MILLIMAN REPORT

Climate Risk Solutions

A discussion of potential adaptions and opportunities for life insurers

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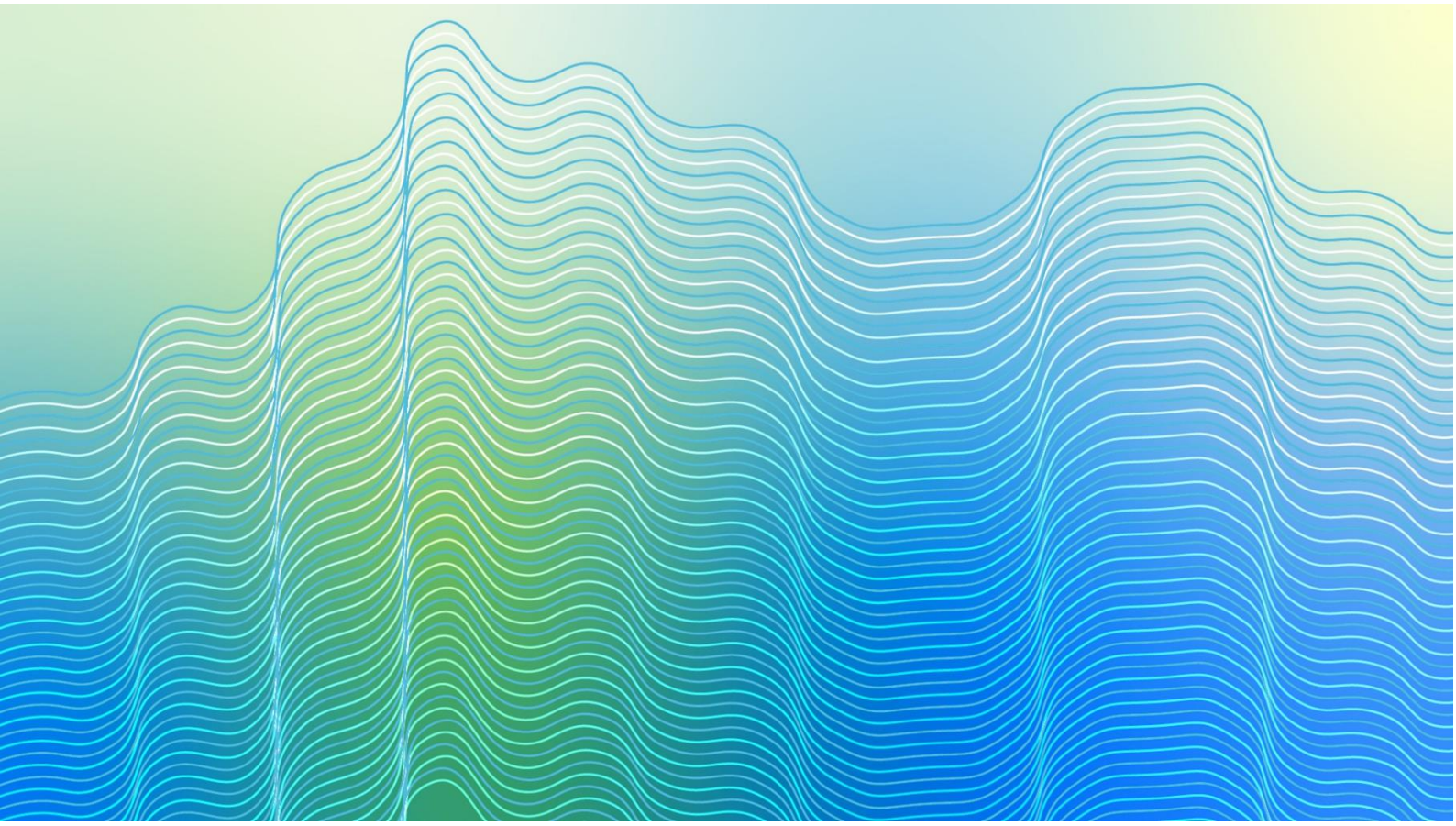

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Section 1: Executive Summary

In our accompanying Milliman research report on Climate Risk Management, we discussed how insurance companies can assess their climate transition risk. Once climate transition risk has been assessed, the next question is what could insurers be doing about it?

In this paper we discuss some potential areas for consideration. Given the vast scale of the topic, our discussion is not meant to comprise an exhaustive list. However, we hope it helps provide some useful insights, perspectives, and food for further thought.

We provide a summary of some of the approaches insurers have already been taking, to help provide a potentially useful benchmark to your own company's current strategy. Here we particularly focus on the management of investment risk in legacy investment portfolios. Secondly, thinking more broadly about product strategy, we discuss some ideas about new areas insurers could be considering to help in making a contribution in addressing climate change. Some of these ideas are more developed than others, but hopefully they may help to stimulate further thinking around potential new product innovation for your organisation.

We split the report into two sections, illustrated by the schematic below.

INVESTMENT RISK

Driving Decarbonisation	▪ **Divestment:** Divesting requires careful consideration of the climate transition risk exposures and whether it is likely to be an effective strategy in practice for achieving decarbonisation. Divesting from thermal coal is a common strategy for many large insurers. ▪ **Engagement:** This is a tactic more aligned with establishing long-term relationships with investee counterparties for key holdings. Engagement can be a powerful tactic when collaborating with other investors. The Climate Action 100+ initiative sets out an industry standard framework for this. ▪ **Passive Portfolio Optimisation:** Active decisions are required over the choice of benchmark. There is now a proliferation of specialist benchmarks that optimise weights to reduce the carbon footprint of an index and align with decarbonisation pathways.
Managing Decarbonisation Risk	▪ **Carbon Emissions Trading Schemes:** Carbon Emissions Trading schemes (ETS) are becoming an increasingly expanding regulatory requirement for various sectors of the economy. They act to impose a regulatory price on carbon emissions. ▪ **Carbon Derivatives for Risk Mitigation?** Carbon derivatives on key emissions trading schemes are becoming more liquid. We discuss the pros and cons of using these derivatives for long-term risk mitigation purposes.
Investing in Green Enablement	▪ **Equity Investment:** There is a positive aspect to climate transition risk in the potential market opportunity from sectors that will help enable the net zero economy. Specialist equity can capture growth from these sectors. ▪ **Bond Investment:** Insurers could play a leading role to further scale and mainstream this asset class niche, which is likely to be key in financing investment for a net zero economy. ▪ **Existing Property Investment:** Retrofitting projects on existing commercial property investments could provide an opportunity to enhance returns. ▪ **New Infrastructure:** The UK and EU have ambitious targets for new renewable energy structures, which could present attractive investments for some insurer liabilities, if the challenge of specialist expertise can be met.
Scaling Negative Emissions	▪ The Intergovernmental Panel on Climate Change (IPCC) has set out the case for a need for negative emissions technology, albeit with a degree of caution. Swiss Re and AXA are examples of European (re)insurers already investing in this area.

PRODUCT STRATEGY

Influencing Customer Behaviour

- The banking and non-life insurance sectors have already been developing products to positively influence customers towards sustainable behaviour, as well as embedding green practice in product management. This includes green mortgages, green house insurance, green motor insurance and default application of carbon offsetting.
- Great Eastern of Singapore recently claims to have launched the first 'green life insurance' product—a three-year guaranteed savings plan that invests exclusively in projects aimed at climate change mitigation.

Enabling Green-Conscious Customers

- **Green Investment Option:** There is a clear need to offer investment options to new customers who are keen to have an impact on climate change. Demand is likely higher for younger segments, and so combining a financial technology (fintech) solution may be appealing.
- **'Climate Neutral Now' Carbon Offsetting Option:** The voluntary carbon market can be an important mechanism for channelling finance to climate projects in developing countries. Offering an option to offset the carbon footprint funded by portfolio investments, with a regular payment to purchase carbon credits, can be a way to support this market. Given the continuing increase in carbon price, range of potential projects and fragmented carbon markets, devising an appropriate pricing and risk management strategy will likely be important for success.
- **Community Energy:** Smart technology now exists to enable community energy on a geographically dispersed basis. Direct renewable energy ownership can be a smart way to hedge energy price inflation. This also enables customers to have a tangible positive impact on climate change.

Supporting Customers in Personal Decarbonisation

- **'Micro-Infrastructure' Green Bonds:** Insurance companies are now issuing green bond debt. Such capital proceeds could potentially be used to offer financing to customers on domestic renewable energy and energy efficiency installations. Financing could be bundled with life insurance cover. Standardisation can help manage cost. Composite insurers that offer property insurance may also be well placed to manage risks.
- **'Electric Vehicle Endowments':** The endowment structure, traditionally used for cost-efficient funding of house purchases, could potentially be translated to fund electric vehicle (EV) purchases instead. Insurers could offer such financing for EVs only, to drive the shift away from combustion engines.
- Leaving the transfer of EV ownership to contract maturity gives flexibility should customer preferences change. As society shifts towards a low-carbon economy in the coming years, outright vehicle ownership may become less popular, with the emergence of shared ownership models.

Taking a Holistic View to a Better Retirement

- **Aligning Personal Decarbonisation With Retirement Savings:** Given the parallel crisis in retirement savings adequacy, careful consideration ought to be given to financing of personal decarbonisation to avoid substituting regular savings into a pension. Instead, personal decarbonisation financing products could be designed to also align with increased savings towards a pension. Regular premium payments could default into pension savings at the end of the financing term. Tax-free cash entitlements could also be targeted for financing purposes.
- **Holistic Retirement Planning:** Traditionally, retirement planning involves optimising income from a pension pot to meet retirement goals. However, financial well-being in retirement is a function of both income and expenses. Domestic energy costs are a key element of core expenses.
- **Domestic Renewable Energy Self-generation and Energy Efficiency:** These options are now at a cost level that can deliver attractive returns on investment over a typical retirement planning period. The returns can, in some scenarios, be superior to expected returns on cash flows from many retirement income products.

Section 2: Investment Risk

OVERVIEW

In our accompanying Milliman research report on Climate Risk Management, we discussed how insurance companies can assess their climate transition risk. A significant component of transition risk relates to financial or investment risk—i.e., potential losses on the investment portfolio from the transition to a low-carbon economy occurring differently to the expected path currently priced into the markets.

Given the now accepted global consensus of the need to achieve a net zero economy in the coming decades, the overarching approach to managing this investment risk is to set out a framework for aligning to net zero. There are various recent industry organisations, initiatives, and standards that have emerged in recent years. The following schematic sets out a common structure, to bring together a range of potential actions that feature in many of the strategies that have been adopted, or are being considered, for net zero alignment.

FIGURE 1: NET ZERO INVESTMENT FRAMEWORK DIAGRAM – A SUMMARY OF POSSIBLE ACTIONS

ESTABLISH CREDIBILITY

- Define and assert beliefs, principles, and policy
- Agree and set appropriate targets
- Define strategy and a plan for implementation, management, and accountability
- Embed into existing frameworks, policies, and mandates

IMPLEMENT

DRIVE DECARBONISATION

(MANAGE RISK)

- Measurement (exposure)
- Measurement (impact)
- Due diligence & screening
- Integration
- Optimisation (e.g., low carbon tilts)
- Engagement / stewardship
- Divestment from thermal coal

ENABLE GREEN FINANCING

(CAPTURE GROWTH)

- Direct infrastructure investment
- Invest in new/growing sectors
- Review taxonomy exposures
- Support and invest in new markets (e.g., green bonds)
- Issue green bonds directly
- Support negative emissions

COLLABORATE & INFLUENCE

- Engage and influence stakeholders
- Join and participate in industry groups
- Support and drive industry policy advocacy

COMMUNICATE & DISCLOSE

- Publicise beliefs and actions
- Disclose strategy, plan, and performance
- Disclose risk metrics – e.g., carbon intensity
- Disclose action metrics – e.g., voting record
- Comply with industry standards – e.g., TCFDs (Task Force in Climate Related Financial Disclosures)

The Paris-Aligned Investment Initiative Net Zero Framework paper[1] sets out an industry benchmark on how to embed net zero, and discusses some of the components above in more detail. In our recent Milliman research paper on environmental, social, and corporate governance (ESG) investing, we also present some case study examples of how institutional investors (insurers, pension fund managers, and asset managers) are implementing various aspects of this framework.

For the remainder of this section on Investment Risk, we delve into some of these areas in greater depth, to discuss techniques for managing climate transition risk in an insurer's legacy investment portfolio. This is based upon an assessment of what some UK and EU insurance companies are already doing, as well as a consideration of a few new areas that potentially we may see insurance companies exploring in future.

DRIVING DECARBONISATION

In our recent Milliman research report on Climate Risk Management, we presented various case study examples on how to assess exposure to the financial aspects of transition risk within an investment portfolio. Once the investment risk exposure is understood, the question is what to do about this exposure?—which could be from both a financial perspective and, more broadly, a company strategy perspective.

We discuss some of the main potential actions from the framework provided above. One overall point to note is that, in assessing which combination of approaches is the most optimal, there is likely to be some trade-off between risk reduction (or avoidance) and the potential to have an impact. There are many factors and nuances to consider when assessing potential impact, which likely explains why we still have no clear industry consensus on a single way to define and measure ESG.

Divestment

When it comes to aligning investment strategy with the need to take action on climate change, divesting from fossil fuels is one of the most widely supported calls to action by green activists,[2] and indeed many institutional investors have already divested holdings or set out clear timetables to do so. However, many also advocate that care be taken with such a tactic.[3] If the divestment movement is strong enough to push listed fossil fuel companies into private hands, then they may become less easy to influence. Listed investors can potentially have greater impact through applying consistent pressure to company management to change corporate strategy, to cease allocating capital towards new fossil fuel projects and reinvest capital towards alternative business lines.

There are different levels to divestment: from declining to participate in new bond issuance from a specific counterparty, to actively selling down and existing positions. Divestment could also be used as a last resort tactic, in efforts to persuade changes in corporate strategy and sustainability practice. There are also potential challenges to consider in following through with divestment. The need for diversification in narrow markets and buy-and-hold strategy constraints could restrict the ability to make the investment decision, and illiquid markets could also limit what could practically be executed at reasonable cost.

Ultimately a decision would likely be driven by the evaluation of climate transition risk exposure. A number of factors will come into play, including the extent of stranded assets and whether they are captured appropriately in market valuations; whether corporate management has a strategy and capability to account for climate change risk; and the extent to which the overall business strategy, or potential new business strategy, makes sense; also secondary aspects, such as financing decisions made by investment banking exposures.

Considering specific sectors, the investor community appears to be achieving near consensus on divestment from thermal coal. The following table lists the number of UK and EU insurers (which is not intended to be exhaustive) we have found that have a stated policy to divest from this sector, with varying definitions on % of revenues that defines a coal investment. A recent article by the Carbon Brief[4] highlights how much the coal

[1] Available at https://www.parisalignedinvestment.org/media/2021/03/PAII-Net-Zero-Investment-Framework_Implementation-Guide.pdf

[2] Financial Times, Letter: Divestment campaigns alter the way fossil fuel groups behave. Available at https://www.ft.com/content/aae8b12f-6336-4f0a-a565-ea51edc36647.

