

GAAEX: 2025 Outlook for Sustainable Energy

Guinness Atkinson Alternative Energy Fund (GAAEX)

January 2025

The election of Donald Trump, slower than expected interest rate reductions and low-cost Chinese competition drove sentiment and earnings for sustainable energy lower in 2024. The solar, wind, battery and electric vehicles (EV) industries all reached record levels, as did global clean energy investment, while a rapid uptake in artificial intelligence (AI) querying and data center demand promises more pressure on global power grids and power generation. Renewables remain at the bottom of the cost curve, and we believe investment should grow, helping sentiment to recover and for 2024 to be seen as a cyclical low. A high level of mergers & acquisitions (M&A) in 2024 shows that the sector represents an attractive long-term growth opportunity. Our portfolio, which offers broad exposure to companies that are well placed to benefit from the energy transition, now trades at a 26% one year forward discount to the MSCI World Index despite offering greater earnings growth potential.

Sentiment towards sustainable energy globally, especially in the **United States**, was dominated by the US election cycle in 2024. The outcome was a backward step for the energy transition and uncertainty persists in early 2025 around President-elect Trump's plans to unwind components of the Inflation Reduction Act (IRA). As a result, IRA-led investment slowed dramatically in 2024 but Republican desire for the jobs and investment associated with it remained strong.

In contrast, **China** continued to reap benefits in 2024 from decades of investment in sustainable energy technologies, building nearly twice as much wind and solar capacity as the rest of the world combined, delivering the lowest clean energy costs globally and building over 60% of the world's consumption of electric vehicles. Despite rapid renewables growth, China added around 80 gigawatts (GW) of new coal fired power capacity in 2024. In contrast, there seemed to be little real progress from **Europe** around commitment and investment as part of the Net Zero Industrial Act while COP29 passed with little in the way of progress on climate finance.

Global **investment** in clean technologies grew and is likely to have hit nearly \$2 trn in 2024 (up from \$1.7 trn in 2023, almost twice the spend on coal, oil, and gas in the year) reflecting the fact that renewable electricity is the cheapest form of new electricity supply in most situations. This came despite the broader macro-economic backdrop being less supportive than initially expected with only 3 US interest rate cuts delivered in the year. Despite this, there was a clear trend of **M&A activity** in the sustainable energy space suggesting that acquirers see the weakness in the sector as merely a cyclical slowdown, meaning that business valuations are attractive.

Around 690 GW of new **renewable generation capacity** was installed in 2024, 170 GW higher than the record installations seen in 2023 and more than triple the 194 GW installed pre-COVID in 2019. Solar was dominant (at around 460 GW) with wind in second place (around 110 GW) followed by hydropower then bioenergy. A rebound in hydro meant that renewable electricity generation in 2024 increased around 13%, outpacing global electricity demand (estimated 3% growth in 2024). Lower energy prices reduced the desire for efficiency, with investment in energy efficiency falling by around 3%.

Electric vehicles saw continued adoption in 2024. After growing at over 50% and 35% in 2022 and 2023, sales of plug-in vehicles grew by around 20% to around 17 million units, reaching a 20% penetration rate in 2024, one year earlier than our long-held forecast. Global **lithium-ion battery** demand grew by 29% and battery pack costs fell in 2024 due to rapid growth of lower-cost Chinese manufacturing based on lithium-ion phosphate chemistry. EV penetration surpassed 50% in China in the second half of the year and 60% of all

Chinese EVs were cheaper than their ICE equivalents in 2024. Tariff tensions rose as President Biden more than tripled tariffs on Chinese imports of batteries and EVs.

The **solar** industry grew rapidly in 2024, with installations of around 600 GW, up around 4 times (40%pa) since 2020. Module costs fell to just 9 cents per watt, below the cash cost of manufacturing. The **wind** industry delivered record installations of around 124 GW as manufacturers continued to recover from supply chain bottlenecks as well as raw material and labor cost inflation.

Rapid uptake of AI querying and growth in data centers brought **strong renewable power demand** and put pressure on developed world power grids, causing shortages for key products like transformers. Renewable power prices increased, and we saw a renaissance for nuclear power in the United States.

Against this backdrop, the Guinness Atkinson Alternative Energy Fund delivered a total return of -11.85% in 2024 vs its benchmark the MSCI World Index (net return) of 18.67%. Since repositioning six years ago, the fund has delivered **a return in excess of its investment universe**, based on an equal weighted average calculation.

Performance data quoted represents past performance; past performance does not guarantee future results. The investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance of the Fund may be lower or higher than the performance quoted. Performance data current to the most recent month end may be obtained by visiting www.gafunds.com or calling 800-915-6566.

Looking ahead to 2025 and beyond, we expect the following:

President Trump will **struggle to make substantial reforms to the IRA** and will enjoy more success using his executive powers to promote fossil fuels. Republican support for the jobs and investment coming from the Act may restrain Trump's ability to repeal it and the final outcome may be that Trump's election is more positive for fossil fuels, via lower regulation and environmental protection, than it is negative for clean energy directly. Expect his focus to be on domestic content requirements for tax credits, Foreign Entity of Concern (FEOC) definitions, and subsidies for offshore wind. Greater tariffs on clean energy imports, lower environmental restrictions, greater liquefied natural gas (LNG) exports and the departure of the United States from the Paris Agreement are on the cards near term.

Politics aside, **US electricity demand will continue to surge** due to AI querying, data centers, re-shoring and the broader trend of electrification. Significant grid upgrades, a record interconnection backlog and skilled worker and product shortages will keep the market, which has seen little growth in the last twenty years, very tight. New nuclear is unlikely before the mid-2030s meaning that renewables and gas-fired power generation will be in demand. Globally, renewable power generation is expected to grow 7-8% in 2025.

Clarity from Trump and electricity supply/demand realities will allow the US industry to address **its substantial backlog of IRA-related investments** while Europe likely regains some investment from the US as a result of the election-related hiatus. In stark contrast, we see further rapid growth in China as renewable energy was again listed among the "strategic industries" whose development should be supported long-term by policymakers. Broadly speaking, investments requiring subsidy or consumer incentivization will continue to be less well placed as a result of pressured government finances.

Electric Vehicle sales will grow and likely reach around 20 million in 2025. If current adoption S-curves are followed, EVs will make up over 80% of new vehicle sales in China and Europe by 2030, with the US reaching that level by 2035, as they become cheaper to buy, cheaper to run and cheaper to maintain. Lithium-ion battery prices likely deflate further (down around 5% in 2025) and will reach \$70/kWh (kilowatt-hour) in 2030 if historic learning rates hold. Demand growth and increased industry concentration should allow battery manufacturers to increase utilization and benefit from positive operating leverage.

Solar will remain the cheapest renewable and will grow across all major geographies in 2025 with installations reaching around 670 GW. China will be around half of the market with North America and Europe seeing demand increases due to the desire of “big tech” for quick-to-market, zero carbon electricity with long term price visibility.

Wind installations will reach a record level of around 145 GW with China being less than half of the market. Faster permitting and raw material cost deflation will support the outlook for growth and margins and installations will continue to grow to around 200 GW by the end of the decade.

The energy transition is generally progressing well, and the multi-decade positive outlook remains. However, within this secular trend, there are cycles at play, some of which are in an “up” phase (e.g. electrical equipment, building material, grid investment) and some in a “down” phase (e.g. battery/EV supply chain; solar upstream). We are confident in the **structural growth offered by the transition** and believe that the challenged industries are at or close to a cyclical trough.

With the US election behind us, we look to a reduction of financing costs (i.e. interest rate reductions feeding into consumer and project financing) to drive investments into the clean energy sector. Together with growing AI and data center demand, stricter energy efficiency requirements, massive grid upgrade program and the implicit operating leverage within our manufacturer investments we believe that confidence in **portfolio earnings will start to improve** from a low level.

The consensus-derived earnings per share growth outlook for the fund (16.4%pa for 2024-2027E) sits at a premium of nearly 6%pa vs the MSCI World index. We do not think that the 26% one year forward P/E discount of the fund reflects this earnings scenario but, instead, something that is worse than that implied by current interest rates and inflationary conditions. If valuations do not improve, we would expect to see continued **high levels of M&A activity** in the sector.

As such, investor interest in sustainable energy equities should start to improve from very poor levels as energy security and increased individual, social and government pressures for consumers to become more energy efficient continue. We believe that the Guinness Atkinson Alternative Energy portfolio of approximately 30 broadly equally weighted positions, chosen from our universe of around 250 companies, provides concentrated exposure to the theme at attractive valuation levels that are particularly attractive relative to consensus earnings growth expectations.

