



A Framework for Avoided Emissions Analysis:

Uncovering Climate Opportunities Not
Captured by Conventional Metrics

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| Authors



ANDREW HOWARD
Global Head of Sustainable Investment
Schroders



MERVYN TANG
Head of Sustainability Strategy, APAC
Schroders



LOW PING YEE
Head of Institutional Business/Sustainability Lead, Southeast Asia
Schroders



RACHEL TEO
Head of Futures Unit and Senior Vice
President, Economics & Investment Strategy
GIC



WONG DE RUI
Vice President, Economics & Investment Strategy
GIC

ABSTRACT

This paper introduces a framework developed by GIC and Schroders to measure and integrate Avoided Emissions into investment and portfolio analysis.

Foreword

Foreword by Johanna Kyrklund, Group CIO, Schroders

The worldwide impetus to net zero is catalysing innovations, technologies and in turn investment opportunities that will redefine portfolio strategies for the long term. Investors can no longer afford to ignore the implications of these seismic shifts.

The additional lens from Avoided Emissions analysis, complementing conventional carbon metrics, is therefore vital to investors seeking to establish a clear view of the opportunities and risks of our portfolios. As our analysis shows, the industries with exposure to Avoided Emissions have already begun to outpace the growth of the broader market, a gap we expect can only widen given the significant policy and consumer tailwinds.

Avoided Emissions is no longer just a concept. Affirming the value of this research, we have already put the Avoided Emissions framework to work, integrating it into our proprietary tool SustainEx, which measures a portfolio's overall environmental and social contribution. This is an important extension of our investment analysis toolkit, and positions us ahead in identifying and capitalising on the winners from the shift to a low carbon economy whilst avoiding the losers, benefitting our clients' portfolios in the long term.

As global institutional investors who both have a keen interest in understanding the long term implications of the climate transition on our portfolios, we hope that this strategic research collaboration with GIC will accentuate the importance of this under-researched topic, and spur the integration of Avoided Emissions in investment and portfolio analysis.

Foreword by Kevin Bong, Director, Economics & Investment Strategy, GIC

Investors need to fully consider the causes and effects of climate change on our portfolios, and prepare and participate in the multi-decade carbon transition that will likely entail a rewiring of the modern economy. We need new and better models, tools and methods to integrate this trend into our investment frameworks and decision-making processes.

GIC has been studying climate change for over a decade, and we seek to stay at the frontier of research to ensure the resilience and success of our portfolio in the face of climate risks. For example, as carbon emissions data became more standardised in recent years, we built an internal carbon dashboard tool that enabled us to measure the carbon intensity of our portfolio companies and stress-test them with various carbon price scenarios.

Avoided Emissions introduce a new and important dimension to a growing set of metrics that investors and policymakers need to make better decisions. It captures the positive contribution toward reducing carbon emissions that traditional carbon metrics miss. This helps investors like GIC better identify companies that are likely to be winners in the ongoing carbon transition. One key feature we are excited by is the ease of integration across conventional Scope 1, 2 and 3 emissions data to enable a more consolidated and holistic view of our investment portfolio.

We are very pleased to have co-developed this framework with Schroders. It is one of many fruitful ideas born from continual dialogue in an enduring relationship. Climate change integration is a journey that we are all on together. We hope that Avoided Emissions will be a valuable contribution to the broader community's discourse and decisions, and we welcome comments and conversations ahead to refine this important new framework.

| Executive summary

Climate change will be a defining investment theme for the coming decades. As governments' and societies' decarbonisation commitments translate into tangible policies and actions, giving rise to winners and losers in the green transition, the importance of meaningful and comprehensive carbon measures is higher than ever.

Conventional measures only inform us of the emissions companies generate from their own operations and value chains. However, the **leaders in the decarbonisation race are doing more than reducing their own emissions; they are developing products and services that can drive significant reductions in economy-wide emissions.**

Avoided Emissions provide an additional lens by capturing companies' contribution to emissions reductions through the substitution of high carbon activities with low carbon alternatives, as these are not reflected in their conventional Scope 1, 2 and 3 metrics.

We have developed an **Avoided Emissions framework to capture these emissions savings**, which are calculated relative to a baseline where low carbon technologies had not been deployed. These represent real emissions reductions and will be vital to global decarbonisation efforts. Our framework is based on a proprietary **systematic value chain approach**, drawing on academic and industry literature to capture the **contribution of a broad set of industries to Avoided Emissions, with an emphasis on investability and scalability.**

The Avoided Emissions framework is built for direct application to investment analysis and the benefits are twofold:

1. Sharpens our abilities to **identify and assess an extended set of winners from the green transition, which are otherwise not captured using traditional carbon metrics or “green revenues”.**
2. Allows for ease of comparison with Scope 1, 2 and 3 emissions under **a common unit of measurement, enabling a more integrated and holistic approach to**

building a portfolio that reflects both climate risks as well as opportunities.

We examined 19 carbon-avoiding activities and industries, and quantified the emission savings for each dollar of revenue (tCO₂e/US\$m). If **adoption of these activities were now at the levels we expect in 2030, almost a quarter of economy-wide emissions could be eliminated.** This highlights the importance of these low carbon products and services to decarbonisation efforts.

We also applied the Avoided Emissions framework to the broad MSCI ACWI Investable Market Index (IMI) stock universe and a focused portfolio of companies accelerating the low carbon transition. The analysis shows the latter made significant contribution to emissions reduction, even though their Scope 1, 2 and 3 emissions are undifferentiated.

The analysis further substantiates that **companies with positive Avoided Emissions exposure saw revenues grow by an annualised rate of 7% over the past three years, which are 20% faster than the MSCI ACWI IMI stock universe as a whole¹.** The global impetus to decarbonise will continue to provide a strong tailwind to this growth, making it all the more imperative for portfolio analysis to include Avoided Emissions.