[3] Financial Times, The ESG investor's dilemma: to engage or divest? Available at https://www.ft.com/content/814cbd2c-00db-41b7-91af-28435301a8a2.

[4] Carbon Brief, Guest post: How world's coal-power pipeline has shrunk by three-quarters. Available at https://www.carbonbrief.org/guest-post-how-worlds-coal-power-pipeline-has-shrunk-by-three-quarters?utm_campaign=Carbon%20Brief%20Daily%20Briefing&utm_content=20210914&utm_medium=email&utm_source=Revue%20Daily.

industry has been in decline since the 2015 Paris Agreement, with now only **six** countries actively pursuing new coal plants, **four** of which are expected to be unlikely to proceed further. Such bleak prospects for this sector make it a more straightforward case to apply an investment exclusion. Key differences are around defining % of revenues for a 'coal investment' and timescale for divestment of legacy exposures.

FIGURE 2: UK AND EU INSURERS THAT HAVE SET PLANS TO DIVEST FROM THERMAL COAL

Insurer	Max % revenues	Target Date (where given)	Insurer	Max % revenues	Target Date (where given)
Aegon	25%		Lloyds of London	30%	2025
Allianz	30%		Munich Re	30%	Completed
Aviva	5%	2022	PIC	10%	2025
AXA	30%	2030 (OECD)	Prudential	30%	2022
Generali	20%	2030 (OECD)	Scottish Windows	10%	
Legal & General	20%		Zurich	30%	

For the oil and gas industry, it is a different story. There have been a few notable recent success stories in pressure from investors and activists leading to incremental change in the corporate strategy oil majors, in a climate-aligned direction. Investors are likely to be encouraged by the corporate transformation of the Danish company Orsted, which in the space of 10 years transformed from a fossil-fuel intensive energy company to a renewable energy leader,[5] as a model example of what companies in this sector could achieve.

As well as negative risk from stranded assets, there are potential asset opportunities, from the storage potential of depleted oil and gas fields for sequestered carbon dioxide—if paired with appropriate emerging technologies. However, staying invested in a company to encourage change could still come with significant risk. This could be direct risk of failure of engagement efforts to enact change, or external risk from rapid changes in both financial market and customer sentiment, should the effects of and concerns around climate change worsen. The point on sentiment is particularly highlighted by media pressure to label any fund with allocation to fossil-fuel investments as 'greenwashing' at face value, without exploring the nuances as to why a sustainable investing strategy may lead to good reasons for this holding. We discuss how this risk could potentially be managed to some extent in a later section.

Finally, the divestment approach could also be applied from an underwriting perspective. The recently convened Net-Zero Insurance Alliance brings together eight of the world's leading insurers and reinsurers to play their part in accelerating the transition to net-zero emission economies. They are committing to individually transitioning their underwriting portfolios to net-zero greenhouse gas emissions by 2050. As an example, Swiss Re has plans to tighten its policy for underwriting re/insurance across its property, engineering, casualty, credit and surety, and marine cargo lines of business. This includes thresholds for new thermal coal exposures, as well as starting to withdraw insurance support from the most carbon-intensive oil and gas production.[6]

Engagement

Engagement can involve both active stewardship of the existing investments, as well as active participation in the due diligence of new investment issues. Engagement aligns with an approach of establishing a long-term beneficial relationship with investee counterparties. Collaboration between investors can also be powerful in helping to achieve engagement goals, particularly so for smaller asset owners.

A key global initiative for coordinating engagement by influential investors is Climate Action 100+. Their latest annual report[7] outlines some encouraging statistics and results. Although clearly there is still a long way to go in achieving their mission. The **160** companies engaged by the initiative are responsible for an estimated **80+%** of

[5] Ørsted, Our Green Energy Transformation. Available at https://orsted.com/en/about-us/about-orsted/our-green-energy-transformation.

[6] Swiss Re., Launch of UN-convened Net-Zero Insurance Alliance - Swiss Re as a founding member. Available at https://www.swissre.com/sustainability/stories/pioneering-un-net-zero-swiss-re.html.

[7] Climate Action 100+, Progress Report. Available at https://www.climateaction100.org/progress/progress-report/.

global industrial emissions,[8] across **32** markets. They set a framework of standards known as the Climate Action 100+ Net Zero Company Benchmark, and currently **43%** of focus companies now have a net-zero target, **10%** of companies including Scope 3 emissions[9] within this target.

We see a wide range of active participants from the global institutional investor community, including **12** insurer asset managers and **18** insurer asset owners from the UK and Europe.[10] To highlight just one case study example, Aegon Asset Management have taken on an active role in engaging with ArcelorMittal, a steel and mining company headquartered in Luxembourg. As detailed in their UK Stewardship Code Compliance Statement,[11] this has involved them holding a number of meetings with the company management and engaging them with the Climate Action 100+ Net Zero Company Benchmark.

Progress so far has included:

- Commitment to targets of carbon neutrality by 2050 and 30% emissions reduction by 2030
- Committing to working on various pilot technologies for carbon-neutral steelmaking, including producing steel with hydrogen from renewables from 2020
- The company joining the Energy Transition Commission and being a driving force on net zero pathways
- The publication of a Climate Action report, which included scenario analysis

Passive Portfolio Optimisation

For actively managed portfolios, divestment or engagement are two of the key tools to help achieve managing climate transition risk exposure from investment portfolios, alongside other impacts and sustainable investing goals. For passively managed portfolios, key active investment decisions will instead be around the choice of index used to benchmark the portfolio. There has been a recent proliferation of ESG and climate-themed indices to enable passive funds to embed management of climate-related exposures and exposures that have business models aligned with global efforts to address climate change. Some investors have taken a step further and collaborated with index providers, to create bespoke indices that incorporate their specific views around metrics and methodologies to utilize, on how to achieve their sustainable investing goals.

We provide a comparison table of some of the methodologies underlying some of the main recent indices in the appendix, to illustrate the variation in different approaches. Key features from these indices include:

- **Greenhouse gas emissions** – The main feature of these indices is to underweight companies that have a high exposure, and overweight companies that have a low exposure, relative to a traditional market-capitalization weighted benchmark index. There are various methodologies that could be considered to define exposure. Greenhouse gas (GHG) emissions include all of Scope 1, 2, and 3 emissions,[12] or exclude Scope 3. Carbon emission metrics could be defined as ratios relative to sales (**carbon intensity**), relative to market capitalization or enterprise value (**carbon footprint**), or relative to earnings (**carbon risk**). Methodologies would target a specific % reduction relative to a traditional parent benchmark.
- **Fossil fuel reserves** – Some indices also apply similar weighting adjustments to companies with fossil fuel reserves exposure, to reflect their stranded asset risk.
- **Green revenues** – A distinguishing feature between 'low-carbon' indices and broader 'Paris-aligned' or 'climate-related' indices, is whether they make adjustments for companies with a high proportion of green and/or brown revenues. A model, framework or taxonomy is required to define what constitutes 'green' or 'brown' revenues for a given company and/or sector, and how they align to activity consistent with the transition to a net zero economy. Weighting adjustments are then applied accordingly.

[8] Based on total 2018 emissions for all Climate Action 100+ focus companies (CDP data), compared to 2018 global emissions (Global Carbon Project data).

[9] Scope 1 are direct emissions from owned or controlled sources; Scope 2 are indirect emissions from the generation of purchased energy consumed by the reporting company; Scope 3 are all other indirect emissions that occur in a company's value chain.

[10] A full list of names is provided in the Appendix.

[11] Aegon, The UK Stewardship Code 2020 Compliance Statement. Available at https://www.frc.org.uk/getattachment/543fc40f-43de-4e8a-9ce7-63f24d495893/Aegon-AM-UK-Stewardship-Code-Compliance-Statement-(March-2021)-Final.pdf.

[12] Scope 1 are direct emissions from owned or controlled sources; Scope 2 are indirect emissions from the generation of purchased energy consumed by the reporting company; Scope 3 are all other indirect emissions that occur in a company's value chain.

- **Transition Performance Indicators** – Some of the more advanced indices also make weightings adjustments based upon transition performance metrics, e.g., on management quality for implementing net zero corporate plans, or actual performance in reducing corporate carbon emissions.
- **Banking Sector** – An interesting feature of one particular index family is to limit the active weight of banking sector constituents to no more than their underlying index weight—to reflect the sector's funding role for large carbon emitters as a contributory factor to climate change, an impact not currently factored into current climate assessments.
- **Net Zero Pathways** – Some indices will also implement net zero pathways for the index's overall aggregate carbon emissions, with specific % reduction targets.

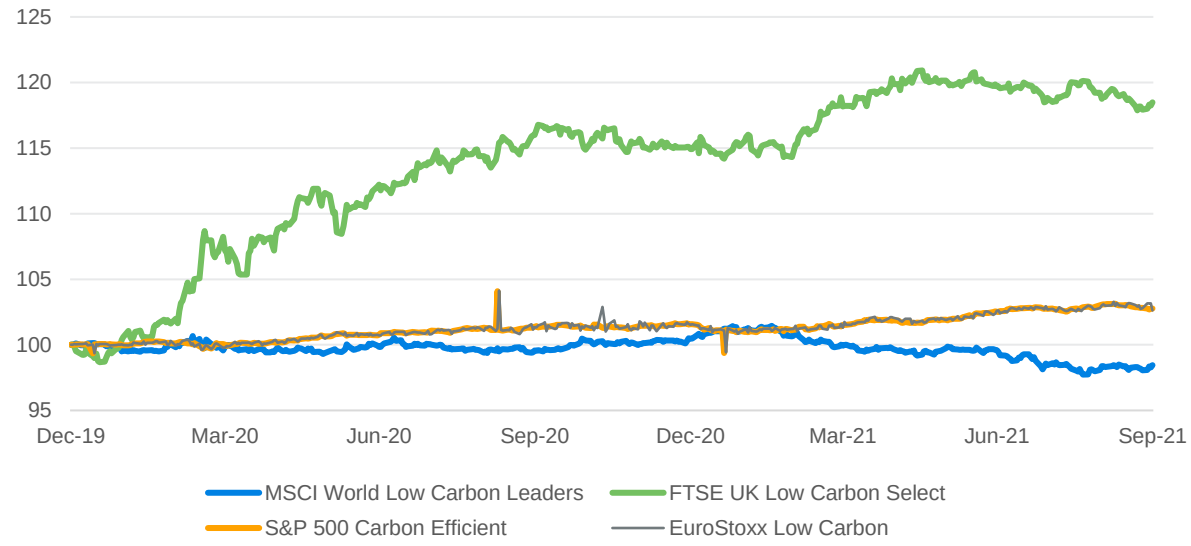
Most of the indices available are in the equity markets, where it is likely demand so far has been greatest. However, similar indices are also emerging for corporate bonds as well.

One interesting observation to note is that in recent years we have generally seen outperformance from these indices compared to their more traditional market-capitalization weighted parent benchmarks. The chart below compares performance based upon a basket of these specialist equity indices relative to the key traditional benchmark, in a few of the major geographical markets. The relative performance is calculated assuming a long position in the low-carbon index, and a short position in the traditional market capitalization weighted parent index, at the start date.

For UK equity, there has been clear outperformance of the low-carbon index, largely driven by low weightings to some oil majors that fared poorly during the depths of the pandemic crisis. For US and European equity, the application of low-carbon weightings has led to a small but steady outperformance. For broader global equity, the MSCI methodology has tracked the parent index more closely, and currently leads to a slight underperformance.

Certainly in recent times, given the increased attention by many asset managers to ESG, this has led to an increase in demand for some of the better performing ESG stocks. The sceptical market observer may question whether this may be leading to a 'green bubble.' The counter argument is that externalities such as climate transition risk, and carbon emissions specifically, have not been included in equity valuations previously, whereas the market is now starting to price these in, given a likely increase in regulatory and government actions such as carbon emissions allowance schemes and increasing potential risk of investor activism. This is an area that Milliman are continuing to monitor, to be able to assist clients in how to factor such relative performance of green asset classes into their capital models.

FIGURE 3: RELATIVE RETURN OF LOW-CARBON EQUITY BENCHMARK INDEX (COMPARED TO TRADITIONAL PARENT INDEX)



Data source: Bloomberg data and Milliman analysis.

Methodology: The relative return is calculated based upon taking a long position in the low-carbon index and a short position in the traditional market-capitalisation weighted parent index on 31 December 2019. The parent indices are MSCI World, FTSE All Share, S&P 500, and EuroStoxx 50 for the respective low carbon equity indices labelled in the graph legend.

MANAGING DECARBONISATION RISK

As noted previously, many companies are choosing to remain invested in carbon-intensive companies, to have the opportunity to actively influence a business to decarbonise. However, this still leaves them exposed to climate transition risk from the investment. Carbon-related metrics are a common method to assess exposure, and the Bank of England Biennial Exploratory Scenarios (BIES) scenarios do provide reference to carbon price scenarios.

Financial impact from transition risk, will have many factors—a carbon price is likely to be a strong factor, either:

(1) **Directly** through company participation in carbon emissions trading schemes

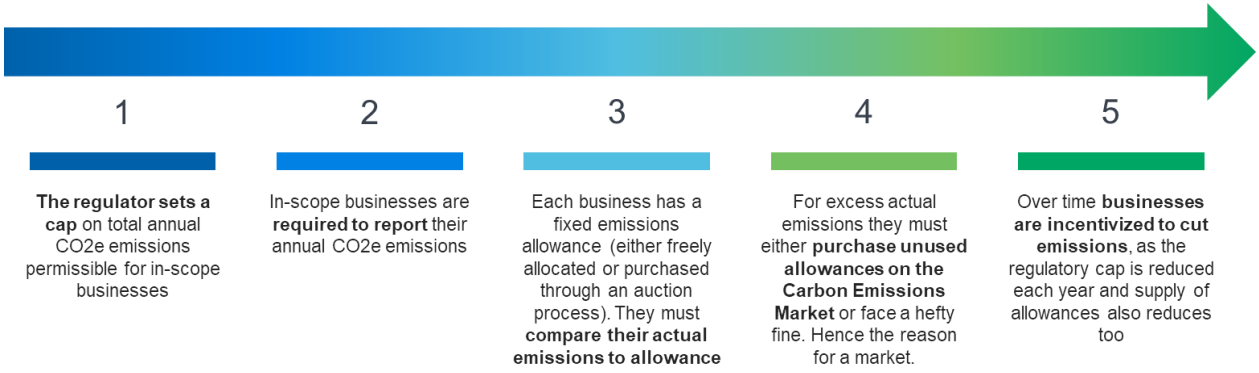
(2) More **indirectly** through influencing internal company carbon prices, used as part of corporate strategy or capital allocation decision-making, or

(3) Through **market sentiment**, e.g., a high carbon price may be viewed as the market seeing an accelerated transition, and so valuation of those companies that are not well-positioned may fall. This may not be directly due to their carbon emissions cost, but through other factors such as litigation risk, product strategy, stranded asset risk, etc.

Carbon Emissions Allowance Market

To expand in greater detail on the first point, many companies are now required to participate in regulatory carbon emissions trading schemes. The following diagram provides an illustration of what a typical carbon emissions trading scheme entails.