Key themes in the Guinness Atkinson Alternative Energy portfolio

Theme	Example holdings	Weighting (%)
1 Electrification of the energy mix	 	36.9%
2 Rise of the electric vehicle and auto efficiency	 	9.8%
3 Power semiconductors	 	9.8%
4 Battery manufacturing		4.0%
5 Expansion of the wind industry		9.2%
6 Expansion of the solar industry		8.1%
7 Heating, lighting and power efficiency		17.9%
8 Geothermal		3.5%
9 Other (inc cash)		0.7%

Source: Guinness Atkinson Asset Management (December 31, 2024)

Sustainable Energy Policy, Investment, & Economics

The year of 2024 was dominated by the election cycle in the **United States**, starting with the nomination of Donald Trump as Republican candidate in January and concluding with his “clean sweep” election success in November. His term will bring a shift in US energy policy as he targets reduced energy costs, “energy dominance,” and improved competitiveness for US industry via the removal of environmental regulations. A target for him (to raise funds to support tax cuts elsewhere) is the Inflation Reduction Act (IRA), the key Democrat-led legislation providing \$369bn of tax credits for clean energy investment. Trump views the IRA as being “*industry-killing, jobs-killing, pro-China and anti-American.*”

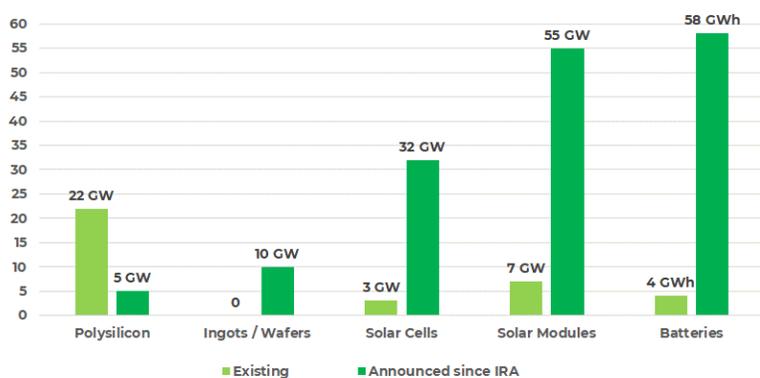
Since the legislation was passed in 2022, nearly \$450bn in private investment has come into the US clean energy sector, according to the Clean Investment Monitor and, by our analysis, more than three-quarters of all IRA-related manufacturing projects announced have been channeled into Republican states. Earlier in 2024, the World Economic Forum assessed that over 170,000 jobs had been created and that over nine million jobs would be created over the next decade, with the legislation catalyzing as much as \$3 trillion of further investment. The investment is so significant that, in August 2024, 18 Republican senators wrote to the Speaker of the US House of Representatives asking him to preserve the IRA’s energy tax credits¹ as they were so important to the economic outlook of their states. These the new jobs do not appear to be at the expense of fossil fuel industry jobs and with this in mind, many observers disagree with Trump’s views, instead suggesting that the IRA’s focus on building a new domestic supply chain for lower-carbon energy is building a new industry with new jobs, while being pro-America and anti-China.

Nonetheless, the election outcome is a backward step for the energy transition in the United States. With respect to the Inflation Reduction Act, we think that President Trump will struggle to make substantial

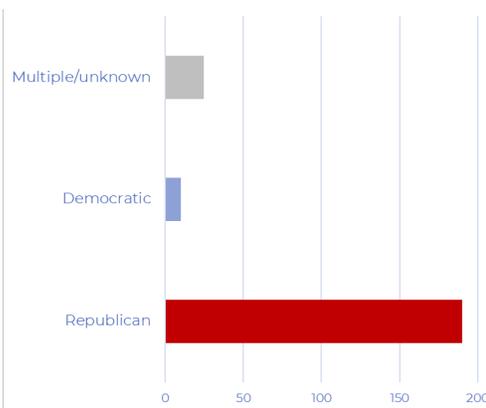
¹ <https://garbarino.house.gov/sites/evo-subsites/garbarino.house.gov/files/evo-media-document/FINAL%20Credits%20Letter%202024.08.06.pdf>

reforms and that he will have more success using his executive powers to promote fossil fuels instead. We expect him to put greater domestic content requirements on the various IRA tax credits, to broaden the reach of Foreign Entity of Concern (FEOC) designation beyond the electric vehicle industry and to slow down the awards of new offshore wind permits (since offshore wind is a federal activity). In addition, he will likely leave the Paris Agreement, lift the liquified natural gas (LNG) export pause, roll back environmental restrictions and impose new tariffs (in excess of those placed by Biden in mid 2024) on imports related to renewable energy, particularly from China.

Existing and announced clean manufacturing capacity



Total announced projects by partisanship since Aug 2022 (\$bn)



Source: American Clean Power Association, World Economic Forum, FT. October 2024.

The threat of a second Trump presidency impacted sentiment globally for the sustainable energy industry throughout 2024. However, it is worth remembering that the US represents only c.7% of global solar installations, around 8% of global wind installations and around 11% of global EV sales. This is not to downplay what is an important growing market in the energy transition, but to put it into global context. We would also stress that the majority of tax credits provided by the IRA are helping to accelerate lower-carbon sectors that already compete successfully, on an unsubsidized basis, with fossil fuels. In short, regardless of the election result, the global energy transition continues, as does the US energy transition.

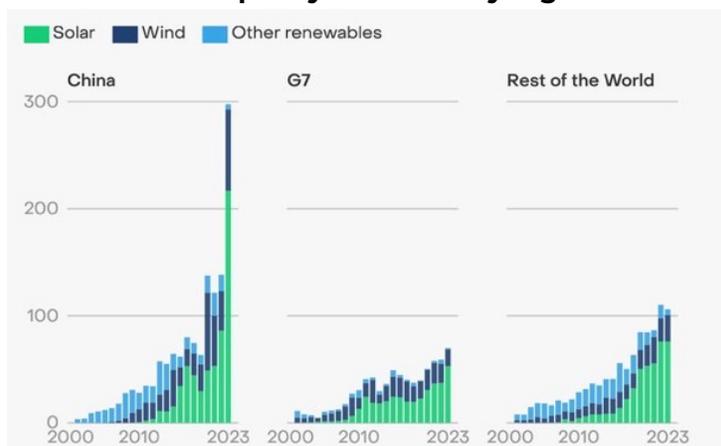
While the uncertainty around Trump’s plans will continue in the first half of 2025, we ultimately expect investment under the IRA to pick up once again, since there is a substantial backlog of planned investments. According to the Financial Times, approximately 40% of major manufacturing projects funded by the IRA have been delayed or paused indefinitely in 2024, partly due to electoral uncertainty. Lifting the uncertainty around this investment would have a significant pro-growth multiplier effect on the US economy, and the growth would occur largely in Republican states.

Beyond the IRA, we would stress that the critical issue for the US is the fact that electricity demand is surging as a result of the growth of Artificial Intelligence querying and data centers as well as the wider trend of electrification. This is a critical energy issue for Trump to deal with if he is to win the “AI arms race”, requiring him to oversee significant grid upgrades and near-term growth in both renewable and natural gas-based power generation. With new nuclear projects likely ten years away, there is a need for him to clarify his

position around manufacturing and tax credits quickly and allow the US clean energy industry to reset and return to an investment mindset. There is an urgency required to resolve these issues.

In contrast, **China** continued to reap benefits in 2024 from decades of investment in sustainable energy technologies, building nearly twice as much wind and solar capacity as the rest of the world combined, delivering the lowest clean energy costs globally (with onshore wind being the cheapest) and building over 60% of the world’s consumption of electric vehicles. We will likely look back and see that China achieved its target of 1,200 GW in wind and solar installations in mid 2024, around six years ahead of schedule. We view China’s ability to offer comprehensive, long-term demand-side and supply-side policy support as a key differentiator, allowing it to increasingly dominate the global clean tech environment.

Annual renewable capacity additions by region 2000-23 (GW)



Source: Ember, 2024

We expect this rapid growth to continue as renewable energy (alongside grid modernization) was again listed among the “strategic industries” whose development should be supported by policymakers. As such, China’s stimulus announcements in September to bolster domestic production and support profitability gave a further boost to its clean technology industry. In November, the new Energy Law established a comprehensive regulatory framework for the energy sector providing long term clarity and addressing overcapacity in the solar PV manufacturing space.

Chinese electricity demand growth was likely around 7% in 2024, forcing the government to set more stringent broader energy intensity improvement targets (2.5% for 2024), especially after missing targets in 2023 (delivering only 0.5% vs a target of 2%). Despite its acceleration in renewable power, China still targeted bringing on around 80 GW on new coal fired generation capacity in 2024. As of July 2024, China had 1,161 coal plants, over 50% of the world total, according to Statista.

In contrast, there seemed to be little real progress from **Europe** around commitment and investment as part of the Net Zero Industrial Act. Amendments to the European Climate Law (which targets net zero greenhouse emissions by 2050) were made to reduce the EU’s net greenhouse gas emissions by 90% by 2040 (relative to 1990). This new interim target was designed to accelerate the transition and put the EU on a path towards a healthier and safer future, to avoid wasted investments in fossil fuels, boost the competitiveness of Europe’s businesses and to make Europe more resilient.

As has often been the case in Europe, we found the bloc to be “long” on targets but “short” on actual support to help establish the supply chains and domestic manufacturing to allow the targets to be achieved. The Green Deal Industrial Plan and the Net Zero Industry Act and Critical Raw Materials Act (all passed in 2023) do not yet appear to be catalyzing investment in the EU as little new central funding was announced to support these ambitions. As a sign of the difficulties being faced, Swedish battery manufacturing plant Northvolt filed for Chapter 11 bankruptcy protection in the United States in November after new orders were cancelled, new financing failed, and Chinese competition increased.

Relative to previous events, **COP 29** in November in Azerbaijan was lightly attended and appeared to do little to progress broader decarbonization goals. Notable wins included Mexico setting a 2050 net zero target, Indonesia (operator of the fifth largest coal fleet in the world) announcing a 2040 coal phase out target (16 years earlier than the prior target) and progress was also made towards a global carbon credit platform. The COP was billed in advance as having a particular focus on climate finance, but the ultimate agreement that developed nations pay \$300bn pa to developing nations was seen by many as being insufficient.

The **broader macro backdrop** in 2024 proved to be less supportive than initially expected. Predicted interest rate cuts did not occur and the 4.4% yield on 10yr US treasuries at the end of the year ended up being 40bps higher than it was at the start of the year, as only three US cuts were delivered (versus six expected at the start of the year). Trump’s election has slowed the tenor of expected US rate cuts in 2025, with only 1.5 more cuts of 25bps expected by the end of 2025. Inflation trended the right way, but service costs remained higher than hoped, leading to some stickiness and continued raw material cost issues for many manufacturers.