As research in this space is still at a nascent stage, there is significant opportunity to further develop the framework. We highlight a few areas below where the analysis can be extended:

- Widen the coverage of carbon-avoiding activities
- Factor in regional and sector variances
- Augment with additional non-revenue measures
- Extend from public to private markets

For institutional investors, the investment implications of the multi-decade climate transition are immense. Our framework for incorporating Avoided Emissions in investment and portfolio

¹ The Schroders calculation is based on companies exposed to Avoided Emissions in our framework. This is not guaranteed and may not be representative of future growth.

analysis is a pivotal step which we believe will add valuable insights to investors.

Introduction

Tackling climate change is no longer optional. Worldwide commitments to net zero, regulatory pressures and intensifying consumer awareness have turned decarbonisation into the dominant investment theme for the next decades. The transition is catalysing innovations and technologies that can displace high carbon activities, and capital is expected to move at an unprecedented scale to advance these transformative developments².

Yet investors currently lack a robust framework to systematically assess the opportunities this transition will bring, and the impact it will have on their portfolios. Conventional carbon analysis focuses on emissions as a problem and risk to be addressed, especially greenhouse gases that companies emit through their activities, either directly (Scope 1), indirectly through energy usage (Scope 2), or across their value chain (Scope 3).

However, the **leaders in the decarbonisation race are doing more than reducing their own emissions; they are developing products and services that can drive significant reductions in economy-wide emissions.** Wind turbine manufacturers are a stark example. Under most conventional analyses, they are penalised for high emissions. A traditional emissions lens fails to, however, recognise wind turbines' contribution to economy-wide emissions reductions as they help displace fossil fuel power generation.

The current solution to this blind spot is to use the share of revenues linked to clean technologies (eg. "green revenues") as a complementary lens. However, this approach does not tell us what impact each dollar of "green revenue" has on climate mitigation, and therefore cannot be compared or combined with conventional carbon emission measures.

The Avoided Emissions analysis we describe here provides the additional lens that makes carbon analysis more

² IRENA (2019) estimates that US\$110 trillion or an average of 2% of global GDP is needed to be deployed into low carbon technologies between 2016-2050 to keep global warming below 2°C. Another paper by McCollum et al projects that we need US\$2 to US\$4 trillion in annual investments to meet similar goals. Nature Energy (2018). *Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals.*

complete. This approach focuses on opportunities and impact, thereby enabling investors to appraise their portfolios more holistically. **When used together with carbon emissions, Avoided Emissions completes the picture for a portfolio's exposure to and impact on the climate transition.**

This paper proposes a **practical and systematic framework to measure and integrate Avoided Emissions** into investment and portfolio analysis. Starting with the identification of investable and scalable activities that can reduce economy-wide emissions if widely adopted, we establish a systematic value chain approach to attribute each activity's contribution to Avoided Emissions.

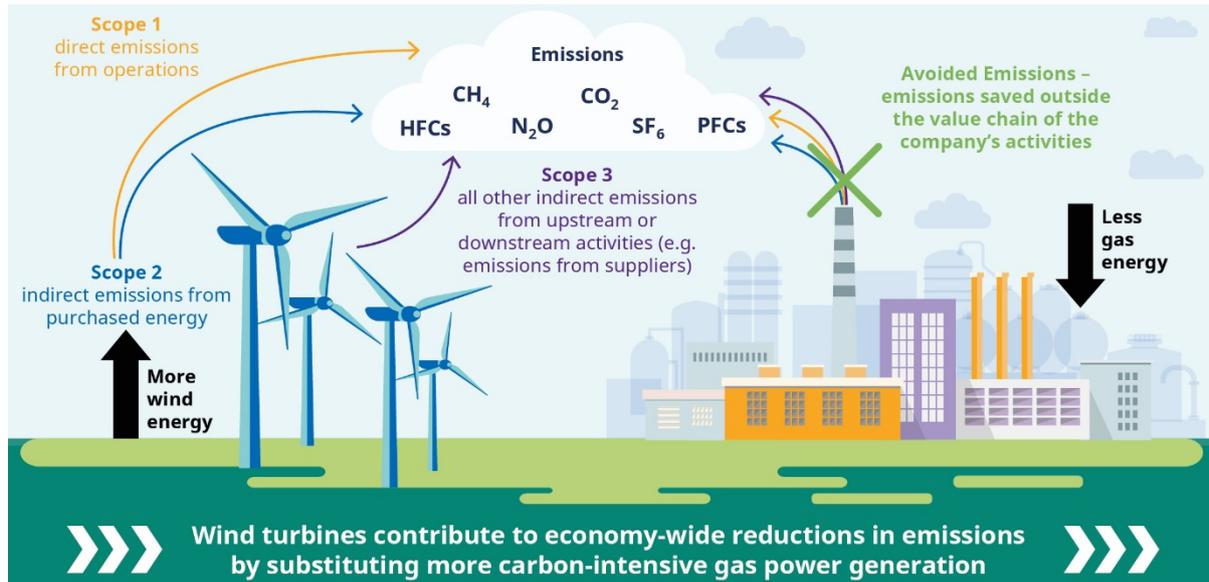
We provide a worked example for a building insulation company to demonstrate how Avoided Emissions are calculated, and further illustrate the application at portfolio level. Finally, we highlight in the conclusion a few areas where the analysis can be extended, which we believe will add further value to institutional investors' application of the framework across both their public and private market investments.

| What are Avoided Emissions?

Avoided Emissions are emissions saved indirectly by products and services through the substitution of high carbon activities with low carbon alternatives. As the emissions are saved outside the value chain of a company's activity, they are not captured under conventional Scope 1, 2 and 3 emission measures. In a way, Avoided Emissions represent a 4th scope; one that helps provide a more complete picture of companies' and portfolios' contributions to decarbonisation.

Exhibit 1 is a graphical illustration of Scope 1, 2 and 3 emissions for a wind turbine manufacturer, alongside its contribution to economy-wide emissions reductions (eg. Avoided Emissions) as the wind turbines are used in wind generation, substituting more carbon-intensive gas power generation.

