-Summary-Jan2021.pdf>

³Trends_Free Summary_Jan2021.pdf World Bank, "World GDP 1960-2019", https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?most_recent_value_desc=true

With governments and companies talking big on spending, we assess where investments can come to fruition – in the form of both solutions and returns.

The Singularity Strategy: Focusing on cash flow and revenue through technology value chains



Source: TSG

While investing in areas like the energy sector to incentivise a paradigm shift makes sense from a policy perspective, it is even more important to track where and which innovative and sustainable solutions actually have an impact and prevail. We specialize in applied innovation and identify where enabling technologies create real value today. Let's take a look at what's behind the buzzword of "the energy transition" and dissect a complex topic into its relevant parts.

At the heart of the transition: Process innovation, sensors, software, semiconductors

The transition we are talking about not only touches on but is driven by structural shifts in the **material processing industry (Advanced Materials)**, with the term 'material' including resources such as food- and other waste. In the infrastructure- as well as utilities sector, **energy and resource management** play a critical role. Here, **sensors and software (Robotics, Big Data, Internet of Things and Artificial Intelligence)** are key technologies enabling efficient resource management. The Singularity Group's new energy expert, **Andres Gujan**, points to software solutions as essential for the energy transition. **"Utility industry and energy industry software solutions will be integral for the management of various renewable sources on the grid,"** he remarked in a Q3 expert call.

Our analysis suggests that the companies with the steepest cash inflow outlook on the back of the energy and materials transition are positioned in the value chains of these innovations. Among the gems in the Singularity portfolios, we highlight **SolarEdge (Singularity Score (SC): 89)**, **VAT Group (SC: 98)**, as well as Singularity Universe companies **Belimo (SC: 100)**, and **Stem, Inc (SC: 100)**.

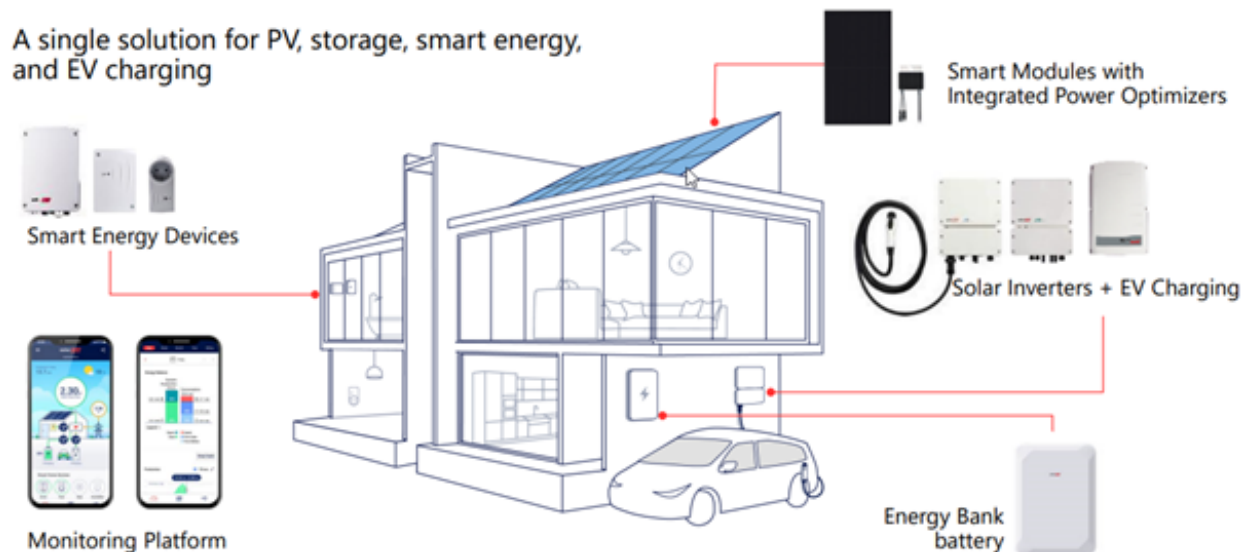
Software in energy and resource management: SolarEdge (Singularity Score: 89):