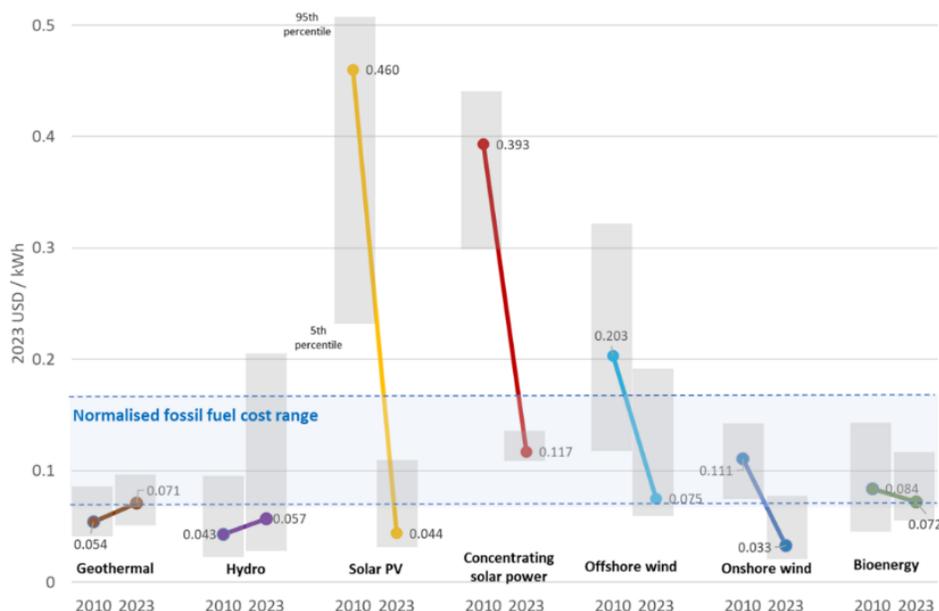
Against these near-term policy and macro pressures, there was a clear trend of **M&A activity** in the sustainable energy space suggesting that acquirers see the weakness as merely a cyclical slowdown with business valuations being attractive. In the fourth quarter, global miner Rio Tinto acquired Arcadium Lithium for a 90% premium in a deal worth \$6.7bn and KKR announced the intention to purchase a 25% stake in Eni’s biofuel unit, Enilive, at a valuation of c.\$13bn, well above market expectations. TotalEnergies acquired German renewable developer VSB Group for c.€1.6bn, EQT and GIC announced that they would acquire a joint stake in Calisen (a UK smart metering company in a deal that values the company at approximately £4bn) while Equinor purchased a c.10% stake in offshore wind developer Orsted, for c.\$2.5bn. These deals follow previously announced takeovers in the sustainable energy space in the year, including KKR’s bid for Encavis, EQT acquiring OX2, and Brookfield’s recent offer for Neoen.

On a similar positive note, **global investment in clean technologies** grew and is likely to have hit nearly \$2 trn in 2024 according to the IEA – almost twice the spend on coal, oil and gas in the year, and up from \$1.7 trn in 2023. Higher-than-anticipated borrowing costs have been offset by easing supply chain pressures and falling prices, especially for solar PV and battery technologies. The greater investment means that clean energy is becoming a greater share of global GDP growth (having averaged 10% in 2023) with the number of clean energy jobs growing and accounting for more than half of employment in the global energy sector

Renewable electricity is the cheapest form of new electricity supply in most situations. According to Levelized Cost of Electricity (LCOE) estimates from the International Renewable Energy Agency (IRENA), the cost of wind and solar projects commissioned in 2023 ranged from \$0.03-0.11/kWh, well below the fossil fuel cost range of \$0.08-0.17/kWh. Despite increases in project financing costs and inflation across the broader economy, the LCOE of solar and onshore wind projects fell by 12% and 3% respectively, vs 2022. This illustrates that renewables remain cost competitive, and this keeps the long-term driver of renewables adoption intact

Global LCOE of newly commissioned utility-scale renewable power generation technologies (2010–2023)

LCOE = levelized cost of electricity



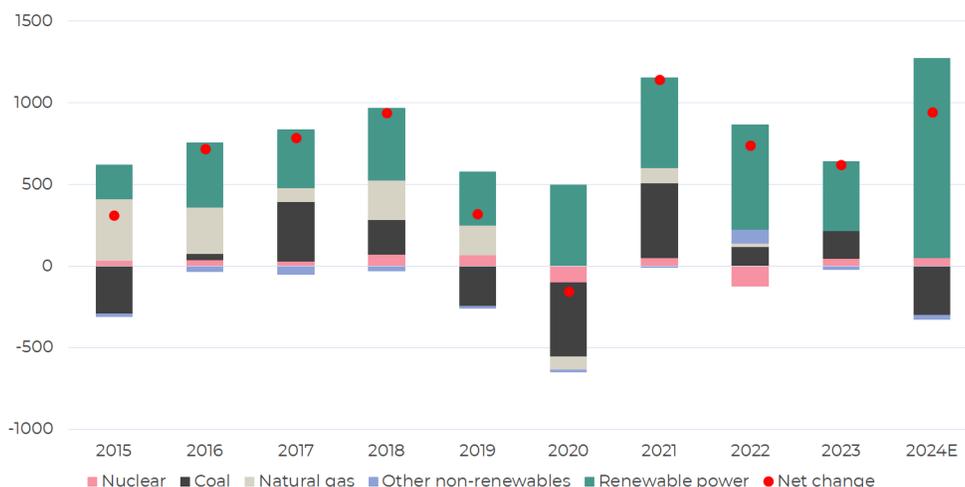
Source: IRENA, Guinness Atkinson Asset Management, December 2024

Renewable installations and power generation in 2024

Around 690 GW of **new renewable generation capacity** was installed in 2024, 170 GW higher than the record installations seen in 2023 and more than triple the 194 GW installed pre-COVID in 2019. At around 460 GW, solar represented around three quarters of the new capacity additions. Wind (at around 110 GW) came next, followed by hydropower, then bioenergy.

Renewable electricity generation in 2024 is likely to have increased by 1,300 TWh (around 13%) reaching over 10,600 TWh, and outpacing global electricity demand (estimated 970 TWh or 3% growth in 2024). Most of the rise in renewable power generation can be attributed to the increase in installed solar and wind capacity. However, the percentage rise in renewable generation in 2024 was also boosted by a strong recovery in hydro output, after drought conditions in various regions curtailed hydro generation the year before. Global fossil generation appears to have fallen by about 330 TWh in 2024.

Change in electricity generation (TWh) 2015-2024E



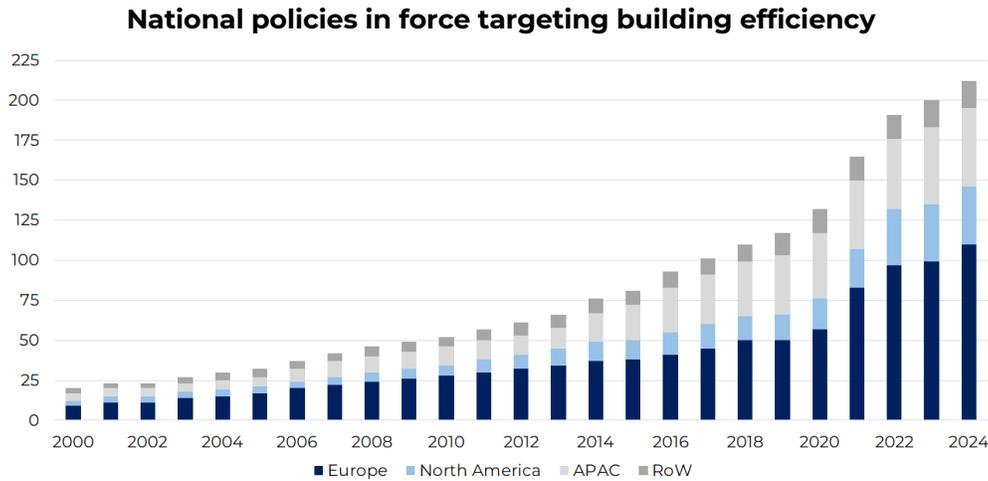
Sources: International Energy Agency; EMBER; Guinness Atkinson Asset Management, December 2024

Global electricity demand rose to another record high in 2024, up by around 3.2% (+970 TWh) versus 2023. Clean energy generation growth is forecast to be even greater (+1,300 TWh), implying a 2% fall in global fossil generation (-330 TWh), mainly coal. More than half of the electricity demand growth in 2024 came from five technologies: electric vehicles (EVs), heat pumps, electrolyzers, air conditioning and data centers. The spread of these technologies is accelerating the growth in electricity demand, but overall energy demand is not growing as fast, since electrification is more efficient than fossil fuels.

The decline in fossil fuel emissions in the power sector in 2024 was led by a resurgent hydro sector reducing the need for coal burn. It is estimated that power sector emissions fell around 3% as a result. Looking into 2025, renewable power is expected to grow at around 7-8%, further displacing coal and gas power, which would result in another year of the electricity sector’s CO2 emissions declining.

Energy Displacement – Efficiency & Alternative Fuels

It is hard to understate the importance of **energy efficiency**. Energy efficiency and energy security raced up the political agenda following the spike in energy prices following the Russian invasion of Ukraine in 2022. This resulted in a 60% increase in building efficiency standards globally between 2020 and 2024.