Exhibit 1: Graphical illustration of a wind turbine manufacturer's carbon footprint



Source: Schroders, GIC

Another example is the growing market for alternative protein. Alternative meat accounted for less than 1% of the overall US\$2.7 trillion meat market in 2019 but could increase tenfold in the next ten years as consumers become increasingly aware of emissions from meat production³. If alternative sources of protein substitute the consumption of farmed meat, emissions from livestock and manure – which made up 6% of human-induced emissions in 2018 – would be reduced. However, using conventional carbon metrics, the producers of alternative meat, as well as industries that support their value chain, do not receive credit for the significant emissions which they can help save across the economy.

A robust framework for Avoided Emissions

We propose **a systematic value chain approach, capturing the contribution of a broad set of industries** to Avoided Emissions while **minimising the risk of double counting the same savings in different industries**. Drawing on academic and industry literature, this framework focuses on carbon-avoiding activities that are **investable** and **scalable**, taking into

³ BCG (2021). *Alternative-protein market to reach at least US\$290 billion by 2035*.

account their economic and technological viability, adoption momentum and cost of carbon abatement.

These savings are defined relative to a baseline carbon emission estimate in a scenario where that product or technology had not been deployed. **Extended coverage** across a large universe of companies and **ease of integration** with other emissions metrics are two important characteristics of the framework, enabling its **direct application to investment analysis**.

We believe the framework will enhance the understanding of the investment implications of the low carbon transition. Highlighting the relevance of this work, Schroders' proprietary tool SustainEx⁴ has incorporated this Avoided Emissions framework which, alongside Scope 1, 2 and 3 emissions, enables **an integrated, measurable view of investments and portfolios' overall environmental impact**.

We see two important benefits that this framework brings for investors:

1. **Identify and assess an extended set of winners from the green transition:** Avoided Emissions can help investors identify and assess companies that are contributing to solutions that mitigate emissions. These companies may not necessarily look "low carbon" now based on conventional measures, but they could have important enabling technologies that help reduce economy-wide emissions and will, thus, benefit from the broader decarbonisation drive.

In addition, a value chain approach provides investors with a broader perspective of companies that are set to gain from this growing demand. In the case of electric vehicles, for example, the analysis will extend to manufacturers, auto parts makers, batteries and other raw materials producers along the whole value chain. **Our framework seeks to provide a robust approach to identify and evaluate winners from the low carbon**

⁴ SustainEx is Schroders' proprietary sustainability tool that quantifies in dollar terms the positive contributions and negative impacts companies have on society. Viewing those externalities through an economic lens provides an objective measure of companies' credit or deficit with society, which will become more important as they crystallise into financial costs or benefits. SustainEx is used by Schroders' analysts and portfolio managers to measure and manage ESG impacts and risks more effectively. The tool covers more than 16,000 companies as of November 2021. (Note: As SustainEx uses third party data as well as Schroders own estimates and assumptions, the outcome may differ from other sustainability tools and measures.)

transition, which are otherwise not captured using traditional carbon metrics or “green revenues”.

2. **Integrated and holistic analysis of climate risks and opportunities:** Scope 1, 2 and 3 emissions focus mainly on the risks, highlighting companies most at risk from the green transition and their contribution to the global climate crisis. Our framework complements this assessment by capturing the potential Avoided Emissions generated by companies and quantifying them in a metric that is directly comparable to these conventional emissions measures (tonnes of emissions relative to sales).

It therefore enables the analysis of risks and opportunities under a common unit of measurement, allowing a more integrated and holistic approach to build a portfolio that can both take advantage of, and avoid risks from, the low carbon transition.

Avoided Emissions and net zero commitments

Some carbon target-setting frameworks, such as the Science Based Targets initiative (SBTi), currently do not view Avoided Emissions as a valid source of emissions reduction. The SBTi explains that Avoided Emissions are not included as companies’ transition risks remain unmitigated if “*emissions associated with the value chain of a company remain unabated*”⁵. That said, they acknowledge that activities captured by Avoided Emissions are “*critical to society achieving net-zero and should indeed constitute part of a company’s net-zero strategy*”, even if they are not part of the formal targets.

Some practitioners view Avoided Emissions as a potential tool for watering down companies’ and investors’ net zero targets. We recognise these concerns in the context of target-setting. However, we believe that a disciplined and thoughtful Avoided Emissions framework can be an important element of net zero targets by governments, companies and investors because:

1. Achieving net zero commitments is not just about stopping investments and activities generating carbon

⁵ SBTi (2020). *Foundations for science-based net-zero target setting in the corporate sector*.

emissions. It requires a commitment to pushing or supporting companies to reduce their emissions, and it is about substituting carbon-intensive activities with cleaner alternatives. Avoided Emissions provide us with a metric to identify these alternatives as we progress towards net zero outcomes.

2. Avoided Emissions provide a constructive, “carrot” approach for companies to focus on new activities, innovations and investments to avoid emissions. The idea is that as companies do more to help avoid emissions through the products and services they sell, economy-wide carbon emissions should fall. Hence, companies need to assess the benefits of the emissions they help save, alongside the emissions they produce.
3. Exposure to Avoided Emissions does not preclude the need for companies to improve their carbon efficiency or develop new technologies to bring down their own Scope 1, 2 and 3 emissions in line with net zero pathways. Avoided Emissions will more clearly measure the gross impact companies have, accounting for both their own emissions and savings generated elsewhere in the economy through greater use of their products and services.

Thus, we consider that continued investment into technologies that can deliver Avoided Emissions will be key to achieving net zero commitments. This makes robust research into Avoided Emissions and their incorporation into investment analysis more crucial than ever.

Overview of the Avoided Emissions framework

We provide below a simplified illustration of the five-step approach we have taken to build our Avoided Emissions framework.