FIGURE 4: DIAGRAM OF A CARBON EMISSIONS TRADING SCHEME (EXAMPLE BASED UPON THE EU SCHEME)



The EU Emissions Trading Scheme[13] is the largest and most mature of these schemes[14]. The mechanism puts a price on carbon emissions and has various measures to actively control the market price with the objective of delivering a steadily increasing price with time, to incentivise cuts in emissions in a measured way. Some of the latest such measures implemented at the commencement of Phase 4 in 2021 include:

- **Annual cap reduction strengthening** – The annual cap reduction has been strengthened to **2.2%** per annum from 2021 (compared to **1.74%** per annum between 2013 and 2020).
- **Market stability reserve –** This is a regulatory mechanism to transfer into reserve any current surplus of allowances and also potentially a release from reserve to address any significant market shortage. This mechanism aims to explicitly manage supply and demand to control price (increase) stability over the longer term.
- **Free allocation to manage carbon leakage risk** – Primary allowance issuance is either conducted via auction or through free allocation. Most company sectors are progressing towards an auctioning process. However, the EU are continuing to support free allocation towards targeted industries, with the motivation of avoiding 'carbon leakage' where excessive cost could lead to business migrating outside the EU to jurisdictions without any emissions trading schemes. The continuation of this policy is likely to be closely linked to the proposals on a carbon border tax, which is currently a highly politically charged topic.

[13] Climate Action (europa.eu), EU Emissions Trading System (EU ETS). Available at https://ec.europa.eu/clima/policies/ets_en.

[14] Further details about the EU ETS can be found at https://www.youtube.com/watch?v=yfNgsKrPKsg.

The new post-Brexit UK Emissions Trading Scheme (ETS)[15] has many similarities to the EU scheme, particularly given the UK was one of the major contributors in developing the original EU ETS. ETS have also been developing in other jurisdictions across the world. The World Bank's annual report on the state and trends in carbon pricing and the International Carbon Action Partnership (ICAP)[16] are key sources of reference for understanding the various global frameworks. A summary of some of the key other global schemes is provided in the following table.

FIGURE 4: TABLE OF GLOBAL CARBON EMISSIONS TRADING SCHEMES

Scheme	Inception Date	Key Features	% of Total Emissions Covered / ETS Cap (MtCO2e)
EU ETS	2005	The oldest ETS in force – now in its fourth trading phase. Linking with the Swiss ETS operational since Q3 2020.	40% / 1,610 (2021)
New Zealand ETS	2008	Broad ETS sectoral coverage including forestry. Implementation of auctioning and market stability measure under a new ETS cap. Pricing mechanism for the agricultural sector scheduled.	51% / 40.3 (2019)
RGGI (Regional Greenhouse Gas Initiative)	2009	The first mandatory GHG ETS with 11 participating states in the US. Pennsylvania is expected to begin participation in 2022.	10% / 108.9 (2021)
California ETS	2012	The broadest carbon pricing system in the US. Continued linkage with Québec. A series of major changes start in 2021, including cost-containment provisions, offset usage limits, and a steeper cap decline.	75% / 320.8 (2021)
Korea ETS	2015	East Asia's first nationwide mandatory ETS and, at the time, the second-largest carbon market after the EU ETS, now in its third trading phase with a stricter cap, updated allocation provisions and third-party participation. 2050 net-zero target currently in the legislative process.	74% / 609 (2021)
UK ETS	2021	The post-Brexit ETS scheme is broadly similar in design to the EU ETS. It is currently considering possible expansion beyond power, industry, and also linking with other ETS schemes.	31% / 155.7 (2021)
China National ETS	2021	The world's largest ETS market, operating as an intensity-based ETS and covering the power sector initially and will roll out to other sectors over time.	40% / 4,000 (2021)

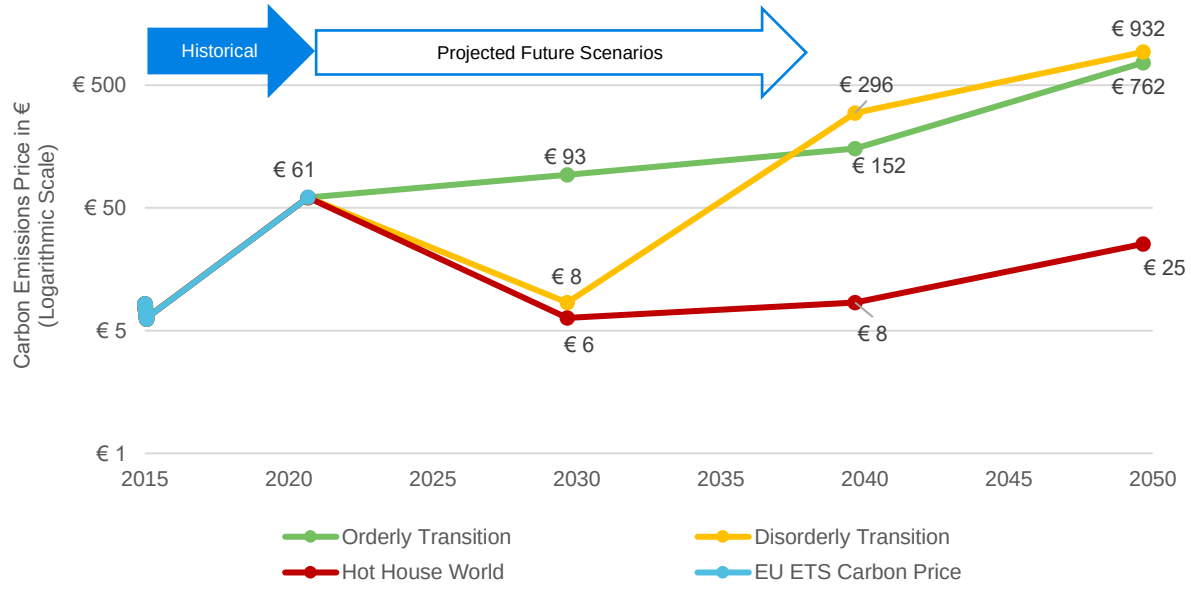
Carbon Exposure – Price

Bringing this all back to climate transition risk, many UK insurance companies will be familiar with the climate change scenarios defined by the Network for Greening the Financial System (NGFS), given the Prudential Regulation Authority's (PRA) biennial stress (BEIS) testing exercise. The following graph compares current actual carbon ETS prices with carbon prices that have been outlined by the NGFS and the PRA in their BEIS 2021 scenarios, all converted to Euros (in line with the EU ETS market). The y-axis is on a logarithmic scale to help, for ease of presentation, given the expected exponential increase in prices.

[15] Participating in the UK ETS. Available at https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets.

[16] State and Trends of Carbon Pricing 2021 (worldbank.org), the International Carbon Action Partnership (ICAP). Available at https://icapcarbonaction.com/en.

FIGURE 5: HISTORICAL CARBON ETS PRICES AND PROJECTED FUTURE CARBON PRICES (LOGARITHMIC SCALE)



Data source: Bloomberg data as of **end August 2021**; NGFS; PRA BEIS scenarios.

Despite the significant increase in carbon prices recently, there is still some way to reach the 2030 Orderly Transition price target. Prices are still below the magical **$100** (or **€93**) benchmark, which is sometimes quoted as the level needed to be on track for meeting the Paris Goals. For example, at this level it is expected steel forged from hydrogen to be cheaper than traditional blast furnace methods, and at a price level that a little higher CO2 capture in the cement industry approaches viability.[17] We should note also that the graph tracks only the EU ETS price, and prices in most of the other global schemes set out in the table above, are still some way below this. For example, the debut price for the new ETS in China in 2021 was around **$8**,[18] and the California ETS price was around **$18**[19] at the start of April this year.

The two transition scenarios provide a target as to where the ETS prices are likely to converge if global regulatory consensus is effective in achieving its decarbonisation goals. The difference between Orderly and Disorderly indicating how the pace of change could impact on overall target price.

Carbon Emissions Futures – Hedge?

Is exposure to a Disorderly transition scenario vs. Orderly transition scenario something that can be hedged? The first point to make is that there are many aspects to transition risk, not just the financial impact on investments. As noted above, the financial impact could be direct, indirect, or just through market sentiment. If there is any financial instrument that is likely to act as a financial hedge, then the carbon emission price is likely to be a good candidate. If the value of portfolio investments falls significantly in a poor climate scenario, due to for example a sudden market re-pricing of high carbon exposures (i.e., often referred to as a 'Minsky moment'). Then potentially the price of carbon emissions may rise, and so an investment in carbon emissions allowances may act to offset against this fall in value from the wider portfolio.

[17] Goodall, Chris, (2020). What we need to do now for a zero carbon future. Profile Books, Main edition.

[18] Reuters. China's carbon trading scheme makes debut with 4.1 mln T in turnover. Available at https://www.reuters.com/business/sustainable-business/chinas-national-carbon-emission-trading-opens-48-yuant-chinese-media-2021-07-16/.

[19] World Bank Group. State and Trends of Carbon Pricing 2021. Available at https://openknowledge.worldbank.org/handle/10986/35620.

Before discussing some of the technical considerations, we present some of the pros and cons:

FIGURE 6: ADVANTAGES AND DISADVANTAGES OF RISK MITIGATION WITH A CARBON ETS FUTURES CONTRACT

ADVANTAGES	DISADVANTAGES
✓ Single instrument that reflects market view of broad societal progress between 'Orderly' and 'Disorderly' transition scenarios, (e.g., in a similar vein to US Treasuries used as a 'flight to safety' for broad market risk).	Only focuses on the financial risk aspect of climate transition risk. ✗
✓ Single instrument that could capture risk from multiple counterparty exposures.	An imprecise hedge and imperfect risk management. Do company investments already hedge their carbon price exposure internally? How does a carbon emission price cost translate to bottom-line EBIDTA and creditworthiness? What about global operations in multiple markets beyond the EU? ✗
✓ A market that is being manipulated by regulators to deliver a positive return over time.	Not appropriate for matching insurance liabilities, so there is a need to make an investment case. Potentially high Solvency II capital charge for a new untested market. ✗
✓ Offers potential asset class diversification.	Potential reputational risk from being seen to profit from the increasing cost of climate change for business, society, and potential investment counterparties. ✗
✓ Arguably providing a societal benefit to support an increasing carbon price needed to accelerate the transition to a 1.5C pathway (i.e., the need for a $100 carbon price soon).	

Under Solvency II the Prudent Person Principle dictates the derivatives should be used only for risk management purposes. Consideration would need to be given on how to define this usage.

From detailed climate transition risk analysis, it may be possible to identify a few material counterparty exposures. From building out climate transition risk future scenario modelling, insurers may now have methodology in place to translate these exposures to financial impacts (as discussed in our accompanying paper on Climate Risk Management). From this analysis, it could be argued that there are liability-related exposures that a carbon emissions price could help to partially hedge. However, modelling methodology may potentially still be in developmental phase, and dependent on a large number of assumptions and/or expert judgement. Such exposure could instead be used to define and provide an upper bound on a 'strategic hedge' position.

Given the potential asset diversification benefits, analysis could also be performed into the impact that this asset class has on portfolio returns. While correlations may typically be based upon backward-looking historical analysis, for this asset class the forward-looking price behaviour is fundamental to consider, in particular, how it behaves under each of the main climate scenarios.

Finally, Solvency II capital treatment needs to be considered. Carbon emissions allowance contracts are likely to be considered as a form of commodity, and so under the Standard Formula they are classified as a Type 2 equity. Unmitigated, this could lead to a high capital charge. One practical mitigation approach to consider is a management action, to dynamically close out the position if the price falls below a threshold level, and a management action to reinstate should the price rise back above the threshold level again. This could be embedded into the investment mandate of a specialist derivatives manager with real-time markets coverage. The risk of a significant crash in the market is albeit smaller in the EU ETS market, given the explicit regulatory mechanisms to control the market, although the risk has not been entirely eliminated.

INVESTING IN GREEN ENABLEMENT

Equity Investment

We are seeing major insurance companies now developing their range of 'climate-conscious,' or more broadly sustainably invested, range of fund offerings, each with their own combination of investment approaches (as described above), investment philosophies and strategies for achieving their objectives. We include a summary of some of these in Appendix 2; case study examples can also be found in our Milliman research paper on ESG investing.

A key component will be to capture the positive aspect of climate transition risk, and potential market opportunity from sectors that are likely to benefit from the transition to a net zero economy. In managing climate transition risk from an investment portfolio, an important component could be ensuring there is sufficient coverage of these sectors, to act as diversification against some of the potential climate transition costs in more extreme climate scenarios. Also, to ensure a diversified mix in sectors where it is still not clear which emerging technologies or solutions will become dominant in the net zero transition. EU and UK regulators are currently devising green taxonomies to assist with driving growth in the green bond market, and these could be a useful reference as they start to emerge. Taking a look to specialist investment managers, we see the following common investment themes:

- **Green Energy** – This covers various aspects including companies supporting renewable energy generation, associated technology, and energy efficiency. There is also the distributed renewable energy generation ecosystem that allows green energy to be created and managed close to the point of use.
- **Green Transportation** – Companies supporting a wide-range of technologies used for electric and hydrogen fuel cell vehicles.
- **Water and Waste Improvements** – Companies that are aiming to address the growing water crisis, considering various aspects of the supply chain including production, treatment, storage, distribution, and management.
- **Sustainable Food and Agriculture** – Companies that are supporting the need to make food systems more resilient and sustainable, covering various aspects of the supply chain including climate-smart production, sustainable processing, conscious consumption, and waste minimisation.
- **Sustainable and Affordable Housing** – This can include various focuses such as sustainable construction, utility efficiency, climate resilience, and community living.

Such themes can help identify potential investment opportunities in established listed companies. However, many of the most innovative technologies that are needed to help support the acceleration in decarbonisation, are likely to be relatively nascent companies that are reliant on venture capital and/or private equity finance.

Insurers are important investors in the European private equity market.[20] However, this market certainly presents its challenges. It is not likely to be appropriate for liability matching purposes. Valuations of private/illiquid investments are not suited to a market consistent framework. Insurers are by nature long-term investors, and so from an economic perspective, they do to some extent offer scope for adopting a 'patient capital' investor mindset. However, capital charges are high for Type 2 unlisted equity. But provisions do exist in Solvency II for 'long-term equity portfolios,' with these being currently subject to ongoing review.

[20] Invest Europe. Insurers. Retrieved 19 November 2021 from https://www.investeurope.eu/policy/key-policy-areas/insurers/.

If there is appetite to invest at the more innovative end of the spectrum, then insurers may find it useful to partner with third parties for expertise and experience in this sector. For example, there are also investor networks with specialist knowledge and experience that could provide opportunities for collaboration on co-investment in this space. Some large (re)insurer groups are starting to establish their own investment funds focused on early/growth stage companies. Munich Re Ventures of the Munich Re Group recently announced a new $500 million fund focused on a number of strategic sectors, including insurance and climate technology and the future of transportation.[21]

Bond Investment

The total amount of global finance needed to address climate change is estimated to be around **$6 trillion** a year for a period of 15 years.[22] To put this into perspective, the total amount of **$90 trillion** represents around **75%** of total current global bond issuance.[23] As the largest asset class, bonds are going to play a fundamental part in meeting this financing need. Hence there has been a lot of momentum in recent years to develop the green and sustainable bond market.