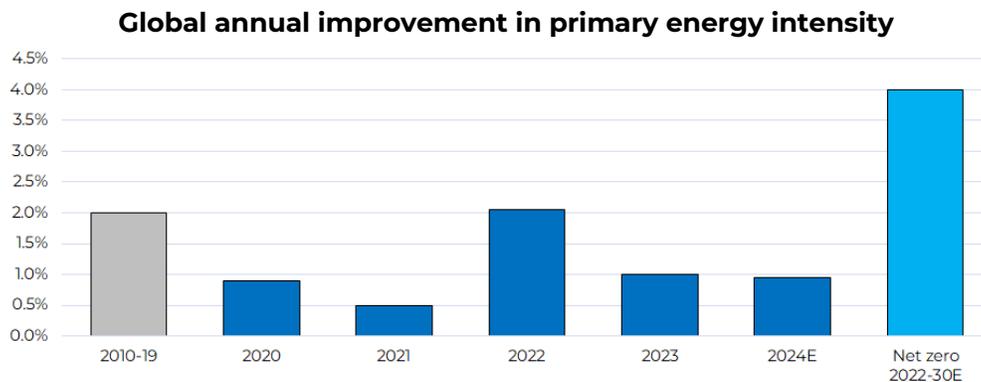


Source: IEA, Guinness Atkinson Asset Management; December 2024
APAC = Asia Pacific; RoW = Rest of World

The increase was most pronounced in Europe, which released the REPower EU plan to rapidly reduce dependence on Russian natural gas imports and fast-track the green transition. In 2024, the EU set new goals to achieve 100% zero-emission buildings by 2050, adding to existing targets to install 10 million heat pumps by 2027 and reduce final energy consumption by 13% by 2030.

In the near term, elevated energy prices drove three years of double-digit growth in global efficiency spending from 2020 to 2022. Investment then retreated 7% in 2023 as higher interest rates weighed on housebuilders and renovation activity and a 16% decline in Chinese construction significantly impacting the delivery of green buildings globally. In 2024, despite continued headwinds, spending is expected to remain resilient, falling just 3% to \$270bn, 35-40% higher than 2019 levels.

We believe that Europe’s decision to end its reliance on Russian gas is likely to lead to structurally higher natural gas (and therefore electricity prices) in Europe and Asia. Higher energy prices should support efficiency project economics, ultimately providing a tailwind to the COP28 goal to double the global average annual rate of energy efficiency improvements from around 2% to over 4% every year until 2030



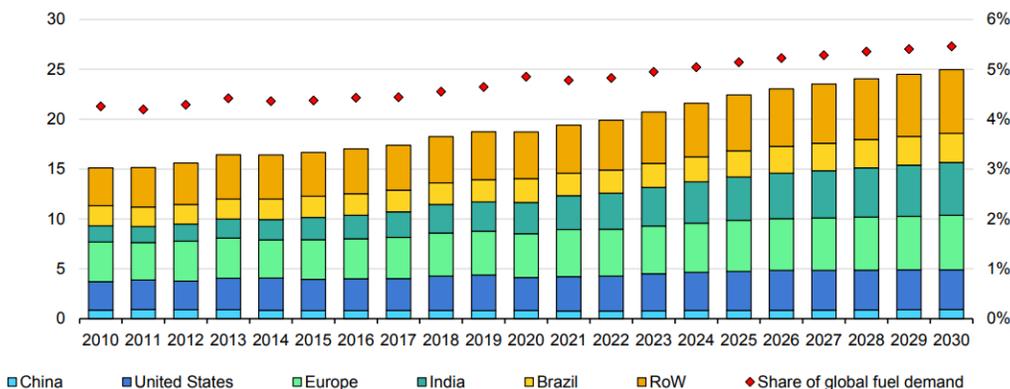
Source: IEA, Guinness Atkinson, December 2024

In the context of an improvement of around 1% in 2023 and 2024, we are cognizant of the scale of this challenge. However, 2025 represents the 10-year anniversary of the signing of the Paris Agreement, requiring governments to update their quinquennial Nationally Determined Contributions (NDCs). Whereas renewable energy deployments have played a starring role in climate efforts over the past decade, we would argue that the greater awareness offered to efficiency at COP28 could see it play a far greater role in international climate efforts over the next decade.

Alternative (or renewable) fuels are set to play an important role in tackling emissions in carbon intensive, hard-to-abate sectors. Global demand for these fuels in 2024 was around 21.5 exajoules (EJ) across industry, buildings and transportation, satisfying around 5% of their energy needs. Solid biofuels were the most prominent, making up 75% of alternative fuel consumption globally, followed by liquid biofuels at 20%, and biofuels trailing at 5%. Four countries - the United States, India, Brazil, and China – represented over 50% of global demand.

Alternative fuel consumption is expected to grow steadily at around 2.5%pa out to 2030, reaching 25EJ with over 65% of demand growth coming from India, China, Brazil, the US and Europe. Solid bioenergy contributes over 60% of the total demand growth with liquid biofuels, used predominantly in transportation, representing around 25% of the total growth.

Global renewable fuel demand (EJ)



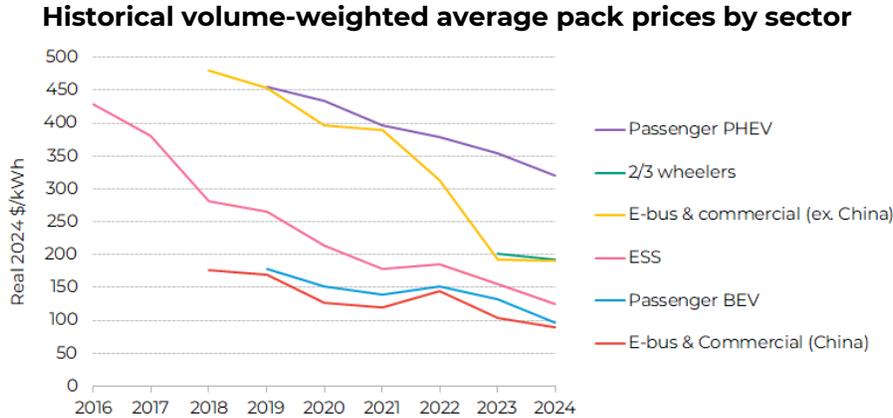
Source: IEA, December 2024

It is important to remember that alternative fuels broadly remain more expensive than their fossil fuel counterparts, meaning that policy support is key to underpinning future growth. For example, the \$2/litre cost of producing biojet (often known as Sustainable Aviation Fuel, SAF) is nearly three times as much as the \$0.75/litre cost of producing traditional jet fuel. Blending targets will still be needed to encourage the uptake of liquid biofuels while limiting the financial impact to consumers.

Electrification – Batteries & Electric Vehicles

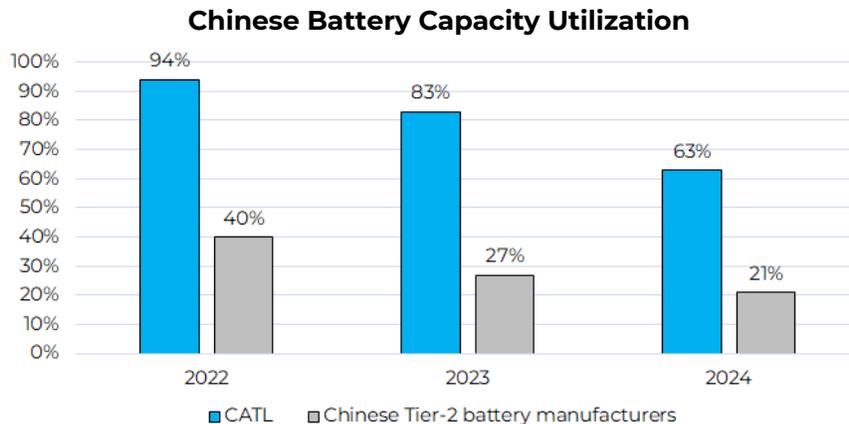
Global **battery demand** is expected to have reached 1.2TWh in 2024, up 29% year-on-year and up nearly 500% since 2020. The market is primarily driven by passenger electric vehicles (EVs), representing 70% of demand, with energy stationary storage (ESS) a distant second at 14%. Looking ahead we expect passenger vehicles to remain the dominant driver, with emergent demand from commercial vehicles acting as a tailwind, resulting in an average annual growth in battery demand of around 20%pa out to 2030.

The average BEV battery price fell below \$100/kWh for the first time in 2024, driven by economies of scale and an increase in the adoption of lithium-iron phosphate (LFP) chemistries. Thanks to its greater stability and lower cost (\$94/kWh vs \$130+/kWh for nickel-based chemistries), LFP's share of the global cathode mix has grown from 17% in 2020 to 44% in 2024. Thanks to its scale and focus on LFP, China now boasts the lowest battery pack prices globally at \$94/kWh, 20-30% lower than the US and Europe, and is the only region to see average prices below \$100/kWh. Assuming a continuation of the 18% historic learning rate, Bloomberg New Energy Finance forecasts battery prices could fall to around \$70/kWh by 2030.



Source: BNEF, Guinness Atkinson Asset Management, December 2024

Weaker than expected EV demand in 2024 led to falling battery manufacturing utilization rates across the industry, falling as low as 21% for tier 2 manufacturers in China compared to 63% for industry leader CATL. Smaller players facing persistently low utilization and weak profitability are starting to respond by curtailing investment or exiting the industry entirely. Benchmark Minerals noted that at least 25 gigafactory projects across China and Europe were cancelled or postponed in 2024, leading to downward revisions to long term supply estimates. Northvolt's bankruptcy served as a fresh reminder of how scale and incumbency act as fierce barriers to entry in this industry, which is why just six companies supply over 80% of EV battery volumes worldwide. With EV penetration due to accelerate across the West in 2025 and 2026, we expect utilization rates at tier 1 manufacturers to inflect positively, helping to boost margins and profitability.