Exhibit 2: Overview of the Avoided Emissions framework



Source: Schroders, GIC

Step 1: Identify carbon-avoiding activities

To identify carbon-avoiding activities that are both investable and scalable, we have prioritised the activities examined in this framework by:

1. Focusing on the biggest sources of anthropogenic emissions, where scope for emissions savings through Avoided Emissions technologies could be largest;
2. Identifying economically feasible carbon-avoiding activities in these sectors which are expected to reach a significant market size over the next decade, taking into account their existing cost competitiveness in abating carbon as well as adoption momentum; and
3. Filtering for activities that can be mapped to disclosed company revenue segment data.

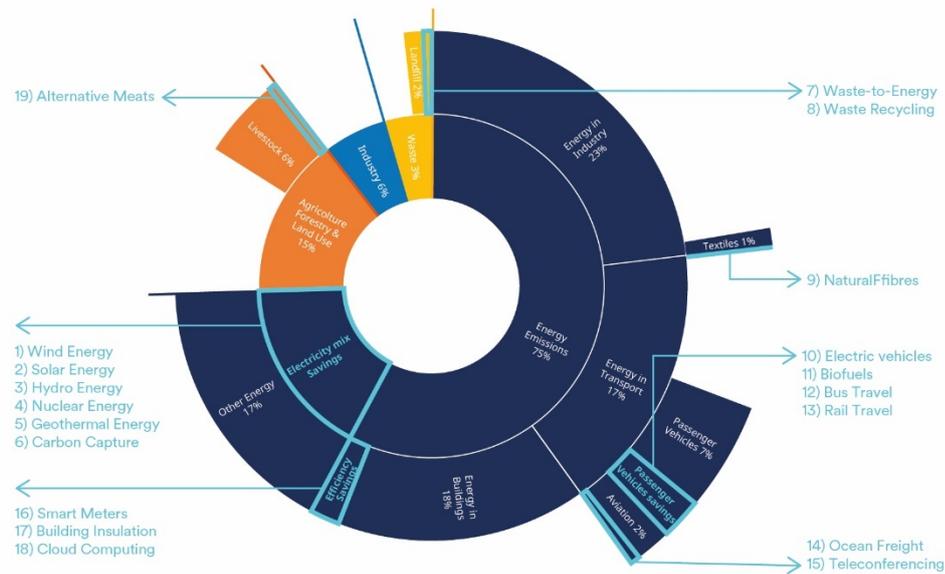
Through the analysis, we have identified an initial list of 19 carbon-avoiding activities (see Exhibit 3). We estimate that almost a quarter of economy-wide emissions⁶ could be eliminated if adoption of these activities were now at the levels we expect in 2030⁷.

Appendix 1 sets out the methodology for identifying these carbon reduction activities in more detail.

⁶ We estimate emissions in 2018 would have been 23% lower if adoption rate of the 19 carbon-avoiding activities was at the level we expect for 2030. For example, we estimate anthropogenic emissions would be 18% lower if fossil fuel generation was 25% in 2018 (compared to the actual figure of 64%). The remaining emissions reductions come from the following: 2% from passenger cars assuming 20% market penetration by electric vehicles; 1.8% from energy efficiency improvements reducing energy use by 10% in buildings; 0.6% from a tenfold increase in market share of alternative meats; and savings from each of the other sources are less than 0.5%.

⁷ For some of these activities, while system-wide Avoided Emissions may appear low on an absolute basis, the emissions reductions can still be significant for companies in these industries. For example, although natural cotton contributes to less than 1% of Avoided Emissions, we calculated that 983 tCO₂e are saved per US\$1 million in sales of natural cotton, compared to a median of 480 tCO₂e across the industries tied to our 19 activities.

Exhibit 3: Global GHG Emissions share by sector and carbon-avoiding activities (sources of Avoided Emissions) (2018)



Source: Schroders, GIC, Climate Watch, based on raw data from IEA's "Net Zero by 2050 -A Roadmap for the Global Energy Sector" Report (2020) and World Resources Institute.

* The inner circle shows the share of emissions by sector (eg. waste). The middle circle breaks down the sector to sub-sectors (eg. landfills). Where relevant, the outer circle provides a further breakdown (eg. passenger vehicles). Carbon-avoiding activities are numbered in green, and the shaded areas represent the share of emissions we estimate they save (23% combined).

Step 2: Estimate Avoided Emissions achieved by these carbon-avoiding activities relative to alternatives

For each of the 19 activities identified in Step 1, we estimate the emissions saved from carbon-avoiding activities relative to two baselines:

1. Emissions from the most relevant carbon-intensive activity (eg. solar energy versus gas energy); or
2. Emissions if the carbon-avoiding activity had not taken place at all (eg. use of solid wall building insulation versus not using solid wall building insulation).

The estimates draw upon existing findings in academic and industry literature. Appendix 2 provides a summary of the estimated emissions saved for the 19 identified activities.

Step 3: Attribute Avoided Emissions to industries across the value chain

The value chain of a single carbon-avoiding activity extends across many industries. The value chain approach allows us to

capture the contribution of a broad set of industries to emissions reductions while minimising the risk of double counting. This is based on an industry's share of economic value-add along an activity's value chain. We recognise that assigning precise figures to each industry's share of the value-add in a full value chain is challenging, and while we have drawn on existing analysis as far as possible, we have also chosen to avoid false precision in the assumptions we make. The value-add, and in turn Avoided Emissions, are assigned as follows:

- **Primary industry:** 50% of the activity value chain's economic value-add and Avoided Emissions. Primary industries include the producer of a technology (such as the vehicle manufacturer for electric vehicles ("EV")) or the provider of a service (such as the operator for bus travel, substituting private transport)⁸⁹,
- **Secondary Industry:** 20% to 30%¹⁰ - These typically include the producers of key parts for a technology (such as auto parts for EVs) or the key equipment used to provide a service (such as the bus manufacturer for bus travel). If there are no clear secondary industries, we would attribute this part of the value-add back to the primary industry.
- **Tertiary industry:** 10% - These typically include producers of raw material components, such as batteries and associated metals for EVs. In some cases, we may not identify any tertiary industry (such as in the case of bus travel) if this is deemed to be insignificant.
- **Others:** Any remaining share of the economic value-add for "other" unspecified contributions to the value chain, such as the provision of financing or raw materials that go into making component parts.