Given their heavy usage of bonds, insurers could play a key leading role in helping to further scale and mainstream this asset class niche. We note that there are also now a range of similar bond classifications—including sustainable bonds, sustainability performance linked bonds, blue bonds, and pandemic bonds—however, given the focus on climate transition risk, we restrict our attention here to green bonds.

Industry standards have been developed to define and certify what can be labelled as a green or sustainable bond. First came the ICMA Green Bond Principles,[24] and secondly, the more stringent Climate Bonds Standards,[25] which set out four main characteristics of a green bond:

1. **Use-of-proceeds** – Clear specification of how proceeds are to be used. In particular, this must be for the funding of projects that have positive environmental and/or climate benefits.
2. **External review** – To ensure credibility of certification, the issuance plans must be reviewed by an independent third-party appointed by the Climate Bonds Initiative.
3. **Management of proceeds** – A clear governance framework to be established and documented for the management of how funds are earmarked to the various projects.
4. **Ongoing reporting** – Annual reporting to provide ongoing information on allocation of funds, continuing eligibility of projects, and the impacts and outcomes of the funded projects.

As shown by the following graph, green bond issuance has been growing rapidly in recent years, with the Climate Bonds Initiative forecasting annual issuance in excess of **$1 trillion** by 2023. We note that the graph shows data up to the first half of 2021 only. The UK recently become one of a number of sovereigns to start issuing green debt this year, with their **£10 billion** first green gilt.[26] Ireland, Italy, Germany, and Spain also recently issued their first green debt, and France were one of the first green government bond issues back in 2017.

[21] Reinsurance News. Munich Re Ventures announces new $500mn startup investment fund. Available at https://www.reinsurancene.ws/munich-re-ventures-announces-new-500mn-startup-investment-fund/.

[22] ICC – International Chamber of Commerce. NCE 2016 (newclimateeconomy.report); What you need to know about climate finance ahead of the One Planet Summit. Available at https://newclimateeconomy.report/2016/.

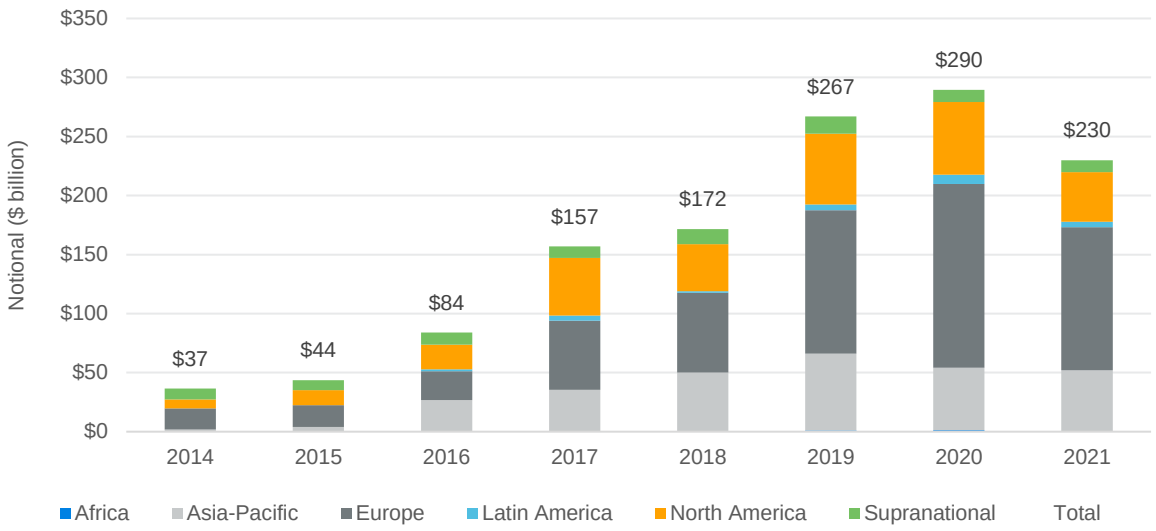
[23] Bond market size (icmagroup.org). Available at https://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/Secondary-Markets/bond-market-size/.

[24] Green Bond Principles (icmagroup.org). Available at https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/.

[25] Climate Bonds Standard; Version 3.0. Available at https://www.climatebonds.net/files/files/climate-bonds-standard-v3-20191210.pdf.

[26] UK Government Green Financing - GOV.UK (www.gov.uk). Available at https://www.gov.uk/government/publications/uk-government-green-financing.

FIGURE 7A: GREEN BOND MARKET NEW ISSUANCE VOLUMES



Source: Market Data | Climate Bonds Initiative.

There has been much commentary on the presence of a 'greenium' on the price of green bonds. Primary issuance of green debt is commonly highly over-subscribed and this demand leads to higher pricing compared to vanilla debt on equivalent terms. This higher price or lower yield dynamic has also been seen in the secondary market too, with green bonds typically being more liquid and frequently traded. However, the greenium does vary by type and currency of issuance, with some current levels illustrated by the following table, which compares average spread levels (measured by Option Adjusted Spread (OAS)) between a green bond and a traditional corporate bond benchmark index.

FIGURE 7B: COMPARISON OF OPTION ADJUSTED SPREAD (OAS) BETWEEN GREEN BONDS AND CORPORATE BONDS

Currency	Average Rating	Green Bond Average OAS	Aggregate Bond Average OAS	'Greenium'
EUR	AA3/A1	60 bps	58 bps	+2 bps
USD	A1/A2	60 bps	70 bps	-10 bps
CAD	AA3/A1	53 bps	89 bps	-36 bps
GBP	A2/A2	82 bps	84 bps	-2 bps

Source: Bloomberg Barclays MSCI Green Bond Index, 16 September 2021.

The continued presence of a 'greenium' means that, on average, there is a comparative financial cost to pay—in part, payment for additional market liquidity that an insurer is likely to value less—in exchange for the non-financial impact that the green bond investments provided. In fact, insurers could use this to their advantage by accessing cheaper financing of their own through the raising of green debt and linking this to their green investment activity. AXA[27], Generali[28], The Just Group[29], and Munich Re[30] are all (re)insurers who have recently issued green bonds. For Generali and Just, the bonds were 11-year maturity, and for AXA and Munich Re 20- and 21-year maturity, respectively. Issuance ranged in size—Just **(£250m)**, Generali (**€750m**), AXA (**€1bn**), and Munich Re **(€1.25bn**). Some issuances also brought other significant balance sheet and capital benefits.

[27] AXA Press release: Successful placement of Euro 1 billion of subordinated green bonds due 2041. Available at https://www.axa.com/en/press/press-releases/axa-announced-the-successful-placement-of-Euro-1-billion-of-subordinated-green-bonds-due-2041.

[28] BBVA issues Generali's inaugural green bond, the first from a European insurance company and the largest in the sector. Available at https://www.bbva.com/en/bbva-issues-generalis-inaugural-green-bond-the-first-from-a-european-insurance-company-and-the-largest-in-the-sector/.

[29] Just Group becomes first UK insurance company to issue green bond - future net zero. Available at https://www.futurenetzero.com/2020/10/19/just-group-becomes-first-uk-insurance-company-to-issue-green-bond/.

[30] Munich Re Issues Green Bond Investment Scheme - (insurance-edge.net). Available at https://insurance-edge.net/2020/09/24/munich-re-issues-green-bond-investment-scheme/.

Despite the 'greenium' investment cost, green bonds potentially have a risk management benefit, in that higher overall demand is likely to reduce volatility of yields in a stressed market. We see some slight evidence of this in the following graph that compares performance of a global aggregate corporate bond index with a global green bond index during 2020 and 2021. The green bond index experienced a slightly lower drawdown during the depths of the pandemic crisis in Q1 2020. We note that it is not a clean comparison, as the corporate bond index on average has a higher credit rating, but a lower duration. Importantly though, green bonds are likely to have greater resilience in extreme climate transition risk scenarios, and so could potentially add valuable portfolio resiliency under long-term climate change scenarios.

FIGURE 8: COMPARATIVE PERFORMANCE OF GREEN BOND AND TRADITIONAL CORPORATE BOND BENCHMARKS 2020-2021

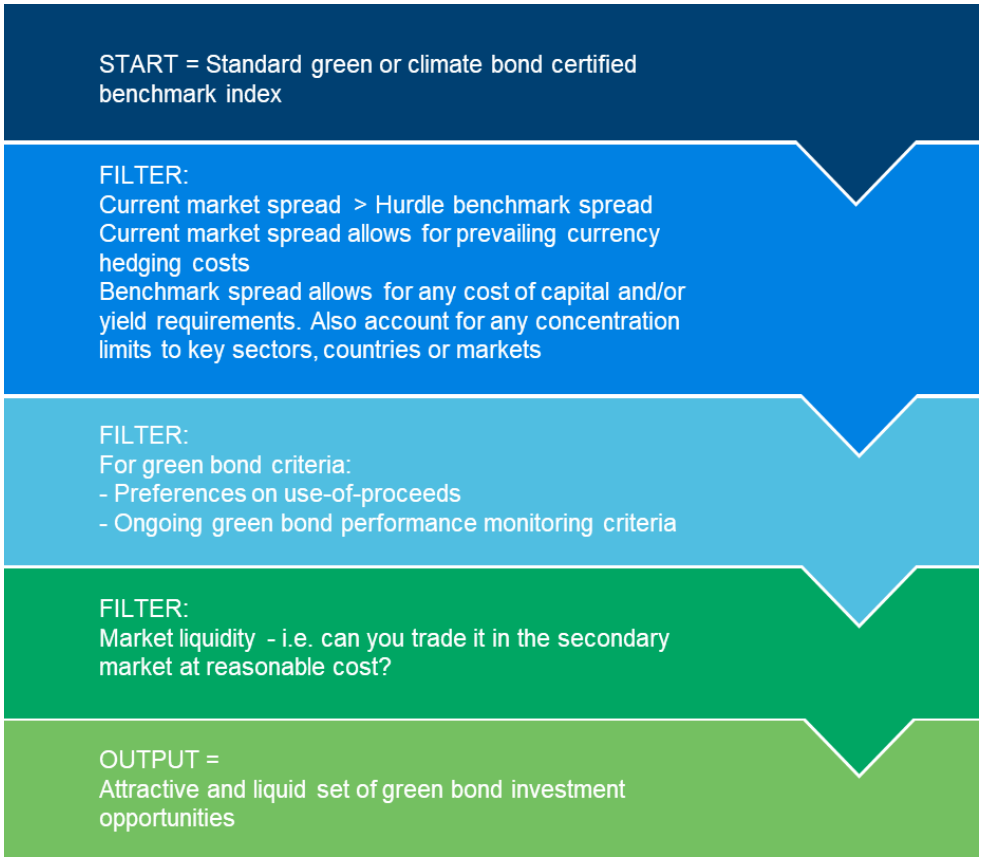
Data source: Bloomberg data and Milliman analysis.

To take advantage of this potential climate resiliency, firstly the new issuance investment process could be updated to incorporate specific consideration for the benefits of green bonds, into the investment evaluation process. Secondly, there could be a case for implementing portfolio replacements, to substitute vanilla bond holdings with green bond equivalents—this is more likely to be for more recent holdings where current market yield levels compare more favourably, and also only where buy-and-hold investment restrictions permit.

The 'greenium' is likely to be heterogeneous to a certain extent, and so to find opportunities where there is less present, having access to as wide a pool of liquidity as possible is preferable. Most green bond issuance to date has been in USD and EUR. Thus, for a GBP-denominated investor there could be a particular advantage to look overseas for a wider range of potential investment opportunities and diversification benefits. From an investment perspective, there could also be a chance to gain yield pick-up from overseas, allowing for currency hedging cost and cash-flow liquidity risk considerations.

A 'customized index' approach could be developed to help identify candidate investment opportunities that takes all these points into consideration. This as illustrated by the following diagram:

FIGURE 9: CUSTOM INDEX APPROACH TO SELECTION OF GREEN BOND INVESTMENT OPPORTUNITIES



Climate or green bond indices and databases are readily available, and a filtering process can be applied to assess constituent candidate bonds for attractive current spread levels (relative to risk-free) and any other concentration limits or portfolio constraints. Importantly, for overseas bonds, this would also allow for the current prevailing currency hedging costs. A filtering process could also take account for specific criteria on green bond characteristics and ongoing performance in meeting their defined green objectives. However, importantly, secondary market liquidity is going to be a crucial factor, i.e., what can be traded at a reasonable cost?

Given the rise in bond index exchange-traded-funds (ETF), including ones focused on green bonds, there is a natural flow of liquidity from the ETF market that could be utilised. A filtering process could therefore account for prevailing market liquidity data, to filter out those issues that currently see reasonable pricing and volume. The filtering process would be a dynamic one, to account for changing market prices and liquidity. The output would therefore be a dynamic set of attractive and liquid investment opportunities, which could then feed into the established investment process.

Property and Infrastructure Investment – Existing

Buildings account for a significant proportion of society's carbon emissions and achieving net zero requires society to overhaul and adapt buildings of all forms to be more energy efficient, to help mitigate climate risk. Many buildings are also potentially exposed to the effects of climate change, and so mitigation and adaption to physical climate risk is also a key consideration. Life insurers have invested a significant proportion into the commercial property market, and so can play a leading role in helping society to achieve this goal.

A key part of insurer's climate risk analysis will include a detailed assessment of climate physical risk from its property portfolio. An analysis of energy efficiency and related carbon emissions' intensity of its property holdings could also help to identify potential opportunities to invest in beneficial building retrofitting projects. From a risk perspective, reducing carbon emissions helps to reduce exposure to some of the financial aspects of climate transition risk.

There are also potential enhancements to investment return to consider. Building retrofit projects could provide a means of additional revenue on property investments. Micro-grid, renewable energy installations, and storage (e.g., solar panels and batteries) could be used to deliver energy to commercial tenants. Such small-scale infrastructure investment could be an ideal usage of proceeds for any finance from an insurer's green bond issuance.

Monetising energy efficiency—from retrofitting changes such as cavity insulation and lighting upgrades—presents more challenges. However, potentially there are ways to innovate contractual arrangements between the property owner and the commercial leaseholder. If credible estimates can be provided on projected savings on energy bills, these could form the basis of entering into a payment agreement from the commercial leaseholder. The payments could be set lower than projected energy bill savings, to be attractive to the leaseholder, and at a level that provides an appropriate return on investment from the retrofit funded by the property owner.

In the UK, the Green Finance Institute has been established by the government to assist in mobilising capital to assist with the Net Zero 2050 plans. They have created a Coalition for the Energy Efficiency of Buildings (CEEB),[31] to develop the market for financing a net-zero carbon and climate-resilient built environment. In leading the industry to drive forward commercial building retrofits, the CEEB could provide a useful source of collaboration.

Property and Infrastructure Investment – New

Investment in new renewable energy infrastructure can be particularly attractive to insurers with annuity liabilities. For example in the UK, Pension Insurance Corporation (PIC) has been a notable investor in large-scale offshore wind projects. Debt-financing has been designed to be Consumer Price Index (CPI) inflation-linked and amortising in a manner that is a good match for the pension cash-flow liabilities.[32] The revenues from such projects have been backed by government contract-for-difference (CfD) schemes, which links prices to CPI over the financing period. This government mechanism[33] helps to remove exposure of projected revenues to volatility in wholesale energy prices.