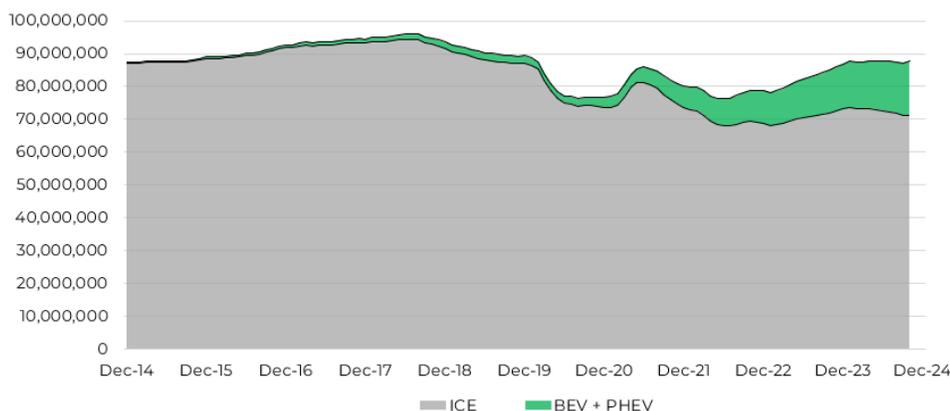


Source: Bernstein, Guinness Atkinson Asset Management, December 2024

Last year also saw rising trade tensions after the Biden administration more than tripled tariffs on Chinese imports of lithium-ion batteries (7.5% to 25%) and quadrupled tariffs on Chinese EVs (25% to 100%) in an attempt to shield domestic manufacturers from China’s “unfair economic practices”. With the election of Donald Trump, trade barriers look set to rise further in 2025 and beyond. Given Trump’s hostile stance towards China, we see it as highly likely that the US will incentivize “friendly” countries to bring their technology and build battery manufacturing capacity in the US, presenting an opportunity for Japanese and South Korean manufacturers.

Global light vehicle sales are expected to have fallen by 2-3% in 2024 with **Electric vehicles** continuing to gain popularity, growing 20% year-over-year to 17 million units (a 20% penetration rate). Meanwhile, internal combustion engines (ICEs) continue to lose share, with sales having fallen by around 25% since their peak in 2017.

Rolling 12-month Light Vehicle Sales by Drivetrain (LHS)

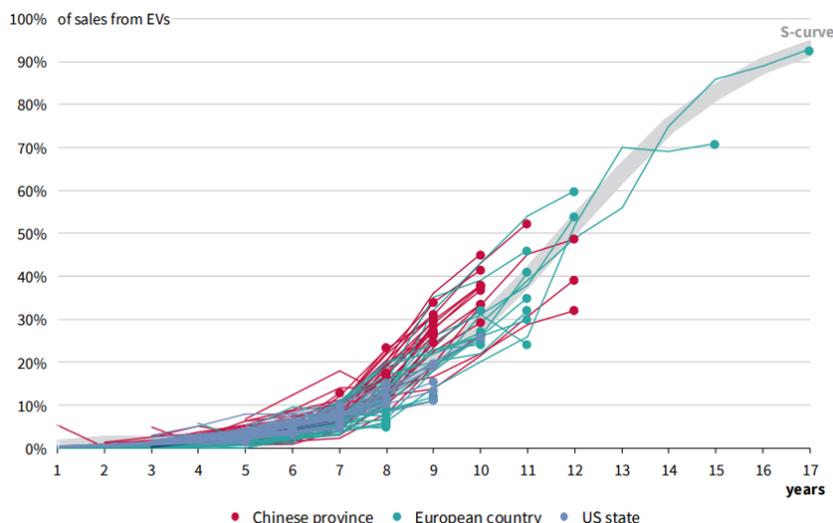


Source: Cleantechnica, LMC, Guinness Atkinson Asset Management, December 2024

Slowing EV sales growth was largely attributable to higher financing costs, a post-COVID inflationary spike in vehicle prices and a weakening macroeconomic environment. Lower interest rates and cheaper batteries will improve EV affordability and should act as further positive catalysts for the sector.

We take confidence from Norway, which has banned ICE vehicle sales this year after seeing EV penetration rise from just 10% in 2013 to over 90% in 2024. While Norway is a small high-income country, it is interesting that its EV adoption curve is being tracked very closely by China, which achieved EV penetration rates of over 50% in the second half of 2024. Indeed, RMI analysis covering over 110 countries, states, and provinces across Europe, the US, and China found a universal S-curve pattern to EV deployment, with EV sales taking six years to get to 5%, and only another six years to get to 50%. If growth continues along these S-curves, RMI estimates that electric vehicles will make up over 80% of new vehicle sales in China and Europe by 2030 with the United States reaching that level by 2035.

Share of car sales from EVs along an S-curve



Source: RMI; December 2024

Ultimately, we believe EVs will be cheaper to buy, cheaper to run and cheaper to maintain, driving the journey towards 50% global EV sales penetration in 2030 and over 90% sales penetration in 2040. While regulatory and policy-based initiatives have been necessary to grow the EV industry to critical size, it is ultimately better technology (Chinese battery manufacturer CATL has developed a lithium iron phosphate battery with a 1,000km range), better efficiency (EVs convert over 85% of energy stored into motion, compared to less than 40% for ICE vehicles) and better economics (60% of all EVs sold in China in 2023 were cheaper than the ICE equivalent) that will cause EVs to dominate.

Renewable Installations – Solar, Wind, Power Grids, & Nuclear

The **solar** industry delivered remarkable growth again in 2024, with global installations of around 600 GW, up around four times (40%pa) since 2020 and nearly double the 22%pa growth achieved between 2014 and 2019. The rapid uptake is undoubtedly due to the vast improvements in both solar technology and solar economics with module prices continuing to tumble, falling by 90% over the past 10 years to a record low of just 9 cents per watt in 2024, below the cash cost of manufacturing.

Solar continues to become more efficient. Around 20 years ago, solar modules were 5% efficient, 10 years ago they were 15% efficient, current modules are around 25% efficient and current research suggests that we may achieve 50% efficiency over the longer term. This could open the door to solar power costs falling 50-75%, to as little as 1-3 cents per kilowatt hour (c/kWh), thereby cementing its position at the bottom of the electricity cost curve.

Looking to 2025, we expect growth across all major geographies to result in full year global installations of around 670 GW. China will continue to dominate, making up approximately 50% of the global market as it attempts to decarbonize its power grid and achieve peak emissions before 2030. Growth should remain robust in North America driven by “big tech” looking to lock in solar power purchase agreements which offer zero carbon electricity with long term price visibility and one of the fastest times to power. Datacenters also

provide a tailwind in Europe, which is expected to grow at a more restrained pace, after more than doubling in size over the previous 3 years.

Global solar module installations, 2010-2025E (GW)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025E
OECD solar installations (annual)																
North America	1	2	4	6	7	8	15	12	12	15	22	26	26	40	48	53
Germany	7	7	8	3	2	1	1	2	4	4	5	6	7	15	15	16
Spain	0	0	0	0	0	0	0	0	0	5	4	6	9	9	8	9
Rest of Europe	3	4	5	5	5	8	5	7	9	14	15	21	28	46	55	56
Australia	0	1	1	1	1	1	1	1	4	3	4	6	4	6	4	5
South Korea	0	0	0	1	1	1	1	1	2	4	6	4	3	3	3	4
Japan	1	1	2	7	10	11	8	7	7	7	9	6	6	5	4	5
Total OECD	17	23	24	24	25	31	32	31	39	53	65	75	86	128	141	152
<i>Change</i>	10	7	0	0	2	5	1	0	7	14	12	10	18	42	55	25
Non-OECD solar installations (annual)																
China	0	3	3	14	13	19	30	53	44	33	52	69	107	260	309	330
India	0	0	1	1	1	2	5	10	11	11	4	13	19	14	27	29
Rest of non-OECD	1	3	3	4	6	4	8	7	12	21	29	26	40	42	123	156
Total Non-OECD	2	5	8	18	21	27	46	72	67	65	85	107	172	316	458	515
<i>Change</i>	1	3	2	11	2	6	19	26	-5	-2	20	22	58	144	286	198
Total solar installations (annual)	19	29	31	42	46	56	75	101	106	118	150	182	252	444	599	667
<i>Change</i>	11	10	2	11	4	10	19	26	5	12	32	32	76	192	347	223

Source: BP, BNEF, PV InfoLink, IEA, Guinness Atkinson Estimates; December 2024

Thinking longer-term, solar power sits at the bottom end of the power generation cost curve and significant increases in solar power generation are inevitable and necessary in a low-carbon energy system. Record-low module prices will only improve the volume outlook and the down cycle will end, providing opportunities for manufacturers to regain normalized profitability levels. To offset the intermittency, we will need to see solar+storage projects being more broadly economic in order to displace new build fossil fuel power generation. Over the last couple of years, the cheapest solar+storage projects (LCOEs in the range of 4.6-6.0 c/kWh) are already competitive with the cheapest new gas/coal fired power projects (LCOEs in the range of 3.9-4.5 c/kWh and 6.8-6.9 c/kWh respectively). Higher cost projects still require subsidy and incentives.

Turning to the **wind industry**, manufacturing capacity grew by 21 GW in 2024, vs 12 GW in 2023. Total installations grew to a record 124 GW as manufacturers continued to recover from supply chain bottlenecks, raw material and labor market cost inflation and onerous non-profitable contracts that were priced before the wave of inflation that hit global raw material and labor markets in 2021. Wind operators also saw greater stabilization in 2024 with no new significant project cancellations as the interest rate easing cycle started to improve project economics. In addition, power purchase agreements (PPAs) for wind reached record highs in the US (\$65/MWh in Q3 2024 according to Levelten) and remain near all-time highs in Europe (€89/MWh). This sustained pricing, as interest rates have started to decline, has shored up new project economics, and has provided much needed certainty to operators who have sat on the sidelines through the last two or three years.