⁸ The 50% is based on NYU Stern data (January 2021) showing gross margins (a proxy for economic value add) averaging 37% across 7,582 US companies. We then add back the value from direct labour costs into gross margins so that effectively employing companies receive the Avoided Emissions benefits from labour share of the value add, assuming direct labour on average contributes to around 10-20%.

⁹ We have made an exception for cloud computing, which we have allocated 80% of the value chain to the service providers, as there are few other industries with significant roles in the value chain. Global companies that predominantly offer software and cloud computing as a service often have gross margins exceeding 80%.

¹⁰ The percentage depends on estimates for the share of costs.

Step 4: Quantify Avoided Emissions intensity for each industry

To derive a single metric that can be compared across industries while taking into account the differing revenue from providing the carbon-avoiding technology or product, we normalise the Avoided Emissions calculated for each industry based on the price of a typical good or service¹¹. We also quantify the Avoided Emissions intensity which is expressed as tonnes of emissions per million dollar of revenue (tCO₂e/US\$m).

Appendix 3 provides a list of our estimated Avoided Emissions intensity by industry.

Step 5: Derive Avoided Emissions intensity at company level

The final step is to calculate the Avoided Emissions intensity for individual companies based on their revenue exposure profile across industries identified in Step 4. We first map the industries we identify as having exposure to avoided emissions to revenue segments defined by the FactSet Hierarchy dataset¹². We then measure the company's Avoided Emissions based on their weighted proportion of exposed revenue. If the company is exposed to different carbon-avoiding activities and industries, these would be accounted for and weighted accordingly.

To illustrate the approach, we provide a worked example for building insulation – one of the 19 identified activities – to demonstrate how Avoided Emissions are calculated for Owens Corning, a US-listed Fortune 500 company and a leading producer of building insulation materials and fibreglass composites.

¹¹ We have used reported power production volumes instead of revenue for low carbon generation as it serves as a better indicator of output than revenue, given variation of prices regionally. We have not used alternatives to revenue data outside of power due to lack of data availability, but plan to explore this in future enhancements to the model.

¹² We used the Factset dataset of companies' revenues to identify the companies' exposures to the 19 emissions-avoiding activities identified in Step 1. Of the 7,000 discrete Factset revenue segments, we could map almost 200 segments to the 19 identified activities.

Worked Example: Avoided Emissions Framework – Building Insulation and Owens Corning

Exhibit 4: Illustration of the 5-step approach to calculate Avoided Emissions for building insulation which is then used to derive Owens Corning’s Avoided Emissions metric

Step 1	Step 2	Step 3	Step 4	Step 5		
Identify carbon-avoiding activities	Estimate avoided emissions achieved by these carbon-avoiding activities relative to alternatives	Attribute avoided emissions to industries across the value chain	Quantify avoided emissions intensity for each industry	Map industries to revenue segment	Estimate each company’s revenues from carbon-avoiding activities	Derive avoided emissions intensity at company level
Building insulation	52 tCO ₂ e per installation of solid wall building insulation	Primary sector - insulation manufacturer (50%): 26 tCO ₂ e	Estimated installation cost of \$14,000: $26\text{tCO}_2\text{e}/14,000 * 1,000,000 = 1,857 \text{ tCO}_2\text{e}/\mn	Industrial and Materials ↓ Insulation	Owens Corning’s revenue breakdown: 37.9% from Insulation	$0.379 * 1,857 =$ 704 tCO₂e/\$mn

Source: Schroders, GIC

Step 1: Identify carbon-avoiding activities

First, we had identified building insulation as one of the 19 carbon-reducing activities because it is one of the most effective solutions to reduce energy usage in buildings, which is a key emitting sector and accounts for 18% of anthropogenic emissions in 2018. It is also economically viable as the carbon abatement cost is negative. This means emissions can be reduced at a profit as the cost savings from reduced energy usage exceed the cost of installation and usage.¹³

Step 2: Estimate Avoided Emissions achieved by these carbon-avoiding activities relative to alternatives

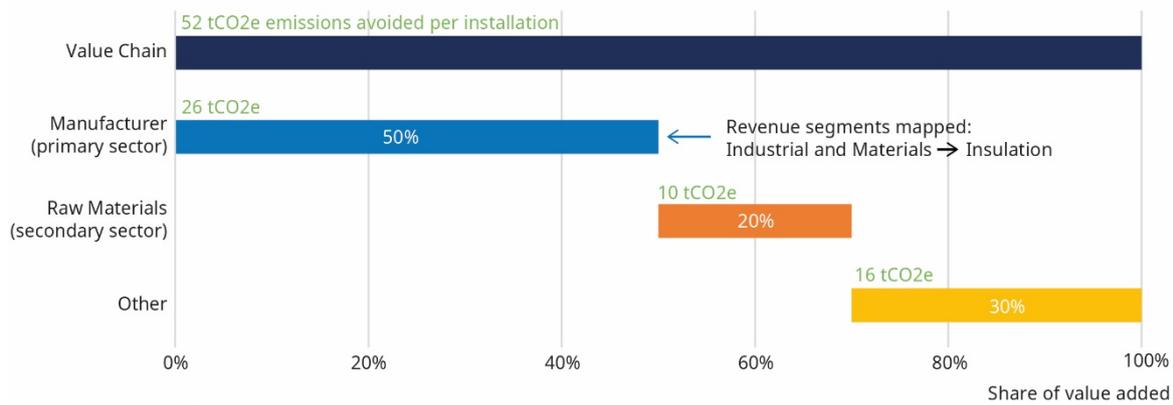
Solid wall insulation is estimated to result in annual emissions savings of around 2.6 tCO₂e compared to an uninsulated building. Assuming a 20-year usage, this equates to **52 tCO₂e** of savings over the lifetime of a single installation.