Certainly, there is plenty of scope for future new offshore wind investment in Europe. The UK has recently increased its target for 2030 capacity to 40 Gigawatts (GW), and the EU strategy is targeting 60 GW by 2030.[34] Even if insurers are not directly involved in funding capital investment for new installations, potentially there is still a role to play to help lead investors to recycle capital, given the massive financing need required by these government targets. Mature assets that have actual operational experience may also be lower risk, and so more attractive to insurers from a risk perspective, although returns may also be lower. As demonstrated by PIC, they could also be an attractive way to match against inflation-linked liabilities that are difficult and expensive to hedge with derivatives or more traditional assets.

In the UK, the government has also recently expanded its CfD scheme to other forms of renewable energy—including solar, onshore wind, energy-from-waste, and floating offshore wind.[35] The CfD scheme is an important pricing risk mitigation mechanism to help make such infrastructure projects attractive to investors. Another key challenge is the origination, sourcing, and due diligence for projects. But partnering with specialist firms in this area can help bridge the gap in expertise. Investing through a syndicate of co-investors could be another avenue to explore, to pool the resources, share knowledge, and make project due diligence more cost effective.

[31] Coalition for the Energy Efficiency of Buildings (greenfinanceinstitute.co.uk). Available at https://www.greenfinanceinstitute.co.uk/ceeb/.

[32] Pension Insurance Corporation press release. Available at https://www.pensioncorporation.com/media/100080/press-release-pic-invests-in-walney-offshore-wind-farm-final.pdf.

[33] Contracts for Difference - GOV.UK (www.gov.uk). Available at https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference.

[34] W Denis Europe. Specialist insurance vital in expanding European wind energy market. Available at https://www.wdenis.eu/news/specialist-insurance-vital-in-expanding-european-wind-energy-market.

[35] Contracts for Difference: draft budget notice for the fourth allocation round, 2021 (publishing.service.gov.uk). Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1016774/cfd-ar4-draft-budget-notice.pdf.

The Solvency II Standard Formula allows reduced capital requirements for debt investment in infrastructure—for example, providing a **25%** saving for a **10**-year bond of credit quality **3** (further details are provided in the appendix). Potentially new infrastructure investment opportunities that are appropriately classified and meet the conditions set out in the Solvency II rules, could allow insurers to take advantage of these capital optimisations, although the question would remain as to whether holding less capital is appropriate given the nature of the risk. The strict criteria are intended to demonstrate and justify why a lower capital requirement is permissible. If a holistic view was taken to risk, to account for potential impact in future climate change scenarios, and a potential resilience that such infrastructure could provide to an insurer's asset portfolio, then this may give some added justification in favour of taking advantage of this capital reduction.

SCALING NEGATIVE EMISSIONS

The role of negative carbon emissions, or Carbon Dioxide Removal (CDR), is a controversial one. Many cite that placing emphasis on yet-to-be-proven CDR technologies, distracts from the urgent need to rapidly reduce existing emissions. However, the IPCC in their discussion of 1.5C net emissions pathways, imply that CDR is a necessary requirement alongside rapid and deep cuts in existing emissions:

> ***The Role of Carbon Dioxide Removal***
>
> *All analysed pathways limiting warming to 1.5C with no or limited overshoot use CDR to some extent to neutralize emissions from sources for which no mitigation measures have been identified and, in most cases, also to achieve net negative emissions to return global warming to 1.5C following a peak (high confidence). The longer the delay in reducing CO2 emissions towards zero, the larger the likelihood of exceeding 1.5C, and the heavier the implied reliance on net negative emissions after mid-century to return warming to 1.5C (high confidence).*
>
> The IPCC – Global Warming of 1.5 ºC — (ipcc.ch)

The IPCC do take a balanced view though, treating CDR with a degree of caution, and highlighting the risks of too much reliance on such technology.

> *CDR deployed at scale is unproven, and reliance on such technology is a major risk in the ability to limit warming to 1.5C. CDR is needed less in pathways with particularly strong emphasis on energy efficiency and low demand. The scale and type of CDR deployment varies widely across 1.5C pathways, with different consequences for achieving sustainable development objectives (high confidence).*

Life insurance companies may wish to consider following Swiss Re's recent example of venturing into the negative emissions market. In Swiss Re's recent paper,[36] they further reiterate the case for the need for negative emissions. CDR technology is still in its infancy, with a high degree of investment risk and a need for long-term investment horizons. Given their scale and ability to manage and take on long-term risk, life insurance companies may be better placed than many to act as investment partners with this sector, to help society in driving forward this technology. Such investment could also help align with climate transition risk scenarios. An increasing risk towards disorderly transition, places greater emphasis on the need for CDR technology, and increases the perceived market value of this sector.

Swiss Re have recently partnered with ClimateWorks[37] on a Direct Air Capture technology that has recently become operational on a small-scale in Iceland.[38] This is a technology that filters CO2 from the air, and through a chemical process stores the CO2 in mineral form underground. Although currently more expensive than popular nature-based solutions, it is considered one of the most durable approaches with minimal risk of reversal of the carbon sequestration. Over the long term, committed long-term investment could help to drive down the cost and help to scale-up this industry.

[36] Swiss Re. The insurance rationale for carbon removal solutions. Available at https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-carbon-removal-technologies.html.

[37] Swiss Re and Climeworks launch partnership by signing world's first ten-year carbon removal purchase agreement. Press release available at https://www.swissre.com/media/news-releases/nr-20210825-swiss-re-climeworks-partnership.html#:~:text=Swiss%20Re%20and%20Climeworks%2C%20a%20leading%20specialist%20in,dioxide%2C%20worth%20USD%2010%20million%20over%20ten%20years.

[38] CleanTechnica. Climeworks Direct Carbon Capture Facility Goes Live In Iceland. Available at https://cleantechnica.com/2021/09/09/climeworks-direct-carbon-capture-facility-goes-live-in-iceland/.

AXA have been helping to drive innovation with nature-based solutions. A key advantage of nature-based approaches is that they may have wider benefits beyond pure climate risk mitigation. For example, AXA XL have partnered with The Nature Conservancy,[39] to create Blue Carbon Resilience Credits[40]—tradable credits that value both carbon sequestration benefits and coastal protection resilience benefits. Restoration of mangrove ecosystems is one of the practical examples being explored.

The challenge for an insurance company is that this sector does little from an asset-liability matching perspective, and the Prudent Person Principle may also act as a hindrance. CDR and Negative Emissions would likely be more suited to a strategic investment to align with any corporate strategy goals on climate change, and once results and implications of a detailed climate transition risk analysis of the overall business have been understood. In the next section, we also discuss how leveraging their green-conscious customer base could be one way to accumulate funds for investing in such technology.

Section 3: Product and Service Offerings

OVERVIEW

As well as considering how to manage climate transition risk from an investment perspective, business strategy is another key area to address. 'Greening' existing product offerings and introducing new product offerings to meet 'green consumer needs' could be a way to avoid potential reputational risk of not being seen to act on climate change. Evolving product strategy in this way could also be a response to potential exposures highlighted in a company's climate transition risk analysis, and a way to build in resilience to the business over the longer term.

INFLUENCING CUSTOMER BEHAVIOUR

Financial services providers have already started to develop product offerings that aim to adapt existing product to be more 'green,' or aim to influence customer behaviour towards low-carbon alternatives. This is particularly the case for banking and non-life insurance, with some examples as follows:

- **'Green Mortgages'** – Ecology Building Society became the first UK lender to offer green mortgages back in 2006, when it introduced its C-Change discount mortgages. Through this product, Ecology offers discounted mortgage rates to homeowners building or converting sustainable homes or undertaking retrofits and energy improvements. There are now a number of providers in the UK, as set out in a recent Green Finance Institute report,[41] and in other European countries.
- **'Green House Insurance'** – some house insurance policies offer lower premiums to homes that have green certification. Others have adapted their claims policy to provide replacement with greener alternatives upon any insurance claim.
- **'Green Motor Insurance'** – techniques to incorporate incentives into motor insurance include mileage-based tariffs to encourage efficient vehicle usage, lower premiums for hybrid and EVs, and sustainable claims management where used body parts are considered for repairs.[42]
- **Embedding Carbon Offsets** – Co-Op Insurance are the first UK insurance company to offer a carbon offset program[43] which offsets a proportion of its motor and home insurance customers' carbon emissions, as standard.

[39] AXA XL. Ocean Risk Initiative at AXA XL. Available at https://axaxl.com/about-us/ocean-risk-initiative.

[40] AXA XL. A Blue Carbon future: how innovative thinking aims to increase coastal resilience and meet climate targets. Available at https://axaxl.com/fast-fast-forward/articles/a-blue-carbon-future-how-innovative-thinking-aims-to-increase-coastal-resilience-and-meet-climate-targets.

[41] GREEN MORTGAGES (greenfinanceinstitute.co.uk). Available at https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2021/05/GREEN-FINANCE-GREEN-MORTGAGES.pdf.

[42] Green-Solutions.pdf (allianz.com). Available at https://www.allianz.com/content/dam/onemarketing/azcom/Allianz_com/migration/media/press/document/Green-Solutions.pdf.

[43] Co-op. Co-op Insurance leads the way with its new carbon offset programme. Available at https://www.co-operative.coop/media/news-releases/co-op-insurance-leads-the-way-with-its-new-carbon-offset-programme.

What can the life insurance industry do to 'green' their product and service offerings in a similar way? We are already seeing some international insurance companies now claim to have the first green life insurance offerings. Great Eastern of Singapore in July 2021 launched a green life insurance product.[44] This is a short-term (three-year) single premium guaranteed savings plan, which invests exclusively in projects aimed at climate change mitigation.

We present some ideas that continue further on this theme below. Given the huge scale of the climate change crisis, there are a whole range of areas where life insurers could potentially play a role. This section is not intended to provide an exhaustive list of solutions, but instead aims to help stimulate some new thinking on how else insurers could assist their clients in meeting their needs and desires on climate.

ENABLING GREEN-CONSCIOUS CUSTOMERS

'Green' Investment Option

Following on the theme of the Great Eastern example. As well as managing potential climate transition risk in the investments backing a legacy portfolio, consideration could also be given to providing attractive investment options to new customers that are keen to have an appropriate impact on addressing climate change. In the UK, the 'Make My Money Matter' campaign has recently been publicising to consumers how impactful their pension fund choices can be in addressing climate change. An increasing number of defined contribution (DC) pension providers in the UK are now adapting their default funds to have investment strategies aligned with net zero, incorporating various combinations of the approaches discussed in the previous chapter.

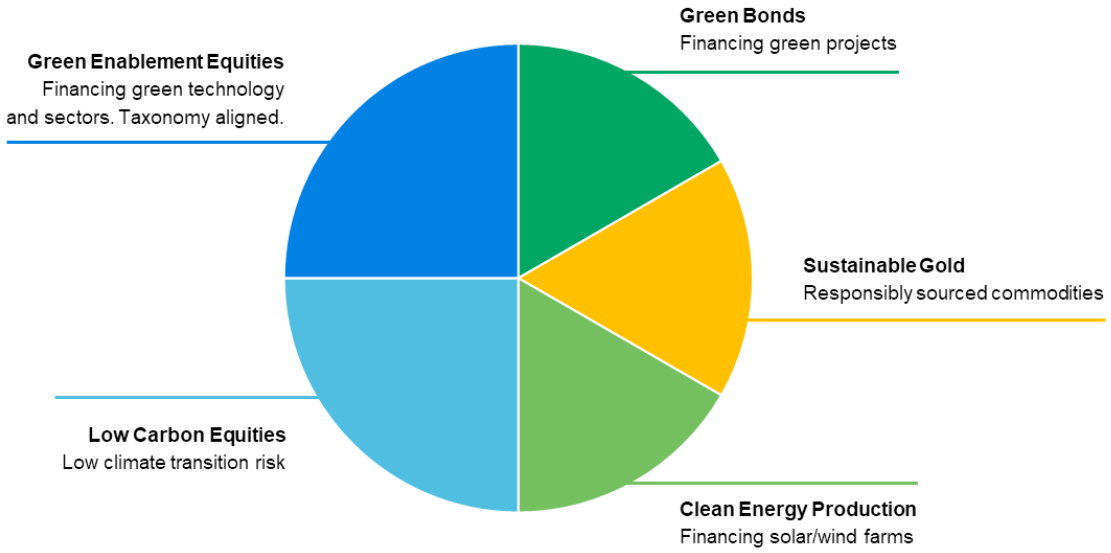
Younger market segments are particularly keen to have a positive climate impact, and for such market segments, some form of fintech solution is also likely to be appealing and get the most engagement. As an example, one of the most recent new providers of sustainable investing via an app in the UK market is Clim8 Invest. Features of this investment offering that appeal to green-conscious consumers include:

- **Targeted investment policy** – 100% focused on clean energy, clean technology, smart mobility, clean water, sustainable food, and recycling.
- **Absolute exclusions** – 0% exposure to oil and gas exploration and production and 0% coal extraction as an explicit requirement.
- **Alignment to global targets** – Portfolios mapped to the UN Paris Climate Agreement. UN Sustainable Development Goals (SDGs) are another commonly referenced global standard.
- **Clearly communicated impact information (quantitative)** – Explicit impact measurement for investor portfolios, e.g., CO2e emissions saved (or equivalent in car kilometres driven); clean energy generated (or equivalent hours of iPhone usage)
- **Clearly communicated impact information (qualitative)** – Qualitative information on some key constituent investments and their specific contribution to addressing climate change.

There are now a range of potential niche investment classes, which enable insurers to provide a diversified multi-asset investment portfolio that is 100% focused on green, as illustrated by the following example allocation.

[44] Life Insurance International. Great Eastern unveils Singapore's first green life insurance offering. Available at https://www.lifeinsuranceinternational.com/news/great-eastern-unveils-singapores-first-green-life-insurance-offering/.

FIGURE 10: AN EXAMPLE DIVERSIFIED GREEN MULTI-ASSET PORTFOLIO



Indicative example by Milliman

'Climate Neutral Now' Carbon Offsetting Option

Carbon offsets (or purchasing carbon credits from the 'voluntary carbon market') involve paying money towards specific projects that aim to avoid and/or sequester carbon emissions. These have been used by some corporate firms in their sustainability or net zero plans, to balance against their existing unabated carbon emissions, in calculating their overall carbon footprint.

Such usage of carbon offsets has been a controversial topic. Many in the industry take the view that such usage distracts from focusing on the overall and urgent need to rapidly reduce physical carbon emissions. The Science Based Targets Initiative in particular, have excluded usage of carbon offsets in their definition of what constitutes net zero. Hence the less restrictive term of 'climate neutral,' may be more appropriate to use. There is also the real risk of carbon capture reversal, with the recent forest fires occurring in plantations funded by carbon offsets being a notable example.

Proponents of the voluntary carbon market instead highlight how carbon offsets can be an important mechanism for channelling finance to the projects in need of funding in developing countries. This is significant, particularly given the backdrop of political leaders from developed countries still struggling to commit to the **$100 billion** per annum climate finance pledge for poorer countries at COP26,[45] which took place in Glasgow, Scotland from 31 October to 13 November 2021. Many carbon offset projects are focused on protecting existing rainforests or restoring degraded ecosystems, for which there is a high degree of urgency and need, and for which well-designed projects have also proven to be effective. The following sets out some examples of current live projects accredited with Gold standard certification for their climate impact.