As a key player in the photovoltaic (PV) systems value chain and provider of new energy solutions, SolarEdge is uniquely positioned to benefit from rapidly expanding global solar demand. According to BloombergNEF, global solar installations increased by a compound annual growth rate of 23% from 2010–20, and based on continued policy support and increasingly favorable economics of solar power the double-digit trend is likely to continue. For further context, solar installations accounted for more than half of newly added electrical capacity in the first half of 2021 in the US, a key market for SolarEdge.⁴

The Israel-headquartered company's core product portfolio comprises power optimizers and inverters for PV systems and a cloud-based monitoring platform. As the solar energy industry has evolved, SolarEdge has developed and acquired various smart energy technology solutions including energy storage systems (ESS), electric vehicle components and charging capabilities, smart energy management, grid services and virtual power plants, as well as uninterrupted power supply (UPS) solutions.

The optimized inverter system – a combination of power optimizer and inverter – maximizes power generation at the individual PV module level and reduces the cost of energy production. An in-built communication device enables access to a cloud-based monitoring platform which provides full data visibility at each level, allowing for comprehensive analysis, fault detection, and alerts. SolarEdge's inverters act as smart energy managers for the management of PV energy, battery storage, smart devices and grid interaction, allowing system owners to maximize self-consumption and backup capabilities by controlling the timing of consumption and storage of PV energy. These inverters are also key in the energy grid's transition from centralized power stations to a network of distributed, renewable energy sources by acting as local control systems that can manage the energy resources of such an underlying distributed network.

SolarEdge's Complete Residential Solution



Source: SolarEdge Investor Presentation

⁴Solar Energy Industries Association/Wood Mackenzie, "Solar Market Insights Report 2021 Q3", <https://www.seia.org/research-resources/solar-market-insight-report-2021-q3>

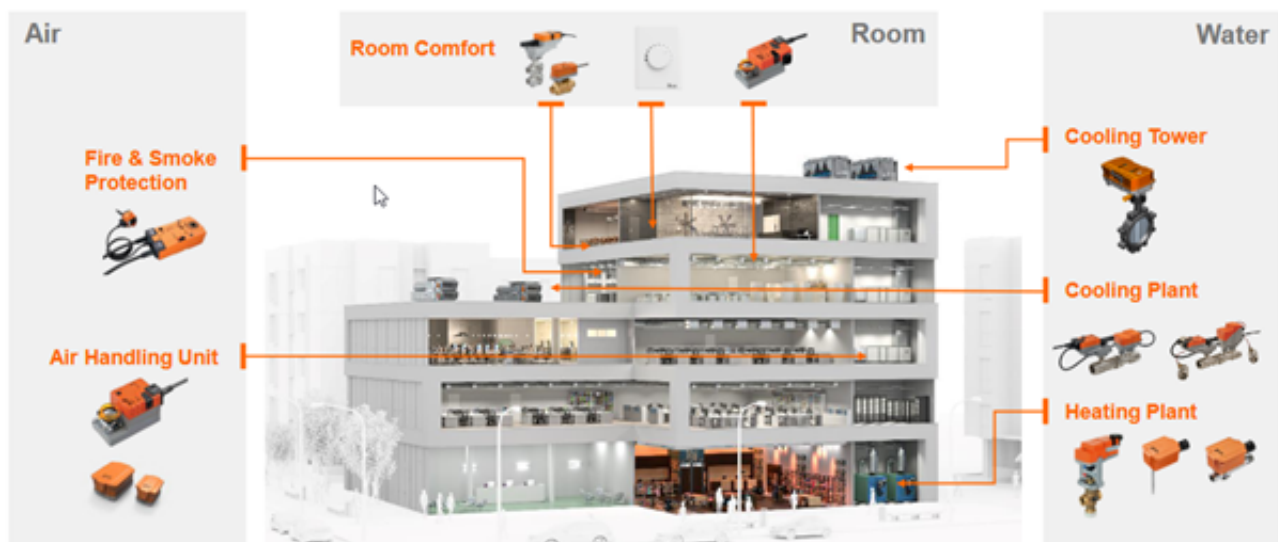
Sensors in energy and resource management: Belimo (Singularity Score: 100)

is a global leader in the area of field-devices for controlling heating, ventilation and air-conditioning (HVAC) systems and is headquartered in Switzerland. Buildings account for more than 40 percent of global CO2 emissions. With appropriate building controls systems, energy savings of up to 50 percent can be achieved compared with buildings lacking such features. As such, energy efficiency is the largest source of energy.