Looking into 2025, we estimate a record level around 145 GW of new installations, an increase of around 21 GW versus 2024. Encouragingly, well over half of that increase is ex. China, suggesting a material ramp in growth in the sector in the key North American and European regions.

For wind operators in 2025, we expect faster permitting and development of onshore projects, driven by new European policy. Policies such as the German “Overriding Public Interest” veto on local planning dissent has facilitated permitting increases while the UK’s de-localization of large wind farm approval (announced in Dec’24) and the proposed German Transport Streamlining (to ease the overland transport of large wind turbine blades) should have a meaningful impact on installations in 2025. For wind equipment

manufacturers (OEMs) the 2025 outlook for margins is attractive as the pricing of new order intake remains elevated, even as raw materials, namely steel, have broadly dis-inflated in 2024. Further, 2024 saw execution of the bulk of the remaining legacy backlog, meaning that 2025 has potential to deliver a strong inflection in gross margin.

Industry wind turbine pricing (€'m/MW)



Source: Company Data, BNEF, Guinness Atkinson Asset Management estimates, 2024

We see a near 60% increase in installations to around 200 GW by the end of the decade, with onshore growing at 6%pa and offshore growing at 20%pa. The starting point for the industry is healthy, with industry level book to bill (the ratio of new orders to existing sales) at c.1.2x on a trailing 12-month basis as of Q3 2024, comfortably above 1.0x. This suggests that the industry has a strong pipeline of work.

Protectionist policy in the US in 2023 promoted the building of a local supply chain for the OEMs and installation companies while protectionism in Europe in 2024 gives us further encouragement, particularly in a market more prone to incursion from the Chinese OEMs who have a 30% cost advantage. The EU Commission is currently investigating competitive distortions in the wind industry, with anti-dumping measures a potential antidote, a solution heavily advocated for by the German Economy and Energy Ministry (BMWK).

We finally remain encouraged by the potential of the Offshore sector to drive growth in the wind industry, as we enter the second half of the decade. Within Europe alone, there is c.26 GW of awarded and approved capacity set to come on-stream by 2030, the equivalent of 2-3 years of onshore growth globally. We would expect this to grow and note that there are 9.2 GW of projects tendered offshore France in November 2024 that will soon join this backlog.



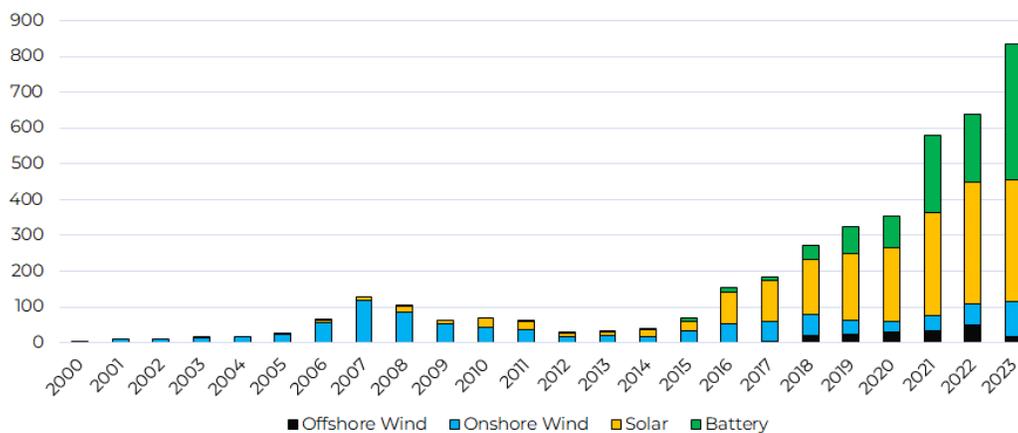
Source: Company Data, Guinness Atkinson Asset Management estimates, 2024

Global power grids will have to be substantially upgraded and extended to cope with higher wind and solar generation. This includes high voltage transmission (covering large distances), medium voltage distribution (covering shorter distances) and low voltage equipment (used within buildings). Within high and medium voltage applications, we continue to see strong growth in transmission and distribution (T&D) spending and the Edison Electric Institute saw US T&D investment at \$95bn in 2024, up 9% versus 2023. We expect a healthy outlook for US grid investment, averaging 8-10% growth per year to 2030, as network owners and operators look to replace and upgrade ageing infrastructure (most of which is 30-50+ years old), harden the grid against extreme weather and build out new capacity.

This final point – new sources of power demand – was a key theme in 2024. After 20 years of flat electricity consumption, datacenters, AI querying, reindustrialization and electrification are set to drive growth of 2-3%pa out to 2030. However, there remains three meaningful bottlenecks to this growth, relevant both in a US and a global context:

- **Labor:** Bernstein estimates that the US will need 50% more linemen by 2035, forecasting a 12,000-worker shortage if the industry continues to grow at its historic rate.
- **Transformers** The average US transformer is 35-40 years old and the US imports around 80% of its large transformers. Supply chains are stretched with prices up 60-80% since early 2020 and lead times tripling to ~150 weeks since 2021.
- **Permitting:** The Lawrence Berkley National Laboratory sees the US interconnection queue at its highest level on record while WoodMac expects that permit applications from as far back as 2020 will not be approved until later this decade.

US cumulative interconnection queue



Source: Generation, Lawrence Berkeley National Laboratory, 2024

These are long-term trends that will require multi-year investment programs, and it is therefore not surprising that **nuclear power** came back into consideration in the US as concerns grew about grid stability. While not necessarily considered to be a “renewable” power source, and despite its checkered past, nuclear power will play a role in the global energy transition and there is not a single credible net zero scenario which doesn’t forecast growth in “carbon-free” nuclear. The 2024 nuclear renaissance saw big tech companies sign deals to restart old reactors, to support small modular reactors (SMRs) and to invest in start-up companies developing nuclear fusion technologies.

A key focus remains SMRs, which are frequently touted as a solution to provide baseload low carbon power generation. However, as far as we are aware, only two SMRs are currently in operation globally - one in Russia (in a maritime setup) and the other in China. With limited information about either, the development schedule and the underlying economics of both are unclear. From what we know, we think SMRs in the US will not be cheaper than gas or renewables-based power generation. In late 2023, NuScale cancelled its planned SMR Carbon Free Power Project (CFPP) in Utah as its costs escalated (requiring 9 c/kWh to be economic, after a 3 c/kWh IRA subsidy) and its start date slipped (back to 2029, from an original plan of 2026). While carbon-free base load power at \$9 c/kWh could certainly be considered “economic”, we would expect project delays and cost overruns to take this substantially higher.

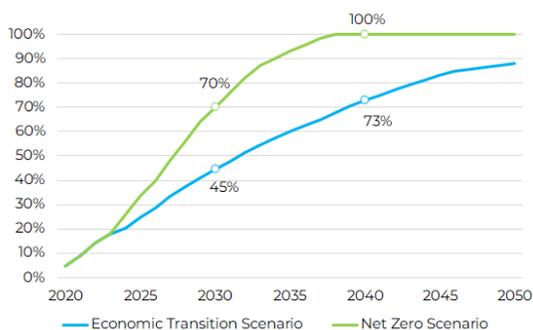
So, beyond restarting idled nuclear plants, nuclear power does not appear to be set for meaningful growth. We expect first power from new SMR facilities to occur after 2032, but even then, it is unlikely that SMRs have any meaningful impact until the late 2030s, in our opinion. This leads to a situation where global power grids will need to be extended and strengthened in order to cope with higher levels of variable renewable power.

Implications of a Net Zero Scenario

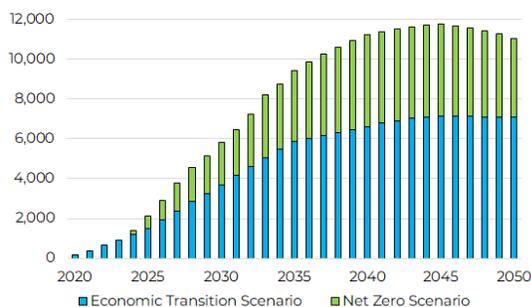
Throughout this document, we refer to our base-case energy transition scenario that reflects our understanding of the industry’s current capacity and plans to provide decarbonization solutions. This scenario is not consistent with net zero and we highlight the following changes across our sub sectors that would be required to deliver a net zero transition:

- Within **efficiency**, annual improvements in energy intensity would need to quadruple from 1% in 2024 to average 4%pa out to 2030 globally. For buildings, this translates into efficiency, electrification and end-use investment increasing to around \$850bn pa this decade (from \$340bn today). For Industry, investment must step up from \$50bn in 2024 to \$125bn pa out to 2030. It is worth noting that our base case scenario already assumes significant energy efficiency gains with world energy demand forecast to grow at 1%pa, half the historic rate of 2%pa.
- **Alternative fuel** production growth would need to more than double by 2030 from 2023 levels (implying 11%pa growth) and then double again by 2050. SAF would have to grow from 0.3% of global jet fuel in 2024 to around 10% in 2030 (substantially higher than our base case 2030 estimate of around 2%)
- For **electric vehicles** and **batteries**, BNEF estimate that in a net zero scenario, global EV penetration rates must hit 70% by 2030 with 100% of vehicles sold being electric by 2040 (versus their current “base case” economic transition estimates of 45% and 73% respectively). This translates into global battery demand of 5.8 TWh in 2030 compared to 1.2 TWh today, almost 60% higher than their base case assumptions, which themselves imply an annual growth rate of 20% pa from current levels.