Step 3: Attribute Avoided Emissions to industries across the value chain

We consider insulation manufacturers the “primary industry” of the insulation value chain and, thus, assign it 50% (**26 tCO₂e**) of the Avoided Emissions calculated under Step 2. This compares to 20% for insulation raw materials, which we see as the “secondary industry”. For this case, no “tertiary industry” is identified and we attribute the remaining 30% of Avoided Emissions to other activities in the value chain. See Exhibit 5 for more details.

¹³ Based on estimates from Goldman Sachs Investment Research (2020). *Carbonomics: Innovation, Deflation and Affordable De-carbonization*.

Exhibit 5: Industry value chain attribution for building insulation



Source: Schroders, GIC

Step 4: Quantify Avoided Emissions intensity for each industry

Industry studies¹⁴ estimate the net annual combined cost for external and internal solid wall insulation at around \$700. Assuming a 20-year usage, the costs are \$14,000. Taking the savings attributed in step 3 (eg. 50% of 52 tCO2e), this equates to an Avoided Emissions intensity of 1,857 tCO2e/US\$m for the **insulation manufacturer industry** (eg. 26 tCO2e/\$14,000 * \$1,000,000).

Step 5: Derive Avoided Emissions intensity at company level, based on exposures across industries

Owens Corning has exposure to the insulation manufacturer industry, with 38% of its revenue generated from the insulation segment. The remaining 62% is derived from roofing and composite materials, which are currently not mapped to any carbon-avoiding activities. Weighting these exposures, we estimate the overall company-level Avoided Emissions intensity at 704tCO2e/US\$m for Owens Corning.

The worked example shows that Owens Corning’s Scope 1 emission intensity is very high, almost three times the equivalent weighted average carbon intensity¹⁵(WACI) of the MSCI ACWI Investable Market Index (IMI) (Exhibit 6). However, using the lens of **Avoided Emissions, this outweighs its Scope 1, 2 and 3 combined, providing another perspective of the company’s contribution to decarbonisation.**

Broadening the analysis to the materials and industrials sectors Owens Corning operates in, we see that the companies typically exhibit a high level of conventional carbon intensity. In the case

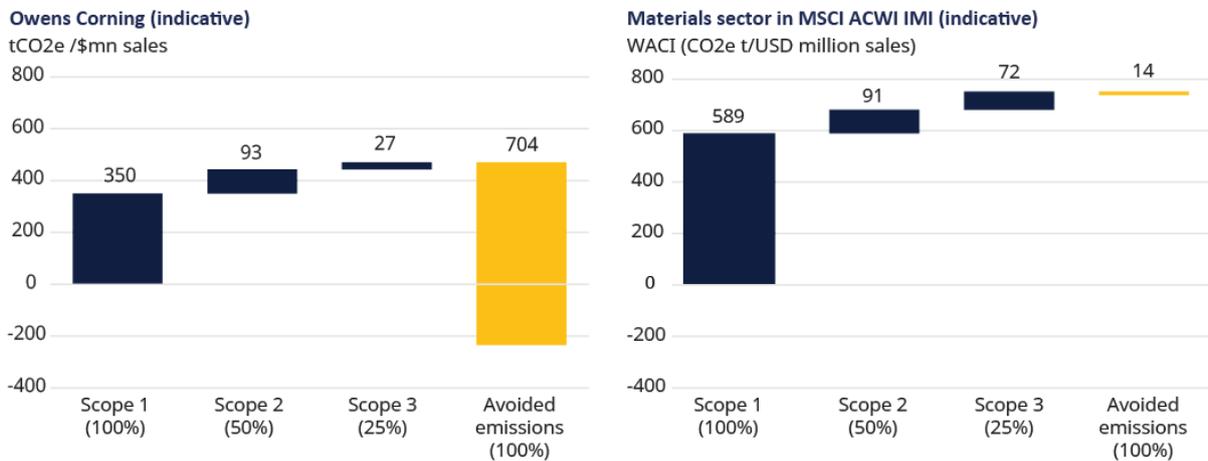
¹⁴ Energy Saving Trust and Element Energy Limited (2013). Review of potential for carbon savings from residential energy efficiency

¹⁵ Calculated by finding the carbon intensity (emissions / \$m sales) for each portfolio company and calculating the weighted average by portfolio weight.

of the materials sector, only 7% of the companies have positive Avoided Emissions exposure. In the industrials sector, only 4% of the 1,463 companies have Avoided Emissions that exceed their combined adjusted Scope 1, 2 and 3 emissions based on our estimates (Exhibit 7).

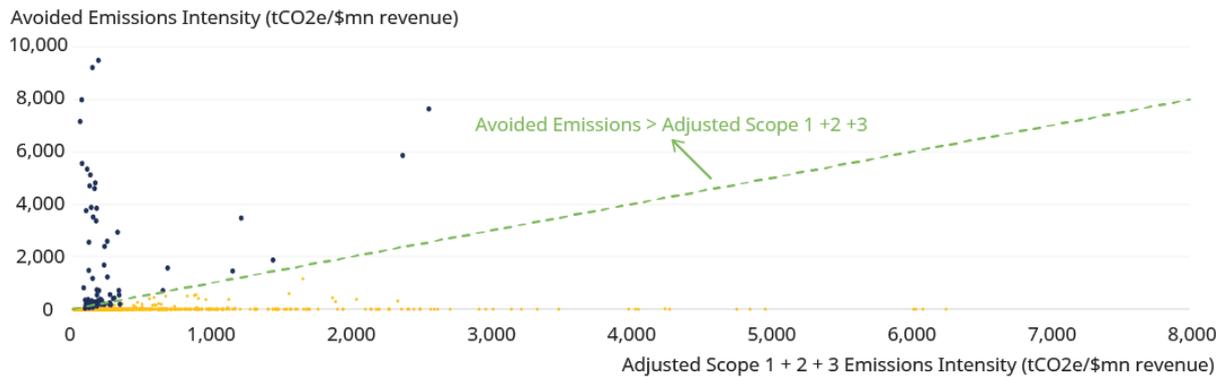
Avoided Emissions analysis can help sharpen our abilities to identify the companies (such as Owens Corning) that are engaged in climate transition opportunities - even if they are in typically high carbon-emitting sectors - which might otherwise be overlooked if we used only conventional carbon footprint analysis.