[45] Bloomberg. Rich Countries Fall $10 Billion Short in Climate Finance Pledges. Available at https://www.bloomberg.com/news/articles/2021-10-05/rich-countries-fall-10-billion-short-in-climate-finance-pledges?utm_campaign=Carbon%20Brief%20Daily%20Briefing&utm_content=20211006&utm_medium=email&utm_source=Revue%20Daily.

FIGURE 11: EXAMPLE VOLUNTARY CARBON CREDIT PROJECTS

Country	Project[46]	Description
Uganda	Lango Safe Water Project	The project will support the provision of safe water using borehole technology to hundreds of households within the Lango region (Dokolo, Otuke, Alebtong, Kole, Lira, and Oyam districts.) By providing safe water, the project will ensure that households consume less firewood during the process of water purification and as a result there shall be a reduction of carbon dioxide emissions from the combustion process.
India	Wind Power Project in Gujarat	The project will generate 115.312 GWh of electricity per year which shall be supplied to the state electricity utility thereby contributing to reducing the energy demand supply gap in the state of Gujarat. The project activity will assist the sustainable growth of the region by providing clean and green electricity to the state electricity grid.
Dominican Republic	Solar PV Project	The project activity consists in the installation of a 60MW photovoltaic Solar Energy Farm, which is considered as a sustainable source of electricity generation. The project activity is developed by Electronic J.R.C., S.R.L. and will be the largest solar power plant in Latin America. It will generate an estimated direct employment for 200 persons during the construction phase and approximately 36 persons during its operational stage.

Data source: Gold Standard registry.

Decoupling the use of carbon offsets from corporate decarbonisation plans may be a significant step to address concerns. As previously discussed, general insurers have already started to embed carbon offsetting of customer emissions from motor and home policies. For a life insurer, an alternative strategy could be to participate in this market by offering carbon offsets as an option on a savings or investment product, where importantly the underlying investment manager is also making a commitment to align strategy with having an impact on climate change or broader sustainability too.

From an investment perspective, it should be noted that carbon offsets always come at a financial cost that involves sacrificing financial return. While the pressures of optimising investment performance may preclude carbon offsets from any default fund offerings—green-conscious consumers may be willing to sacrifice some extent of financial return, to have a greater non-financial impact. Making a carbon offset option available on investments could be particularly appealing to this market segment.

Hence, the idea of a 'Climate Neutral Now' option, which measures the carbon footprint of the underlying investment portfolio and offers the option to pay for carbon offsets equivalent to the carbon footprint. 'Climate Neutral' means to stay in accordance with the Science Based Targets Initiative (SBTI) definition, and 'Now' reflects the offsetting of current emissions, rather than planned decarbonisation to be completed at some future target date.

One suggested approach for implementation could involve the following steps:

1. **Measure portfolio carbon footprint** – An industry standard has been established (PCAF standard) for measuring the footprint of equity and corporate bonds. For some asset classes—e.g., government bonds and commodities—carbon footprint calculation methodology is less well established, and data availability potentially more challenging. Either these could be omitted until industry standards have been developed, or a 'best efforts' approach could be established in the interim.
2. **Commit funds for carbon offsetting** – Once the annual portfolio footprint is known, cash can be immediately set aside (e.g., by divesting fund assets, or through a regular charge) to commit to purchase the equivalent amount in carbon offsets. Consideration may also be given to hedging future price action. The carbon markets (both voluntary and compliance) have exhibited significant recent surges in price. Given likely increased future demand as carbon offsetting becomes more mainstream, carbon offsetting may become more expensive. A suitable strategy may need to be devised to provide stability to near term costs, which could include over-purchasing carbon offsets, hedging with futures contracts, or committing to OTC forward-price agreements.

[46] GSF Registry (goldstandard.org). Available at https://registry.goldstandard.org/projects?q=&page=1.

3. **Negotiate and trade carbon offsets** – There are a wide range of carbon offsets that are available. It may take some time to explore the market and identify projects that satisfy various criteria—e.g., meet specific targets around the type of non-financial impact desired; have sufficiently low risk of carbon emission reversal; be approved by a preferred carbon standard agency; and potentially satisfy certain price targets. There are also electronic exchanges, which can avoid some of the embedded costs of carbon broker commissions, and so help optimise on transaction cost. Once the selected carbon offsets have been reviewed and approved, they can be purchased and registered, and any corresponding futures position backing (and hedging) the purchase be closed out.
4. **Retire carbon offsets against calculated footprint** – The offsetting of emissions comes from the action of retiring a sufficient amount of purchased carbon credits, against the target carbon footprint calculation. This essentially means the carbon credit can no longer be re-sold. Carbon credit registries are used to document and provide an audit trail for retirements.
5. **Communicate impact** – Registered carbon offset purchases are likely to provide quantitative information on the impacts achieved—e.g., CO2e tonnes avoided, trees planted, or other impact measures. As with the Clim8 example above, these could be further developed into more tangible metrics to aid customer understanding—e.g., equivalent in car kilometres driven. But in any case, it can certainly be powerful to ensure these impacts are communicated in customer literature, to give understanding to what 'climate neutral' means. Further qualitative information could also be provided on the specific carbon offsetting projects that were invested in, as well as alignment to standards such as the UN SDGs.
6. **Quantify financial cost** – The incurred cost of carbon offset purchases is something that would likely need to be made transparent in the fund literature, as part of the attribution of overall investment performance (for the selected fund option). Also, it is something that would likely need to be estimated and disclosed at outset, to enable customers to make an informed choice on selecting this option. This links back to the need for an effective carbon pricing and risk management strategy, where purchase costs are kept in line with the original cost quoted to the customer.

To provide some indication of the potential cost, the following table sets out some estimated current costs for the carbon footprint of some key benchmark equity indices. The cost is expressed in terms of reduction in investment return per annum.

FIGURE 12: INDICATIVE COSTS FOR OFFSETTING CARBON FOOTPRINT OF FINANCED INVESTMENTS FOR EXAMPLE INDICES

	Scope 1 & 2 Emissions	Scope 1, 2, & 3 Emissions[47]
Traditional Equity Benchmark		
MSCI World	0.03%	0.18%
S&P 500	0.02%	0.12%
FTSE 100	0.08%	0.78% 48
Low-Carbon Equity Benchmark		
MSCI World Low Carbon Leaders	0.01%	0.11%
S&P 500 ESG	0.01%	0.12%
FTSE UK Low Carbon	0.03%	0.19%

Data source: Bloomberg data and Milliman analysis.

Based upon prices on 29 Sept 2021, weights from 15-16 Sept 2021 (MSCI World and S&P 500) and April 2021 (FTSE).

[47] See footnote on page 5 for a definition of Scope 1, 2, & 3 emissions.

[48] The FTSE 100 is particularly carbon-intensive due to two oil & gas stocks (BP and Shell) and two mining stocks (BHP and Glencore) that have a high allocation in the index of over 13%.

A key assumption in deriving these costs, is the price-per-ton of carbon offset. The CORSIA basket futures price of **$7.15 per ton**[49] was used as a reference. However, at the time of calculation there were prices for carbon offsets varying from **$0.50** to **$46.34** per ton in the electronic carbon offset market. This reflects the wide range of potential projects of varying quality and certification standards that are available.

Data availability is also another key limitation. For Scope 1 & 2 emissions, data availability ranged from **61%** to **85%** of index weights (for the data provider used in this calculation). For Scope 1, 2, & 3, emissions data availability ranged from **51%** to **68%**. As corporate disclosures on carbon emissions improve in the coming years, and as the Task Force on Climate Related Financial Disclosures (TCFDs) become more mainstream and more sectors are included in emissions trading schemes, greater data availability will lead to an increased carbon footprint offsetting cost. Finally, the comparison between traditional market capitalisation-based equity benchmark indices, and corresponding low-carbon versions, shows the benefit of the latter through cheaper carbon offsetting costs.

Community Energy Enablement

As discussed previously, insurance companies are already investing in the development of large-scale renewable energy infrastructure projects. Renewable energy infrastructure typically provides long-term revenue that is a good fit for many typical insurance liabilities. However, if Net Zero 2050 is to be achieved, then there needs to be increased investment across the full range of energy supply. Smaller scale energy production from either domestic installations or small-scale community energy installations are likely to become more prominent, as national power systems become more decentralised. Insurance companies could also play a key role in helping to drive investment at the smaller end of the spectrum, through providing finance options alongside existing savings products.

Concerns around the potential costs that will feed through to end customers and their energy bills, from Net Zero 2050, are highly topical in Europe at present. There is therefore a potential wider societal benefit that insurance companies could offer, to present solutions that enable their customers to invest in practical ways to deliver savings to their energy bills and/or less reliance on the big energy firms.

Community energy—where a collective of people invest in small-scale energy production—can be a way for people to feel more engaged with the journey to net zero. Through direct ownership of a share of a renewable energy facility, it can offer people a way to feel like they are having a tangible impact, with true additionality where it involves the construction of a new installation.

Traditionally, community energy involves geographically localised community investing in the development and management of a local energy infrastructure facility to deliver localised energy. However, smart platform technology now exists that enables the forming of community energy on a virtual basis. As with traditional community energy, it involves a collective group that raises funds and enables construction of small-scale renewable energy, as well as benefit from direct ownership. However, the smart platform technology would then deliver the energy into the National Grid (in the UK). The community energy collective benefits from receiving energy at the operational cost of the facility, rather than purchasing at the wholesale cost in the market, for their share of the investment. As they are not exposed to wholesale market pricing, this can lead to significant savings on their energy bills in the longer term. It should be noted that the smart platform reviews/limits investment to an amount appropriate to personal usage, and also makes clear that it is designed as a mechanism of delivering energy bill savings and is not a speculative investment product.

The smart platform technology is offered by renewable energy sector professionals that would oversee, evaluate, and manage the infrastructure construction on behalf of the community energy collective. Community energy ownership commences once a renewable energy infrastructure construction project has been fully vetted and confirmed as ‘shovel ready.’

[49] Price on 29 September 2021. Source: Bloomberg.

Considering how an insurance company could offer access to this service, the definition of a 'community' could include both its employees—as a potential employee benefit option—and its customers. For customers, this could be a potential add-on benefit, in a similar vein to carbon offsetting, for any savings product with a regular premium. It could also be offered as a rider benefit on products that convert a lump sum into an income, such as an annuity. We discuss the merits of considering renewable energy financing as part of wider retirement planning advice later on in this report. Although whether there are potential legal and regulatory challenges to this approach, and whether such challenges can be overcome, is yet to be fully confirmed.

Furthermore, the insurance company could also co-invest with their employees and/or customers, to make up for any residual financing needs that would be required to get a single project off the ground in a reasonable timescale from the first customer commitment, again providing a long-term asset suited to typical insurance liabilities. Co-investment could also give assurance to employees and customers that this does indeed make financial sense.

Overall, insurance companies with their extensive distribution networks, could be an ideal 'white-labelling' partner or 'gatekeeper,' for enabling this type of technology to become more mainstream.

SUPPORTING CUSTOMERS IN PERSONAL DECARBONISATION

For many retail consumers, supply of heating and electricity to their homes and owning a car, are two of the largest contributors to their personal carbon footprint. Through the supply of home insurance to homeowners and car insurance to vehicle owners, composite general/life insurance companies have established distribution networks to leverage and have a significant opportunity to influence personal behaviour. Furthermore, similar advantages and opportunities to influence exist with business consumers as well.

One of the key barriers to the take-up of low-carbon alternatives is finance and/or perceived cost. New solutions typically involve a large up-front payment with a stream of regular savings or benefits thereafter. Insurers could aim to address this problem by developing product offerings that transform initial costs profiles, so that they can be offset against future regular savings, in a way that is potentially more attractive than existing personal loan or other finance options.

Another potential barrier is apathy or lack-of-awareness about long-term cost savings, even if consumers are increasingly 'climate conscious.' Insurers could incorporate low-carbon options into established decision-making processes, such as existing insurance sales or renewals processes, or pension savings contribution review processes. There could be scope for administrative cost efficiencies and product-bundling to optimise customer behaviour on existing products, which could be leveraged for mutual financial advantage. In the aviation market, carbon-offsetting is now a straightforward add-on to the purchase of a flight, and insurers could look to extend upon this type of approach in a similar vein to savings products.

'Micro-Infrastructure Green Bonds'

Many domestic renewable energy heating and electricity generation options have fallen in cost sufficiently to enable them to prove financial savings over the longer term, on average expected power consumption levels, even without government subsidy, if financing can be provided at reasonable cost.

Insurance companies could aim to leverage their financial strength to provide attractive financing, bundled within an insurance product. Leading insurers have already started to issue their own green bonds, and recently have been able to raise finance at attractive rates to standard corporate debt, given the 'demand for green' leading to a 'greenium.' An example of how this could be offered is as follows:

1. **Insurer raises 'green bond' finance** – Insurance companies could issue a green bond wholesale in the capital markets, to achieve attractive financing rates.
2. **Invest proceeds for willing customers** – 'Use of proceeds' of the green bond are invested in renewable energy heating/electricity generation infrastructure (e.g., roof solar panels; ground heat-pump systems to replace gas boilers, etc.) for customers that wish to proceed. Legal ownership of this infrastructure is with the insurance company for the financing term. This becomes an asset on the insurer balance sheet, for which accounting and Solvency II risk treatment would need appropriate consideration.

3. **Issue combined financing + insurance policy** – Insurer issues a policy to its customer, which combines both repayment financing and life insurance for the financing term. Life insurance is priced to cover the cost of remaining regular premiums due to pooled deaths. Upon death, the renewable energy infrastructure asset is released as a benefit to the customer's beneficiaries. This could also be bundled with additional standard life insurance cover.

   The financing amount and term is designed to be cash flow neutral (or positive), when allowing for expected future savings on energy bills. Financing could also be inflation-linked (and green bond issuance similarly too).

Various approaches could be used to manage risk and optimise on cost:

- **Standardised legal terms**, e.g., include a legal requirement to settle outstanding balance upon any sale of house. Legal first rights to any government subsidies received for the energy installation.
- **Standardised due diligence processes** on permissible technology, technology providers, and a list of pre-approved qualified installation partners (or certification standards that would get approval).
- **Property risk** – There would be a risk of perils on the domestic renewable energy installation. Composite life/general insurers may be well placed to use existing house insurance risk data to price and manage this risk.
- **Counterparty default risk** – For a sufficiently large portfolio, risk of regular payment default from customers can be diversified and appropriate assumptions derived. However, such risk may be significantly higher than existing, more traditional counterparty risk exposures.

A key challenge is the small amounts required for residential rooftop solar. Although small amounts do mean that this could be feasible to have as an "add-on" feature of an existing product, such as life insurance cover for a mortgage, which could help in differentiating the existing product. Small amounts also mean that counterparty risk can be diversified to some extent across a large portfolio. In practice, the insurer may alternatively want to consider offering this in conjunction partner with a renewable energy specialist, who already offers the "zero up-front" cost model. The insurance company could enable distribution, and also look to purchase portfolios of residential solar assets in larger sizes, once a certain threshold has been reached.