EV sales penetration forecasts (%)



Lithium-ion battery demand forecasts (GWh)



Source: BNEF, Guinness Atkinson Asset Management estimates, December 2024

- **Solar** and **wind** generation by 2050 would need to be more than double the levels anticipated under our base case scenario, which already assumes a 4x increase in the wind generation base and a 10x increase in the solar base.
- For **power grids**, net zero would require global grid investment to grow at around 14%pa to the end of the decade, more than doubling from around \$370bn today to over \$800bn by 2030, 50% higher than our base case estimate.
- Under a net zero scenario, **nuclear** power capacity needs to expand by around 15GWpa every year to the end of the decade, reaching 545GW by 2030. Despite this only constituting 30% growth from current levels, new installations must outpace a wall of retirements from power plants installed in the 1970s and 1980s which are now coming to the end of their useful lives.

The Guinness Atkinson Alternative Energy Fund

The Guinness Atkinson Alternative Energy Fund delivered a return of -11.85% in 2024, underperforming the MSCI World Index, which finished the year +18.67%. Within our portfolio, the top contributing segments were our electrical equipment and generation sectors, while underperforming segments included our solar/wind equipment and electrification sectors.

Performance data quoted represents past performance; past performance does not guarantee future results. The investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance of the Fund may be lower or higher than the performance quoted. Performance data current to the most recent month end may be obtained by visiting www.gafunds.com or calling 800-915-6566.

The **electrical equipment** sub sector held four of the top five contributors. In 2024, the sector benefitted from a growing realization that investment in power grids is behind where it needs to be, especially in the face of surging growth of data centers and AI querying. Our electrical equipment names Eaton, Hubbell, Schneider and Itron all performed strongly, driven by an acceleration in global electrification activity, the re-industrialization of the United States and the resolution of supply chain issues which allowed them to pass on inflationary pressures and therefore maintain operating margins. We grew our exposure to this subsector, which saw the best earnings upgrades in the portfolio, with the addition of Siemens mid-year.

Trane Technologies was the individual strongest contributor in the portfolio, helped by its positioning with respect to data centers as well as regulatory changes (which increase the need for better HVAC). Elsewhere in the **displacement** sub sector, Installed Building Products (IBP) and Owens Corning benefitted in the first half of the year on hopes that lower mortgage rates will drive greater housing market activity. At the other end of the spectrum, Nibe shares were under pressure as weak demand meant that the heat pump market remained overstocked at the distributor level as lower cost Asian competition intensified. We exited the position in Nibe towards the end of the year.

Within the renewable power **generation** sector, we own a number of utilities and independent power producers (IPP) that have seen only small changes to cash returns and earnings forecasts over the year. This sector has a higher interest rate sensitivity due to higher debt burdens, so with the yield on the US 10-year treasury starting the year at c.4% and ending the year at around 4.4%, it is not surprising that the expectations for generation companies have not really changed. Sector contribution was neutral, but NextEra bucked this trend, delivering an upbeat "Renewables Development Day" for investors while both of our Chinese wind power producers delivered growing volumes and benefitted from the market rally in China.

Orsted shares stabilized after management announced a reset to the business in February, cutting the dividend and focusing the company on profitable growth but contribution turned negative in the second half. We exited our position in Sunnova, reflecting the company's higher financing costs which has pressured the roll out of residential solar in the US.

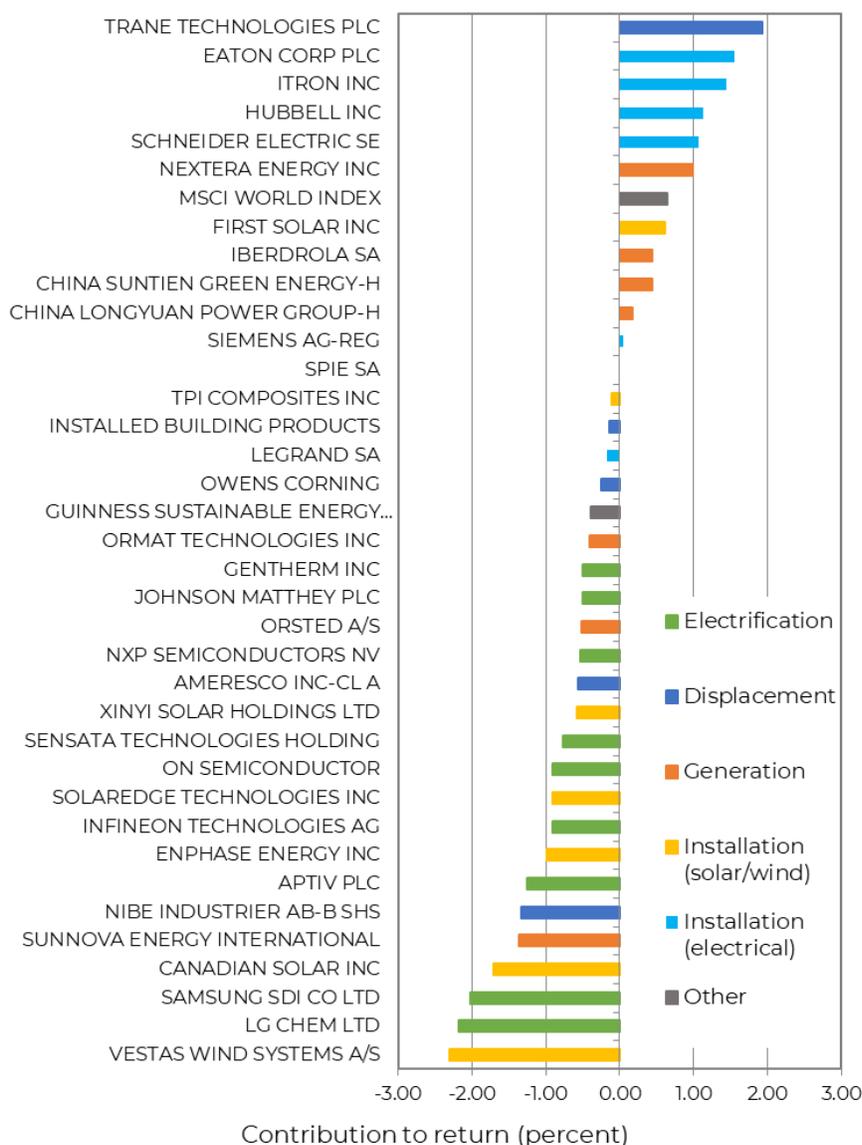
Turning to the more pressured parts of the portfolio, within **electrification** we hold a number of companies that sell components into the electric vehicle supply chain and that also have exposure to the internal combustion engine (ICE) supply chain. Earnings expectations over the last twelve months have soured for all except Aptiv as global auto sales and EV penetration growth have slowed (relative to start of year

expectations), EV launch schedules have been delayed, margins have been pressured, and Chinese competition has increased. All companies here suffered negative contribution. The slower pace of EV penetration in the US and Europe caused LG Chem and Samsung SDI to be among the largest negative contributors. Both companies are critical to US plans to build large-scale battery plants as part of the EV supply chain but both are operating at below 60% utilization, which is weighing on operating margins and EPS.

Solar and **wind installation** companies sit at the heart of the energy transition, but in the recent period, our solar and wind equipment manufacturers have seen mixed earnings growth expectations. In solar, the rapid growth of Chinese solar module supply has led to a market share battle among low-cost Chinese polysilicon and module manufacturers. In our portfolio, this has impacted Xinyi Solar (solar glass manufacturer) and Canadian Solar (solar cell and module manufacturer). Calling the cyclical bottom is never easy, but we do note many polysilicon and solar module manufacturers are now selling products below cash cost. In the downstream, solar inverter manufacturers EnPhase and SolarEdge have indicated that the inventory destocking cycle has ended in the United States and is close to ending in Europe. We see that signs of a “bottom to the cycle” are therefore appearing. The sole positive contributor was First Solar, the US’s leading domestic module manufacturer. The company is a beneficiary of the IRA and finds its modules in high demand from US utility solar players who are drawn to the security of delivery of its products. First Solar’s modules are now sold out until the end of 2027.

The largest individual negative contributor in the year was Vestas, which announced a negative change to the accounting approach it uses for its service contracts. Beyond this specific accounting issue for Vestas, the wind industry continued to recover from its cyclical trough but negative sentiment around Trump’s election caused weakness into the end of the year.

2024 individual stock contribution in USD



Source: Bloomberg, Guinness Atkinson Asset Management estimates

The Guinness Atkinson Alternative Energy fund was repositioned at the start of 2019 and, over the last six years, there has been some substantial volatility across various sustainable energy sectors. Over the entire period, the fund has on average been correctly positioned (overweight or underweight) to all subsectors except wind equipment and other equipment manufacturers. In terms of stock selection, our fundamental value-oriented approach has facilitated good stock selection within the efficiency, EV, IPP, utility and solar equipment sub sectors while stock selection has been negative within batteries, wind and other equipment manufacturers. Over the six-year period, the Guinness Atkinson Alternative Energy fund (post fees) has delivered a return that has been in excess of its investment universe, based on an equal weighted average calculation.