Belimo's energy-saving smart HVAC controls components are small devices with big impact at the cutting edge of energy efficiency solutions in buildings. While it's easy to quantify how much energy is consumed in a building, it's much harder to evaluate where the energy is consumed or wasted. Belimo's products create transparency of the energy flow in a building. Its actuators, control valves and sensors/meters help owners to use the energy in the most efficient manner.

Sensors are the foundation of comfort in HVAC applications and in buildings more generally. Belimo offers a full range of sensors for air, water and outdoor applications to optimally control airflow and water to a building's systems to ensure the proper balance of temperature, humidity and fresh air.

Belimo HVAC Applications



Source: Belimo Company Presentation



Tackling storage limitations

With most renewable sources providing only an intermittent energy supply that can often be at odds with demand, energy storage technologies are critical. The market for energy storage is growing at a rapid rate, driven by declining prices and supportive government policies. The rising demand for storage is expected to increase annual market revenue from around \$2 billion in 2020 to approximately \$16 billion by 2030.⁵ The World Energy Council estimates there could be as much as 250 GW of energy storage installed by 2030.⁶ **The flexibility that storage provides to energy networks and service providers will also drastically change the way in which energy is provided in the future.** For example, customers may become less reliant on stable and secure electricity supply if they are able to store backup energy in their homes or cars. As energy generation and storage solutions become more easily accessible to customers, so will the opportunities to participate in and shape the energy system.

Advances in battery and hydrogen technologies offer promising opportunities for storage solutions. For example, high-capacity batteries with long discharge times – up to 10 hours – could be valuable for storing solar power at night or increasing the range of electric vehicles. While there are currently few such batteries in use, recent projections suggest upwards of 100 GW's worth of high-capacity batteries are likely to be installed by 2050.⁷ For comparison, that is 50 times the generating capacity of the Hoover Dam⁸, with a potentially enormous impact on the viability of renewable energy.

Today, most batteries are made using lithium and cobalt, both of which have limited supplies. Developments in lithium and cobalt recycling are in this respect promising.⁹ As are developments in the use of other materials: Tesla (SC: 89), for example, plans to produce cobalt-free batteries¹⁰; Companies like Natron (not listed) and UK-based Faradion (not listed) are working to replace lithium with sodium, which has similar properties to lithium but is much more abundant. Such sodium-ion batteries are finding promising applications in the stationary energy storage industry. Others still, including US-based advanced materials companies Sila and QuantumScape, are taking steps to improve existing lithium-ion batteries by replacing the graphite anodes used in the batteries with silicon powder. Silicon can pack more lithium atoms into a smaller space, which means both smaller and – critically – more efficient batteries. Such developments are a prime example of **TSG's thesis of technological convergence, bringing together advanced materials and new energy technologies.** They may spur the evolution of new devices – smart glasses, for example, or more sophisticated health monitors. They may also improve the range of electric vehicles and offer additional energy storage solutions for utility providers.

Hydrogen, with its higher energy storage density, has been championed as an encouraging solution to store large amounts of energy over an indefinite period of time. According to TSG expert Lars Jaeger, among the most promising projects in the area of hydrogen energy today are those that use excess renewable energy production to create hydrogen, with hydrogen then serving as an energy storage device. Lars points to promising efforts in Europe's Nordic states, with companies such as Siemens (SC: 49) heavily engaged in hydrogen's commercialization. In addition to utilities, hydrogen may be used for shipping heavy loads, running

⁵Nicholas Nhede, "Global battery energy storage market to grow 23% per annum by 2030," *Smart Energy International*, 19 April 2021, <https://www.smart-energy.com/industry-sectors/storage/global-battery-energy-storage-market-to-grow-23-per-annum-by-2030/>

⁶World Energy Council, 2016

⁷ <https://www.nrel.gov/docs/fy21osti/77449.pdf>

⁸Arizona Power Authority, "History of Hoover," <https://powerauthority.org/about-us/history-of-hoover/>

⁹Mitch Jacoby, "It's time to get serious about recycling lithium-ion batteries," *Chemical & Engineering News*, 14 July 2019, <https://cen.acs.org/materials/energy-storage/time-serious-recycling-lithium/97/i28>

¹⁰Mitsuru Obe, "Cheaper Tesla? Panasonic to develop cobalt-free battery," *Nikkei Asia*, 13 January 2021, <https://asia.nikkei.com/Business/CES-2021/Cheaper-Tesla-Panasonic-to-develop-cobalt-free-battery>



heavy equipment, and also for rocket fuel. Yet encouraging advances in battery technology suggest hydrogen's capabilities may soon be complemented by those of novel batteries. In the transportation industry, for example, opportunities for hybrid battery–hydrogen storage solutions may have the potential to contribute significantly to climate protection and energy cost savings.