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Source: Schroders, GIC, using MSCI carbon emission estimates for Scope 1, 2 and 3.

¹⁶ We adjust scope 2 and 3 downwards by 50% and 75% respectively as companies do not have the same level of control over these scopes, and are less likely to be impacted financially by regulators' efforts for these emissions. Scope 1 and Avoided Emissions are unadjusted.



Source: Schroders, GIC, using MSCI carbon emission estimates for Scope 1, 2 and 3.

Assessing portfolios using Avoided Emissions

Expanding the analysis from individual companies’ exposure to carbon-avoiding activities, we demonstrate the benefits of our framework to providing an integrated portfolio view of carbon exposures, both in terms of Scope 1, 2 and 3 and Avoided Emissions, using two representative portfolios.

- The first is the MSCI ACWI IMI, representing the broad investable listed stock universe.
- The second is a hypothetical “Climate Transition” Portfolio, consisting of companies best placed to accelerate the transition to a low carbon economy in sectors such as renewable power and energy storage, and assigning equal weight to each company.

Exhibit 8 shows the adjusted WACI for Avoided Emissions relative to the other scopes for both portfolios.

The adjusted WACI for Avoided Emissions for companies in the MSCI ACWI IMI (left chart) is relatively modest, at just over a quarter of their Scope 1 WACI. The low volumes of Avoided Emissions in the broad listed investment universe signal that investment opportunities in carbon-avoiding activities are not yet mature and limited in the wider economy and stock market¹⁷.

¹⁷ The lack of comprehensive coverage of carbon-reducing technologies and limited mapping of companies’ exposures to these technologies could partially contribute to the low Avoided Emissions measurement that we have

However, if we were to meet the Paris Accord's goals of limiting global average temperature increases to well below 2°C, investments in carbon-reducing activities will have to increase substantially. Many of these markets will have to grow rapidly as companies look for solutions to achieve their net zero commitments and to align their business models and product portfolios to a decarbonising global economy.

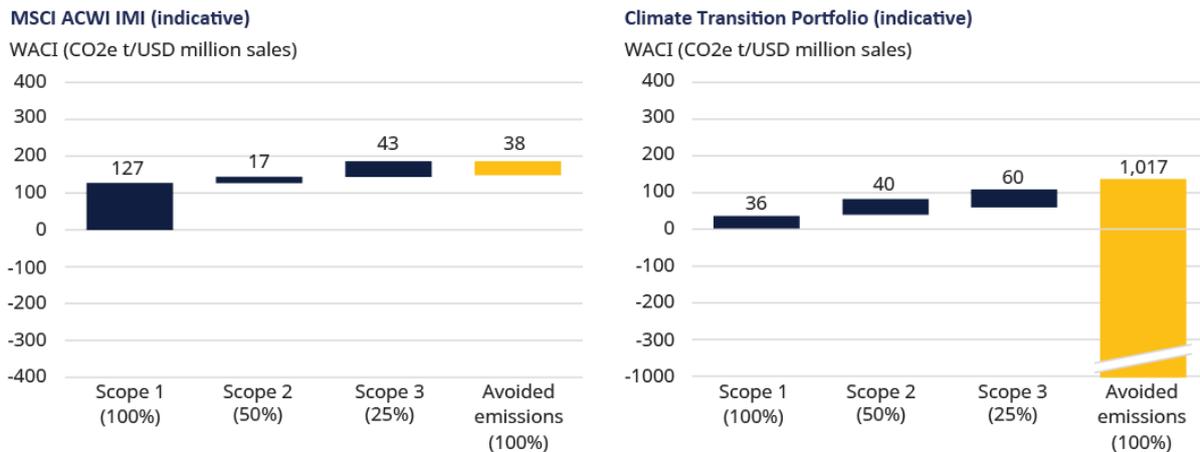
These efforts are also supported by an increasingly enabling policy environment and even direct monetary incentives (such as EVs in some regions). New markets will form as society develops innovative technologies and solutions to decarbonise. This underscores the importance of analysing Avoided Emissions to identify these market shifts and opportunities in a low carbon future.

The "Climate Transition" Portfolio (right chart) demonstrates how a strategy investing in companies that will enable this future could look. The WACI for Scope 1, 2 and 3 emissions for this portfolio are around two-thirds of the WACI for the portfolio representative of the MSCI ACWI IMI, which are not low. However, the WACI for Avoided Emissions is more than seven times this figure. The products and services of the companies in the "Climate Transition" Portfolio are explicitly designed to accelerate the transition to a low carbon economy. **Avoided Emissions analysis provides an additional lens to ensure those benefits are captured in portfolio analysis, and that the companies providing solutions to the climate challenge are recognised and rewarded in capital allocation decisions.**

The analysis further substantiates that **companies with positive Avoided Emissions exposure saw revenues grow by an annualised rate of 7% over the past three years, which are 20% faster than the MSCI ACWI IMI stock universe as a whole**¹⁸. The global impetus to decarbonise will continue to provide a strong tailwind to this growth, making it all the more imperative for portfolio analysis to include Avoided Emissions.

computed. However, we believe that the main driver is still due to the nascency of low carbon investments in the market.