'Electric Vehicle Endowments'

EVs are increasingly taking a larger proportion of new car sales. There are already a number of car finance options on the market that enable customers to overcome the initial up-front cost for an EV. Aside from a personal loan, two common forms are Hire Purchase (HP) and Personal Contract Purchase (PCP). Hire Purchase involves transfer of legal ownership at the end of a payment term, with the funded vehicle acting as collateral. PCP involves regular payments to cover car depreciation, and an option for outright vehicle purchase at the end.

Endowments have traditionally been offered by insurance companies as a more cost-effective way to fund a house purchase. Given the higher up-front expense of EVs, insurers could explore similar application to this market, to provide an alternative financing option alongside HP and PCP. If offered in conjunction with existing long-term savings products, potentially it could also be offered in a way that gives additional incentive in comparison to traditional car financing options. Insurers could also exclusively focus on financing of EVs only to help encourage societal switch away from combustion engines.

Looking forward, in addition to there being a rapid switch from combustion engine vehicles to EVs, many cite the need for a systemic change to car ownership as a whole to help address climate change. Personal car ownership is an inefficient way to meet the personal mobility needs of a society. Shared ownership can help reduce the number of overall vehicles needed on society's roads, and also reduce the manufactured carbon footprint from the vehicle industry in phasing out combustion engines. Ultimately the high initial cost of EVs may act as a factor to encourage take-up of alternative ownership models, and for people to give up their desire for 'outright ownership.'

Therefore, those considering this market would likely need to consider how ownership models could change over the coming years and have an offering that is flexible to adapt to changing needs and preferences. Furthermore, if insurance companies were to become new entrants to the EV financing market, they could be well positioned to help shape and drive changes in vehicle ownership.

In the UK, Octopus Energy are an example of a firm outside of the motor sector, that have recently started offering EVs as a tax-efficient employee benefit option.[50] This allows them to additionally market their energy tariffs alongside. Insurers could look to adopt a similar 'vertically integrated' approach, offering EV finance alongside employee benefit savings plans, or motor insurance distribution (for composite insurers).

Looking at some example costs, according to a recent report published by LV=[51] in the UK, which compared the cost of running nine EVs against their petrol/diesel equivalents, EVs are on average **49%** (**£1306**) cheaper than petrol and diesel cars to run annually—although savings do vary and depend upon the exact EV and equivalent combustion engine model. There are differences in ownership prices to also consider, with EVs typically being more expensive than equivalent combustion vehicles by some margin. This offsets against potential running costs when comparing outright purchase between each vehicle type.

However, the comparison could instead be set against the cost of currently maintaining an existing combustion vehicle. If EV financing payments can be structured to be lower than the potential saving and running costs, and EV ownership pushed to an appropriate future date—as done with HP and PCP—then this would be attractive from a financial perspective. This made even more so, when also considering potential revenue from selling an existing combustion engine, and government incentives such as savings on car tax.

An example of how this could be structured is as follows:

- **Establish partnership with EV specialist** – A partnership agreement could be of mutual benefit, with each providing opportunity to access a wider set of customers.
- **Contractual customer arrangements** – For a customer wishing to switch to an EV the initial contractual process could involve the following:
  - Insurance company agrees to purchase an EV, through selected/trusted EV specialist partner. Insurance company has 100% legal ownership of the EV and provides 100% usage rights to their customer.
  - The customer agrees to take-out a regular premium unit-linked/with-profits savings plan with the insurer. The regular premiums are set at a level that is competitive to both (a) alternative EV financing methods; and (b) the total comparative cost of running an equivalent combustion engine vehicle (i.e., the relative cost saving).
  - **Upon maturity:** The customer agrees to use the funds of the savings plan to pay for the depreciation cost of the EV at the end of the savings plan term (and fund any shortfall). They also have the option to purchase the EV outright (and fund any difference between maturity amount and original EV price).
  - **Upon lapse:** The EV remains with the insurance company. The savings plan is subject to a surrender charge equating to the depreciation cost of the EV. If this is greater than the current value of the plan, the customer is liable for the difference. However, premiums may be set at a level to minimise the risk of this residual liability. The insurance company may then have an agreement to sell the second-hand vehicle back to the EV specialist on pre-agreed terms.
  - **Upon death:** The savings plan could have an embedded term insurance benefit that pays off the residual difference between EV original cost and savings plan fund value. Therefore allowing the EV ownership to pass to the customer's beneficiaries upon death.
- Additional points to consider:
  - **Pension top-up rider:** In the next section we discuss the idea of aligning solutions to the pensions-savings crisis with the climate crisis. One such feature to consider is a default opt-in continuation of regular premiums into a pension savings vehicle, after the savings plan term ends. This works on the assumption that if regular premiums are affordable at outset, they will likely continue to be affordable unless personal circumstances change significantly. In a similar vein to auto-enrolment, this involves harnessing customer apathy for their long-term financial benefit.

[50] Octopus Electric Vehicles. Salary Sacrifice. Available at https://www.octopusev.com/salary-sacrifice-employees.

[51] Liverpool Victoria (lv.com). Are electric vehicles cheaper to own and run? Available at https://www.lv.com/car-insurance/electric-car-insurance/cost-of-owning-an-ev. "£925 of the savings come from fuel/charging, assuming 90% of estimated charging takes place at home using a standard tariff. £273 of the savings comes from maintenance and servicing."

- **Guarantee rider:** If interest rate levels permit reasonable pricing, then there may also be a desire to offer a regular premium guarantee rider on the savings plan, to ensure that the sum at maturity is sufficient to pay for the full cost of the EV. However, in recent years guarantee writers have struggled to make pricing of 100% capital guarantees competitive in the current market environment.

A benefit to the customer from this approach, is that they could benefit from attractive investment returns in a unit-linked/with-profits fund to cheapen the cost of financing. They also have flexibility to switch between EV ownership and alternative usage of their savings (subject to depreciation costs).

For the insurer, this could be viewed as a new direct infrastructure investment, where they are incrementally establishing an EV fleet. There are potentially beneficial diversification benefits for the insurer's investment portfolio. Also, potential benefits to reduce climate transition risk from a business strategy perspective and align with any plans for decarbonisation—although careful consideration would be needed for the manufacture carbon footprint of the EVs.

This would be a new asset class type, and appropriate consideration would need to be given to accounting and Solvency II risk treatment. Potentially an EV fleet could be classified as Property Risk, with an internal model constructed to allow for the specific characteristics of this market. Usage could be made of telemetric and car computer data, where applicable (and with permission from the customer). If a re-sale agreement plan could be negotiated with the partner EV specialist, this may instead transform into a form of Counterparty Risk. Motor insurance perils could also be treated and mitigated in the standard way.

From an accounting perspective, the asset will experience annual depreciation losses. However, the asset is also linked to a PV of positive cash flows from the tied savings product, and so balance sheet impact could be designed/managed appropriately.

Furthermore, as technology develops over the coming years, there could be potential for introducing flexibility into the product offering. It could be possible to offer less than 100% dedicated usage to the original customer, to enable them to make smaller regular payments. Additional revenue could be generated from temporary short-term leasing to other customers, that could offset depreciation costs. This may require autonomous driving to become a reality to be practical. But you could imagine a 'driverless Uber' model becoming feasible, once that is the case in years to come. This sort of adaption would therefore enable the insurer to help drive the societal shift towards a shared ownership approach.

However, realistically a key challenge will be overcoming the difference in financing term, between what is currently typical in the car financing market, and the long term likely needed for this financing approach to make economic sense. This new approach could be a way to challenge current customer preferences on seeing the need to change their vehicle every 2 to 3 years – a high vehicle turnover rate is in itself carbon inefficient. To offer improved affordability on EVs, the message could be that a "longer term" purchase mentality is needed. Early surrender options can still be offered, with appropriate guidance that these are unlikely to be appropriate with the underlying investment strategy and surrender penalties to protect against risk to the insurer. To the extent there is high take-up of the surrender option, then appropriate consideration could be given to use of the second-hand market to have multiple customers across the full financing term for the EV. The risk of non-usage would also need to be carefully considered.

TAKING A HOLISTIC VIEW TO A BETTER RETIREMENT – FINANCIALLY AND ENVIRONMENTALLY

For many life insurance companies, their social mission often includes helping clients to provide for themselves adequately in retirement, through the provision of savings products in the lead up to retirement, and the provision of products that convert pension savings into income at retirement.

As pensions markets around the world are moving from defined benefit to DC pension arrangements, a key challenge faced by many markets, is to encourage people to save sufficiently for retirement. Careful consideration may need to be given to personal savings/insurance products that help finance the costs of personal decarbonisation, to help avoid substituting regular savings into a pension. Taking an alternative perspective, there is a potential opportunity to offer savings products for personal decarbonisation that align with increasing savings towards pensions. We discuss this point in more detail shortly.

With the move towards DC pensions, the conversion of a pension pot at retirement into an income, in the most optimal way, is becoming another key challenge. A change in asset allocation to an investment strategy that is more suited for drawing down an income, and that also de-risks as retirees become more risk averse, is an important part of the solution. Quite often those at retirement have reached the peak of their lifetime savings, and so have the capacity to have a more material impact in helping to finance investment needed to meet net zero than younger generations. For insurance companies offering products at retirement, there is an opportunity to harness such investment potential from this point of asset re-allocation. However, for pension funds that have significant pressures on investment cost, this can be challenging to accommodate.

One thing to consider is adopting a holistic view to retirement. Financial wellbeing in retirement is a function of both income and expenses. The focus of an insurance company has traditionally been to optimise on 'risk-adjusted income' from a pension pot. However, when considering personal decarbonisation there are potential attractive savings that could help reduce regular expenses. These could be made explicitly part of the equation too when considering overall retirement planning.

Aligning Personal Decarbonisation with Pension Savings Pre-Retirement

In the UK, many view there to be a crisis of savings inadequacy for retirement, despite the success of auto-enrolment to ensure workplace schemes lead to 8% of UK salaries going into a DC pension. There is a similar view in other countries. Green finance could be offered in a way that aligns with encouraging additional long-term pension savings too, along a common theme of helping to support for a better retirement for customers (both financially and more broadly on the world they will retire into). Many life insurers provide auto-enrolment DC pensions. Potentially the annual contribution review process could also include personal decarbonisation options with accompanying finance options.

Some considerations could include:

- **Pension top-up riders – regular premiums:** As discussed in the previous sections, regular premiums products for EV or personal decarbonisation financing, could have an automatic opt-in to a pension savings vehicle, after the original savings plan ends. This assumes there are no significant changes that impact on the affordability of regular premiums.
- **Pension top-up riders – excess maturity amounts:** In a similar way, for the EV endowment idea discussed in the previous section, there may be an excess amount received from the savings plan on maturity, over and above the original cost of the EV. The default arrangement could be to have this automatically paid into a pension savings vehicle, and the customer has the ability to opt-out during the sale process, or at any point prior to savings plan maturity.
- **Utilisation of Tax-Free Cash (applicable to the UK):** The EV endowment policy could be written in a pensions tax wrapper, as a supplementary pension savings vehicle to the customer's DC auto-enrolment pension savings. The term of the endowment could be set to mature post age 55 (applicable in the UK). This could then potentially allow the customer to utilise their tax-free cash entitlement to fund the cost of the EV at maturity, and so effectively benefit from an income tax saving on the cost. Their mobility needs may also have changed by the time they reach retirement, and the savings may instead be used for their broader retirement needs.

Personal Decarbonisation as part of Retirement Planning

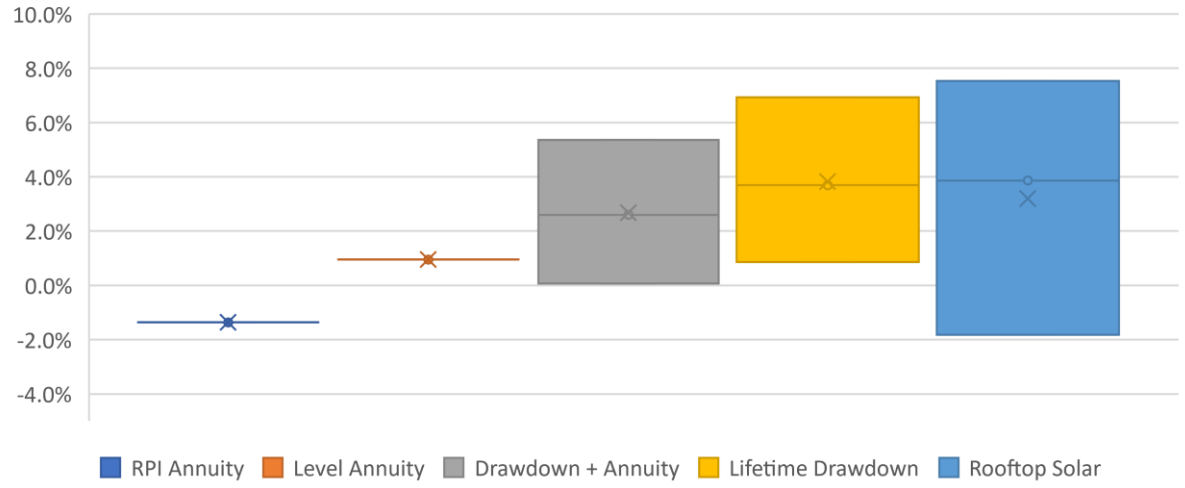
The conversion of a pension pot at retirement into an income, in the most optimal way, is a challenge for many. This being even more so given the low interest rate environment makes retirement income guarantees more costly. Also longer life expectancies now make inflation a more material risk, and place greater emphasis on the need to invest during retirement to some extent. Often the focus of the industry has been on how best to optimise income from a pension pot to meet retirement goals. However, financial wellbeing in retirement is a function of both income and expenses, and domestic energy costs are a key element of core expenses.

A variety of domestic renewable energy and energy efficiency measures are now at a cost, that can deliver an attractive return on investment over a 20- to 25-year timeframe, based upon potential savings on energy bills—this is consistent with typical retirement life expectancies. The following graph compares an illustrative range of estimated internal rate of returns on expected cash flows from a retirement income product, and expected energy bill savings from roof-top solar[52] (based upon UK data from the UK EST).

[52] Energy Saving Trust. A comprehensive guide to solar panels. Available at https://energysavingtrust.org.uk/advice/solar-panels/.

These results are **highly assumption dependent**, and a full list of assumptions is provided in the appendix. However, they are aimed at illustrating the general point that, from a financial perspective, domestic renewable energy can sometimes be on par or more attractive than a retirement income product. The range of returns explores several investment scenarios and assumptions around renewable energy installation. It does not look at the impact of longevity on expected return—this could be another variable to explore in more detailed analysis.