Electric mobility needs the system to catch up, waste-to-energy more promising near-term

With a lot of attention on the move to electrify mobility, a note must be made on the source of this electric power. **“Electric vehicles (EVs) without a clean grid are a problem,”** notes James Khedari on a recent call on transitory challenges and opportunities in the energy system. **“Not for countries like Switzerland, but the US, China, Australia, and many others will still ultimately fuel electric vehicles with coal and gas, albeit via the grid.** It is crucial for the entire system to catch up, and some of this catchup involves small steps in the right direction without being able to go all the way clean.” He highlights the need for diversification in solutions and energy sources and points to tremendous impact potentially coming from **waste-to-energy technologies**. Upcycling is the buzzword that captures this trend: processes that use food waste, materials waste, and energy waste to produce energy (or plastics, or food!).

With electric mobility moving less quickly than expected, the pace is increasing in transportation related software which is essential for the growing range of connected and autonomous devices. Within the transportation industry, for instance, fully connected infrastructures that allow vehicles to communicate with one another may increase vehicle energy efficiency between 5 and 20%,¹¹ reducing emissions and advancing the drive to net-zero. Other aspects of connectivity, including truck platooning for logistics, progress in advanced driver-assist systems (ADAS), vehicle autonomy, and ‘mobility-as-a-service’ solutions may additionally compound this increase. In September 2021, we started to unpack the dynamics surrounding automotive autonomy and ADAS in our report, *Internet of Cars Part II*. The report follows from our Q2 analysis of the Internet of Things (IoT) in the automotive industry, *Here Comes the Internet of Cars*.

Are we about to face the fusion revolution?

Capturing innovation also involves monitoring what is not yet possible. One of these areas is energy fusion technology, a once popular idea that has struggled to gain media attention since. Our view is that the energy transition will involve novel energy sources whose time may come sooner than expected, nuclear fusion foremost among them. Fusion – the process by which two atomic nuclei combine to form a single heavier one while producing massive amounts of energy – is moving closer to commercialization, propelled by developments in high-speed computing, AI, superconducting magnets, 3D printing related pumping technologies, and materials science. It is a technology whose developments we continue to monitor. Last quarter, we held a **roundtable with Christofer Mowry, CEO of General Fusion, and TSG experts James Khedari, Andres Gujan and Lars Jaeger to better understand fusion and TSG’s exposure to it. According to Christofer, today there are more than thirty private fusion companies worldwide, collectively pursuing the goal of “beginning construction of the first commercial pilot plants before the end of this decade”. Please read more about this discussion in our related [blog post](#).**

Semiconductor and nuclear fusion value chain: VAT Group (Singularity Score: 98)

is the global leader in vacuum valve technology, profiting from strong growth across Artificial Intelligence, the Internet of Things, Big Data, the global rollout of 5G telecommunications networks, and importantly the energy transition. Its high-vacuum valves are at the fulcrum of manufacturing processes of semiconductors, solar cells, displays, and a host of other digital devices.

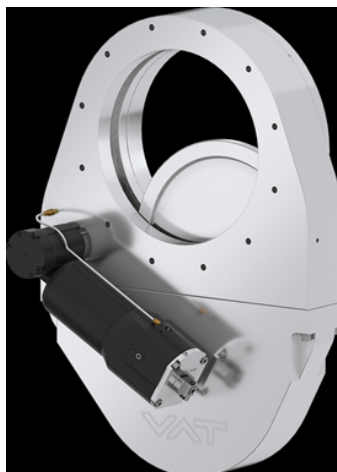
While the bulk of the Switzerland-based company's revenues are semiconductor related, its state-of-the-art valves play a crucial role in various industrial applications and in supporting the energy transition with key applications not only in battery production but also in the first experimental-stage nuclear fusion tokamak reactors (magnetic fusion device).