Attribution of Guinness Atkinson Alternative Energy Fund versus the universe (2019-2024)

Subsector	Average weight			Indicative attribution	
	Universe	Fund	Relative	Sector allocation	Stock selection
Alternative Fuel	3.8%	0.0%	Underweight	Positive	Neutral
Efficiency	10.1%	14.3%	Overweight	Positive	Positive
Battery	14.3%	11.5%	Underweight	Positive	Negative
Electric Vehicles	20.2%	18.7%	Underweight	Positive	Positive
IPP	16.4%	13.9%	Underweight	Positive	Positive
Utility	10.7%	7.7%	Underweight	Positive	Positive
Equipment - solar	8.6%	15.6%	Overweight	Positive	Positive
Equipment - wind	2.6%	7.4%	Overweight	Negative	Negative
Equipment - other	13.2%	11.2%	Underweight	Negative	Negative

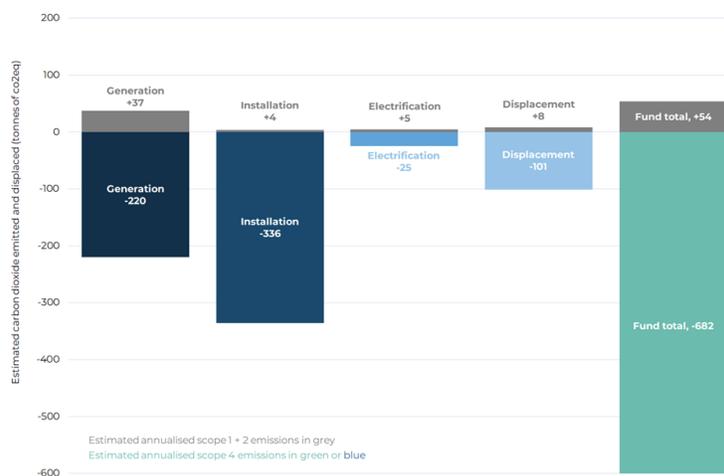
Source: Guinness Atkinson Asset Management estimates, Bloomberg; to December 31, 2024

Positive decarbonization impact of portfolio companies

The Guinness Atkinson Alternative Energy Fund invests in companies playing a key role in global decarbonization, providing a vehicle for investors to align their capital with this positive impact.

In September 2024, we published our latest impact report which detailed the positive decarbonizing impact of the companies held in the portfolio at the end of 2023 (based on calendar year 2023 data). Our headline finding was that the companies in our portfolio sold products and services that helped to displace 682 tonnes of CO2e per USD\$1m of portfolio assets. This figure is based on estimates for energy saved, electric miles travelled, and clean energy generated compared to the continued use of incumbent fossil fuel technologies. In delivering this positive impact, we estimate that the companies in our portfolio generated an annualized “carbon cost” of around 54 tonnes of CO2e per USD\$1m of portfolio assets, based on scope 1 and 2 emissions data.

Estimated annualized carbon cost vs carbon displaced (tonnes) per US\$1m of AUM by sector



Source: Guinness Atkinson Asset Management estimates

Key themes in the portfolio

Within the portfolio, the weighting to consumption (i.e. the demand side of the energy transition) fell from 43.9% at the end of 2023 to 41.6% at the end of December 2024 while the weighting to renewables (i.e. supply side) grew from 51.9% to 57.7% and cash reduced from 4.2% to 0.7%. We currently reflect the consumption (i.e. displacement and electrification sub sectors) and renewables (i.e. installation and generation sub sectors) by combining them into the following investment themes:

Key themes in the Guinness Atkinson Alternative Energy Fund

Theme	Example holdings	Weighting (%)
1 Electrification of the energy mix	 	36.9%
2 Rise of the electric vehicle and auto efficiency	 	9.8%
3 Power semiconductors	 	9.8%
4 Battery manufacturing		4.0%
5 Expansion of the wind industry		9.2%
6 Expansion of the solar industry		8.1%
7 Heating, lighting and power efficiency		17.9%
8 Geothermal		3.5%
9 Other (inc cash)		0.7%

Source: Guinness Atkinson Asset Management estimates; January 2025

The energy transition is generally progressing well, and the multi-decade positive outlook remains. However, within this secular trend, there are cycles at play, some of which have been in an “up” phase (e.g. electrical equipment, building material, grid investment) and some in a “down” phase (e.g. battery/EV supply chain; solar upstream). We are confident in the structural growth offered by both these challenged industries, which appear to be at or close to a cyclical trough.

With the US election behind us, we look to a reduction of financing costs (i.e. interest rate reductions by central governments feeding into consumer and project financing) to drive investments into the clean energy sector. Together with growing AI and data center demand, stricter energy efficiency requirements, massive grid upgrade programs and the implicit operating leverage within our manufacturer investments we think that confidence in portfolio earnings should start to improve. The sector’s depressed valuation levels currently sit very much at odds with this potential earnings outlook.

As such, investor interest in sustainable energy equities should start to improve from very poor levels as energy security and increased individual, social and government pressures for consumers to become more energy efficient continue. We believe that the Guinness Atkinson Alternative Energy portfolio of 30 broadly equally weighted positions, chosen from our universe of around 250 companies, provides concentrated exposure to the theme at attractive valuation levels that are particularly attractive relative to consensus earnings growth expectations.

Jonathan Waghorn, Will Riley, Jamie Melrose, Jordan Patel and Charlie Hogg
January 2025

Performance

As of 12/31/2024	YTD	1 Year	3 Years	5 Years	10 Years
GAAEX	-11.85%	-11.85%	-9.08%	8.72%	4.00%
MSCI World Index NR	18.67%	18.67%	6.33%	11.15%	9.94%

All returns after 1 year annualized.

Inception 03.31.2006 Expense ratio * 1.10% (net); 1.79% (gross)

Performance data quoted represents past performance; past performance does not guarantee future results. The investment return and principal value of an investment will fluctuate so that an investor's shares, when redeemed, may be worth more or less than their original cost. Current performance of the Fund may be lower or higher than the performance quoted. Performance data current to the most recent month end may be obtained by visiting www.gafunds.com or calling 800-915-6566.

* The Advisor has contractually agreed to reduce its fees and/or pay Fund expenses (excluding Acquired Fund Fees and Expenses, interest, taxes, dividends on short positions and extraordinary expenses) in order to limit the Fund's Total Annual Operating Expenses to 1.10% through June 30, 2027. To the extent that the Advisor absorbs expenses to satisfy this cap, it may recoup a portion or all of such amounts absorbed at any time within three fiscal years after the fiscal year in which such amounts were waived or absorbed, subject to the expense cap in place at the time recoupment is sought, which cannot exceed the expense cap at the time of the waiver. The expense limitation agreement may be terminated by the Board of the Fund at any time without penalty upon 60 days' notice.

MSCI World Index captures large and mid cap representation across 23 Developed Markets countries. With 1,546 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

MSCI Global Alternative Energy Index includes developed and emerging market large, mid, and small cap companies that derive 50% or more of their revenues from products and services in Alternative energy.

Cash Flow Return on Investment (CFROI) is a valuation metric that acts as a proxy for a company's economic return. This return is compared to the cost of capital, or discount rate, to determine value-added potential. CFROI is defined as the average economic return on all a company's investment projects in a given year.

Price-to-Earnings (P/E) Ratio is the ratio for valuing a company that measures its current share price relative to its earnings per share.

Earnings Per Share (EPS) is a company's net profit divided by the number of common shares it has outstanding.

Scope 1 Emissions are direct greenhouse gas emissions that occur from sources that are controlled or owned by an organization (for example, emissions associated with fuel combustion in boilers, furnaces, vehicles).

Scope 2 Emissions are indirect greenhouse gas emissions associated with the purchase of electricity, steam, heat, or cooling. Although scope 2 emissions physically occur at the facility where they are generated, they are accounted for in an organization's greenhouse gas inventory because they are a result of an organization's energy use.

COP29, or the 29th United Nations Climate Change Conference, was held in Baku, Azerbaijan from November 11–22, 2024. The conference focused on climate finance and adaptation to climate change.

Basis Point (bps) is a unit of measure used to indicate percentage changes in financial instruments. One basis point is equal to 1/100th of 1%, or 0.01%.

The Organization for Economic Cooperation and Development (OECD) is an intergovernmental organization that helps countries develop economic policies.

Fund holdings and/or sector allocations are subject to change at any time and are not recommendations to buy or sell any security.

The Adviser categorizes the universe of companies it deems to be Sustainable Energy companies into four key areas related to the specific aspects of the energy business. Currently, these key areas are generation, innovation, displacement, and electrification. The Fund holdings in each key area may vary and the Fund's may invest in companies that do not fall within these key areas.

One cannot invest directly in an index.

Earnings Growth is not a measure of future performance.

Opinions expressed are subject to change, are not guaranteed and should not be considered investment advice.

The Guinness Atkinson Alternative Energy Fund's investment objectives, risks, charges and expenses must be considered carefully before investing. The statutory and summary prospectuses contain this and other important information and can be obtained by calling 800- 915-6565 or visiting www.gafunds.com. Read and consider it carefully before investing.

The Fund invests in foreign securities which will involve greater volatility and political, economic and currency risks and difference in accounting methods. The risks are greater for investments in emerging markets. The Fund also invests in smaller and mid-cap companies, which will involve additional risks such as limited liquidity and greater volatility than larger companies. The Fund's focus on the energy sector to the exclusion of other sectors exposes the Fund to greater market risk and potential monetary losses than if the Fund's assets were diversified among various sectors.

GAAEX: 2025 Outlook for Sustainable Energy

Top 10 Holdings as of 12/31/2024:

1. Iberdrola SA	5.23%
2. Schneider Electric SE	5.09%
3. Hubbell Inc	4.91%
4. Nextera Energy Inc	4.88%
5. Eaton Corp PLC	4.78%
6. Trane Technologies PLC	4.77%
7. Siemens AG	4.77%
8. Legrand SA	4.48%
9. Itron Inc	4.10%
10. Owens Corning	3.74%

Distributed by Foreside Fund Services, LLC