FIGURE 13: COMPARISON OF RETURN ON CASHFLOWS OR ENERGY SAVINGS FROM INITIAL INVESTMENT IN RETIREMENT INCOME PRODUCTS (OR PRODUCT COMBINATIONS) AND DOMESTIC RENEWABLE ENERGY OPTIONS



- For the annuities, we consider a single scenario of expected mortality.
- For the drawdown products, we consider a range of investment and interest rate scenarios, and all other assumptions (including mortality) are kept constant at expected levels.
- For rooftop solar, we consider a range of usage scenarios, dependent on time spent in the house, and all other assumptions (including energy inflation and solar performance) are kept constant at expected levels. Returns are calculated based upon assumptions taken from the EST.
-

Product	Average Return (for scenarios considered)	Scenarios Considered
RPI Annuity	-1.4%	Return on expected cash flows from a current market annuity rate (from Money Advice Service) in UK, assuming a 5-year guarantee period, relative to average expected survivorship and 2% p.a. RPI inflation.
Level Annuity	1.0%	
Drawdown + Annuity	2.6%	Return on expected cash flows from a range of stochastic investment scenarios and annuitisation age 80 (further assumptions provided in the appendix). The graph range is between 10th and 90th percentiles.
Lifetime Drawdown	3.7%	
Rooftop Solar	3.9%	Return on expected savings over a 25-year period, across a range of utilisation, Smart Export Guarantee for a household in the South East of England, and 3% p.a. energy price inflation.

Data sources: Moneyadviceservice.org.uk, Energysavingtrust.org.uk, Milliman analysis (using Bloomberg data).

Methodology: Additional information on assumptions are provided in the appendix.

Given the recent energy crisis in Europe with surging wholesale prices impacting on domestic energy bills, this is now even more a pertinent case. Domestic energy bills are only a small component of CPI or Retail Price Index (RPI) inflation indices that underlie inflation-indexation benefits. They are also not necessarily directly correlated to underlying investment returns, if a retiree chooses to adopt a strategy of 'out growing inflation.' A smarter way to hedge against energy price inflation, could instead be to enable self-generation or reductions in grid-energy needs.

Thinking about an example UK retiree, given that shift into DC pensions is still maturing, average typical pension pots at retirement remain modest. **£30,000** could be a representative amount. Assuming a hypothetical market annuity rate of **5%** at current rate levels, this could deliver an annual income of **£1,500** to top of income from the state pension and other sources. For many this is a similar amount to an annual domestic energy bill. The question then becomes, if advising and acting in the best interest of a retiree, would it be better to recommend them to use a proportion of their **£30,000** to invest in domestic renewable energy generation/saving technology with the aim of reducing and hedging their **£1,500** energy bill, or to have their entire pot go into a retirement income product? If the former, then how can pension funds and/or insurers practically provide this as a choice, as well as advise on this choice appropriately?

In addition to the financial aspects, there are also non-financial factors to consider. There is a potential well-being factor from having personally 'done their bit' in helping to address climate change. There is also a legacy factor from helping to leave the world in a better place, for their family and loved ones. One key challenge may be that of portability. Retirement may be a time when property downsizing is considered, and roof-installed solar and ground-installed heat pumps cannot be taken with you to a smaller new property. There will at least be likely compensation from the added value provided to a property. Alternatively, 'smart community energy' that instead delivers savings through the electricity grid to wherever you may reside, could be a more efficient option to consider.

Overall, life insurers could leverage their financial and risk expertise, to play a valuable role in incorporating these choices into their range of retirement income products and the retirement income planning process. Some points to consider could be:

- Including these as potential options in 'retirement wake-up' packs.
- Providing due diligence on personal decarbonisation solutions, technologies and installers, potentially through some trusted third-party partners who specialise in this space.
- Wrapping maintenance cost plans and 'energy bills savings' insurance into a retirement income product. This could leverage general insurance expertise within the firm, if offered by a composite insurer.
- Reviewing and performing due diligence of the financial projections offered by partner technology providers, to ensure that assumptions are appropriate and consistent with other retirement planning advice, and risks are also clearly identified and communicated.
- It may be difficult to include renewable energy options in any default or guided retirement decumulation option. These options could be prominently included in any literature provided to support key retirement decisions, through partnering with third-party specialist firms.

Section 4: Conclusion

As discussed in our accompanying paper on climate risk management, it is clear that life (re)insurers will likely be impacted either directly through physical risks, or from a transition to a greener economy, or both. Once insurers have undertaken a full assessment and accounted for material climate risk exposures, it will be important to then also consider what changes to make to optimise both investment and business strategy.

This research paper outlines some of the key strategies UK and European insurers are already adopting to account for climate change risk. It also explores some potential new avenues to consider, in what is a rapidly evolving topic, and one for which we are all continuing to develop our knowledge and ideas for innovation.

Given the potential adverse material risks posed to life insurers, an important focus is on ensuring resilience in the legacy business. However, the magnitude and scale of economic and societal shifts that need to happen to achieve a net zero economy, also present sizeable new opportunities for capital investment. As long-term investors with sophisticated risk management frameworks, wide distribution networks, and a large capital base, the life insurance industry is also well placed to lead on the deployment of this capital, to help meet this societal need for capital investment. We hope this research paper has helped to stimulate further thinking on how life insurers could be responding to this opportunity, and so help in responding to a clear call for action on climate change.

Section 5: Appendix

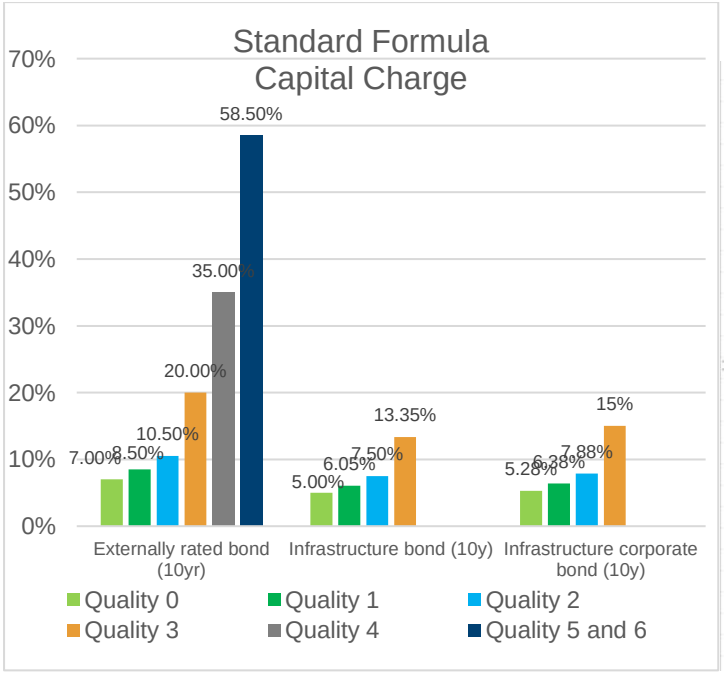
APPENDIX 1: A COMPARISON OF LOW-CARBON EQUITY BENCHMARK INDICES

Name	GHG Emissions	Fossil Fuel Reserves/ Green Reserves	Transition Performance Indicators / Net zero pathways / Banking Sector
FTSE EU Paris-aligned Benchmark Index	Underweight companies according to their GHG emissions.	• Underweight or exclude companies with fossil fuel reserves. • Overweight companies engaged in the transition to a green economy as defined by FTSE Russell's Green Revenues 2.0 data model.	• Over or underweight companies according to their management quality of climate issues. • Apply annual decarbonisation targets (7% average annual carbon emissions reduction relative to the index base year) to reach net zero over 10 years. • Disallow overweight vs. market in the short term.
FTSE Developed ESG Low Carbon Select Index	The target exposure index has 50% of the weighted Operational Carbon Emissions Intensity and weighted Fossil Fuel Reserve Intensity of the underlying index.	A Fossil Fuel Reserves Intensity reduction of 50% and an ESG uplift of 20% relative to the underlying.	
FTSE Global Climate Index	Overweight or underweight companies according to their GHG emissions.	• Underweight companies with fossil fuel reserves. • Overweight companies providing solutions to environmental challenges, that are part of the transition to a green economy.	
MSCI Climate Paris Aligned Benchmark Select Index	• Reduce the weight of companies assessed as high carbon emitters using Scope 1, 2, and 3 emissions. • Increase the weight of companies with credible carbon reduction targets through the weighting scheme.	• Shift index weight from 'brown' to 'green' using the MSCI Low Carbon transition (LCT) score and by excluding categories of fossil-fuel-linked companies. • Minimum 4x ratio of Weighted Average Green Revenue/ Weighted Average Brown Revenue relative to Parent Index.	• Minimum 10% increase in weighted average LCT score relative to Parent Index. • Align with a 1.5°C climate scenario using the MSCI Climate Value-at-Risk and a 'self-decarbonisation' rate of 10% year on year.
MSCI Global Low Carbon Target Index	Overweight companies with low carbon emissions relative to sales and those with low potential carbon emissions per dollar of market capitalization.	Only fossil fuel reserves used for energy are taken into account.	
MSCI Climate Change Index	Minimum 30% reduction in Greenhouse Gas (GHG) Intensity (Scope 1+2+3) relative to the Reference Index.	Have at least equivalent ratio of weighted average 'green revenues' to weighted average 'brown revenues' as that of the underlying investment universe.	• Increases weight in companies which see opportunities from climate transition 3x category tilt score for companies in Solutions LCT Category (green companies) to the parent index. • Annual decarbonisation at 7% starting June 1st, 2021 (base date).
S&P 500 Carbon Efficient Index	Overweight or underweight those companies that have lower or higher levels of GHG emissions per unit of revenue as defined in Eligibility Criteria and Index Construction.		
EuroStoxx Low Carbon Index	Overweight lower carbon emitters/ underweight higher carbon emitters.	Exclude power generation from fossil fuels.	
Bloomberg MSCI Euro Corporate SRI Index		Exclude issuers with greater than 5% revenue from the business activities related to thermal coal, generation of thermal coal and oil sands.	
MSCI Fixed Income Climate Paris aligned Index	Reduce the weight of companies assessed as high carbon emitters using Scope 1, 2, and 3 emissions.	• Exclude categories of fossil-fuel-linked companies. • Shift index weight from 'brown' to 'green' using the MSCI LCT score.	• Minimum 10% increase in weighted average LCT score relative to Parent Index. • The indexes are designed to align with a 1.5°C climate scenario using the MSCI Climate Value-at-Risk and a 'self-decarbonisation' rate of 10% year on year.

APPENDIX 2: A COMPARISON OF 'CLIMATE-CONSCIOUS' FUND RANGES OFFERED BY UK INSURERS

Name	Inception Date	Choice of Funds	Where to Invest / Type of Investments that are Excluded
PruFund Planet Fund	2021	A range of 5 multi-asset funds, each with their own risk profile. Branded PruFund Planet one to five, with one being the lowest risk version and five the highest.	• Access to a globally diverse range of private and public markets, across multiple asset classes and regions. • Exclude things like coal, controversial weapons, tobacco, and companies that violate the United Nations Global Compact on human rights and anti-corruption.
Legal & General Future World Fund Range	2019	A range of 11 funds: • 4x index funds • 3x multi-asset funds • 1x active equity fund • 2x fixed income funds • 1x sustainable opportunities fund	• Invests in a wide range of company shares, bonds, property, and real assets (including property, land, and infrastructure) • Does not hold 'pure' coal miners, manufacturers of controversial weapons, and perennial offenders of the UN Global Compact.
Royal London sustainable fund range	2003	A range of 7 funds from 100% equities to 100% fixed income: • RLP Sustainable Managed Income Trust • RLP Sustainable Managed Growth Trust • RLP Sustainable Diversified Trust • RLP Sustainable World Trust • RLP Sustainable Leaders Trust • RLP Global Sustainable Equity • RLP Global Sustainable Credit Fund	• Invest in companies that provide a net benefit to society, with a key part of this being the identification of companies that provide solutions to global challenges, such as climate change and poor health. • Avoid companies that exacerbate these problems. • Also invest in companies that show ESG leadership in their sectors.
Aviva Investors' Climate Transition range	2019	A range of 4 funds: • Aviva Investors Climate Transition European Equity Fund (2019) • Aviva Investors Climate Transition Global Equity Fund (2020) • Aviva Climate Transition Global Credit Fund (2021) • Aviva Investors Climate Transition Real Assets Fund (2021)	• Invest in companies offering goods and services that mitigate climate risk and are aiding the transition to a low-carbon economy. • Exclude fossil fuel companies.

APPENDIX 3: A COMPARISON OF SOLVENCY II STANDARD FORMULA SPREAD RISK CAPITAL CHARGES FOR QUALIFYING INFRASTRUCTURE INVESTMENTS OR INFRASTRUCTURE CORPORATE INVESTMENTS



Infrastructure Investment

- Cashflows are "stress proof"
- Predictable cashflows;
- Contractual protections;
- Sufficient contingency reserves;
- Various covenants;
- EEA or OECD located;
- Debt or equity specific provisions;

(Article 164a of EU 2015/35)

Infrastructure Corporate

- Majority of revenues from EEA/OECD infrastructure;
- Partially meets some of the above criteria;
- Diversified revenues;
- Some debt specific provisions;

(Article 164b of EU 2015/35)

APPENDIX 4: MODELLING ASSUMPTIONS FOR FIGURE 12

Annuity assumptions:

- RPI-linked annuity rate = **2.473%**.
- Level annuity rate = **4.673%**.
- Annuity rates sourced from www.moneyadviceservice.org.uk assuming age **65**, single life, guarantee period of **5** years and no medical underwriting, with quotes taken on 4 October 2021.
- RPI-linked cashflows assume projected RPI of **2%** per annum.
- Expected cashflows projected assuming survivorship based upon **80%** of **PXA08** mortality, with mortality improvements from **2008** based on the **CMI_2019** model, using a **1.5%** long-term improvement rate.

Drawdown assumptions:

- Lifetime drawdown assumes an Initial (sustainable) income rate = **3.4%** p.a.
- Drawdown + annuity assumes an Initial (sustainable) income rate = **3.6%** p.a.
- Both models increase income annually with projected price inflation, assumed **2%** p.a. on average.
- The drawdown + annuity model assumes **100%** of drawdown funds are used to purchase an annuity at prevailing market annuity rates at age **80**. Future annuity rates are modelled stochastically, varying by future projected government interest rates only, using a Milliman stochastic annuity rate model.
- The drawdown fund is assumed to be invested **50%** in equities and **50%** in bonds and cash. Investment returns from the drawdown fund are modelled stochastically using a Milliman stochastic investment return model.
- **1,000** stochastic scenarios have been considered.
- The average expected return is based upon the average internal rate of return of cashflows across the **1,000** scenarios. Cashflows include income payments for expected survivors and return of drawdown fund for expected deaths.
- The graph illustrates the range between **10th** and **90th** percentile scenarios.
- For more information on the stochastic investment and annuity price models, please contact Milliman.

Domestic renewable energy assumptions:

- Initial cost and annual savings information is taken from www.energysavingtrust.co.uk (EST)
- The average cost for a solar panel installation quoted by EST is assumed to be **£4,800**.
- EST have provided a range of potential energy savings from rooftop solar, for a household in the South East of England, for a variety of usage: home all day; home in mornings; home in afternoons; out until **4pm**; out until **6pm**, and for with and without the Smart Export Guarantee (SEG).
- The average expected return is based upon the average saving across all the above combinations.
- The graph illustrates the range between lowest (out until **6pm**, without SEG) and highest (home all day, with SEG) energy savings.
- Return on energy savings is calculated assuming **3%** p.a. energy price inflation over a **25-year** period.

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