In the case of solar cells, for example, VAT's valve technology enables the creation and maintenance of the purest vacuums necessary for an efficient and clean production process of the most advanced solar cell technologies which require more and more processing steps under vacuum conditions. This is analogous to the production of semiconductor chips with ever decreasing node sizes which also significantly increase production steps under vacuum.

Vacuum technology and consequently VAT's range of valves also play an important role in the electric vehicle market. Electric motors require abrasion-resistant coatings to minimize friction while in lithium-ion battery cells, nano-coated thin film layers protect the electrodes from the electrolyte, thus increasing stability and preventing the formation of harmful dendrites. Moreover, the next generation of solid-state batteries with higher capacity and range and shorter charging times require coating of 3D nanostructures. These advanced coating processes must take place under vacuum and in the absence of oxygen in order to avoid contamination and comply with safety standards. As an added benefit, the vacuum shortens the drying time, increases system throughput and reduces energy consumption.

VAT is a research partner of the International Thermonuclear Experimental Reactor (ITER), the world's largest nuclear fusion project which will begin to test the possibility of sustained fusion in 2025. VAT supplies the development of the tokamak reactor with a catalogue of vacuum valve solutions needed in different areas and which can withstand extreme temperatures and radiation. Most of these valves are customized all-metal valves using metal-to-metal sealing, operating at the limits of what is currently technically feasible.

Pendulum Isolation Valve



Source: VAT



Artificial intelligence in the energy system: Stem Inc (Singularity Score: 100)

What do Amazon, Meta Platforms, Tesla, UPS, and Adobe have in common? They all work with Stem. The company operates and digitally connects battery installation hardware and energy optimization software that can facilitate control over entire energy processes – from generation to storage, distribution, and consumption – and in this way make energy usage more efficient and cost-conscious. Artificial intelligence allows Stem customers to dynamically adjust energy consumption to price changes in the energy market: A system called Athena AI optimizes time-of-use and demand charges, resulting in 10% – 30% monthly electricity bill reductions for commercial and industrial customers. It also helps utilities effectively manage grid capacity in light of ever growing volatility of renewable power generation.

Energy security and geopolitics

Perhaps most importantly, the energy transition is about energy security. The challenge is not only one of decarbonizing energy systems, but of doing so while ensuring energy security and affordability across markets. After all, in the end, the aim of net-zero will be achieved in the developing, rather than the developed, world. As Christofer points out, “You might help some countries like the UK, for example, get to zero carbon and you won’t move the needle on climate change one bit.” In Asia Pacific, for example, coal continues to play a significant role in the region’s energy mix: 52% of its 2020 energy demand and over 70% of its emissions footprint was coal-based.¹² As the world’s manufacturing base and home to a thriving petrochemical industry, cost effective and reliable energy solutions are critical – especially for emerging economies in South and Southeast Asia where economic growth is lagging. Decarbonization pressures being placed on sub-Saharan African nations, which together account for just 3% of the world’s cumulative carbon emissions,¹³ are also pushing regional governments to seek alternate solutions.

Conclusion

The energy transition is a systemic change and challenge. Adaptability is key and this is where innovation plays a crucial role. Companies that apply innovation at the core of their strategies and business models are designed to not only survive, but adapt and ultimately continuously progress. Oftentimes, innovation is not what the public is talking about, it is not the obvious, the visible. It’s the enabling technologies that keep the wind turbine moving, the electric engine running, and the solar panel storing more and more energy. Only if we understand supply chains and the ecosystems in which they are embedded, can we deconstruct and build infrastructures that serve mankind and nature alike. This suggests we must think in the broadest of terms about the energy transition and focus not only on the energy solutions themselves. Understanding what really moves the needle means understanding the details that combine to form a bigger picture.



¹²Shirley Zhang and Lucy Cullen, “Asia Pacific’s Energy Conundrum – Is Net Zero Possible?” *Forbes*, 2 August 2021, <https://www.forbes.com/sites/woodmackenzie/2021/08/02/asia-pacifics-energy-transition-conundrum--is-net-zero-possible/?sh=22bbe1b516a9>

¹³Our World in Data, “CO2 and Greenhouse Gas Emissions,” August 2020, <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions#cumulative-co2-emissions>