¹⁸ The Schroders calculation is based on companies exposed to Avoided Emissions in our framework. This is not guaranteed and may not be representative of future growth.



Source: Schroders, GIC, using MSCI carbon emission estimates

Conclusion

For an institutional investor looking to shift its allocation to align with the opportunities arising from the net zero transition while managing existing exposures to high carbon activities, **our framework allows for ease of integration across conventional Scope 1, 2 and 3 emissions data with Avoided Emissions metrics. It provides a consolidated and more holistic view at the portfolio level.**

This paper puts forth our framework on Avoided Emissions to enable institutional investors to practically and systematically quantify and evaluate economy-wide carbon reductions contributed by industries and companies, and apply this to investment and portfolio analysis.

This presents a significant advancement from current analysis that largely relies on traditional carbon emissions measures which are incomplete and, in some cases, even misleading regarding the contribution that a company makes to the low carbon transition.

There is considerable opportunity to further develop and enhance the framework given that research on Avoided Emissions is still at a nascent stage. We highlight a few areas below where the analysis can be extended, which we believe will add further value to institutional investors' application of the

¹⁹ We have made the same adjustments as we have for exhibit 6, as outlined in footnote 16.

framework across both their public and private market investments:

- **Widening the coverage of carbon-avoiding activities:** The analysis of established activities can be expanded by leveraging alternative data sources (such as products created through recycled materials) and by identifying the most promising technologies (such as green hydrogen).
- **Factoring in regional and sector variances:** The framework currently uses a single global estimate of emissions savings for each activity. The next step is to account for regional or sectoral differences which can be significant. For example, we assume renewables will replace natural gas on a global level. Using regional power generation mixes as a baseline, added renewables capacity may more likely replace fossil fuel sources in regions that are currently more carbon-intensive like the Asia-Pacific.
- **Augmenting with additional non-revenue measures:** The current framework primarily uses revenue data to capture companies' involvement in carbon-avoiding activities. There is scope to include other indicators (as corporate disclosures improve), such as capital investment or research and development spending on emission-saving technologies, to reflect companies' contributions which have not yet translated to revenue.
- **Extending from public to private markets:** The framework can be conceptually applied to private assets as more data is made available. Given that many of the emissions avoidance technologies are likely to be galvanised by private companies, the ability of the framework to capture the private market will make the analysis even more valuable to institutional investors.

We view the framework as a pivotal step to review and incorporate the value of Avoided Emissions in investment and portfolio analysis. Further research will extend the framework's functionality and the application of Avoided Emissions analysis, increasing its importance amidst the drive to meet net zero commitments.

| Appendix 1: Identifying Avoided Emissions

The following section provides more details on the framework we have used to identify the carbon-avoiding activities (sources of Avoided Emissions):

1. **We start by identifying the key sectors of anthropogenic emissions** where the total addressable market for Avoided Emissions is expected to be most financially material. 75% of emissions come from energy usage, either through electricity generation or directly in the transportation, industry and buildings sectors.²⁰ Outside of energy, waste (3%), industry (6% for non-energy emissions such as chemical reactions from cement production) and agriculture, land use and forestry (15%) are also significant emitters.
2. **We then identify economically feasible activities in these sectors** that either displace an existing, more carbon-intensive technology (such as solar displacing gas power), or change behaviour to reduce carbon-intensive activities (such as the increasing usage of videoconferencing which indirectly mitigates aviation emissions by reducing the need for in-person business meetings and business travel).

We use academic and industry sources, such as the International Energy Agency (IEA)'s Clean Energy Technology Guide²¹. We then consider whether an activity is likely to reach a significant market size from now until 2030 based on whether it meets at least one of the following criteria:

- a. **Existing cost competitiveness in abating carbon** (base case for carbon abatement costs of less than US\$100/t)
- b. **Adoption momentum** (existing or expected global market size of > US\$100 billion by 2030)

One way we have looked at cost competitiveness is through carbon abatement costs, which is the dollar cost it takes to eliminate one tonne of carbon for a particular technology or activity. We have chosen a threshold of US\$100/t, reflecting the IMF's assessment²² that limiting global warming to 1.5 to 2 degrees is unlikely without measures equivalent to a global carbon price of around US\$75/t by the end of 2030. This should require at least some developed market nations to have a carbon price of US\$100/t.

However, we cannot use cost competitiveness alone to determine economic viability, as many activities already have sizable existing markets despite being expensive if viewed only through the lens of carbon reduction.

²⁰ World Resources Institute (2020). [*4 Charts Explain Greenhouse Gas Emissions by Countries and Sectors*](#).

²¹ IEA (2020). [*ETP Clean Energy Technology Guide*](#)

²² IMF (2021). [*A Proposal for an International Carbon Price Floor Among Large Emitters*](#).

Electric vehicles (EVs) are a prime example, with carbon abatement costs exceeding US\$100/t even for short-distance urban usage. However, consumers spent US\$120 billion on electric cars in 2020²³, indicating that the market is already significant for Avoided Emissions despite the costs. We have included activities where we expect the market size to exceed US\$100 billion by 2030, reflecting the greater likelihood of financial materiality for markets at this scale.

3. **Finally, we assess which activities can be robustly mapped to revenue segments data.** Our framework predominantly uses FactSet data that attributes company revenues to around 7,000 discrete market segments, in order to map Avoided Emissions to companies. This data is readily scalable to allow us to cover a broad investment universe, although we recognise that in some instances, they are not granular enough to robustly capture all carbon-avoiding activities identified (such as products created with recycled materials, or green hydrogen-related activities).

This list of carbon-avoiding activities is not exhaustive at this time, and we expect that it will continue to grow and evolve as the industry adopts this approach more broadly.

²³ IEA (2021). *Global EV Outlook, Trends and developments in electric vehicle markets*.

Appendix 2: Emission savings by activity

Exhibit 9 shows estimates for the emissions saved by the 19 carbon-avoiding activities we have identified, compared to alternative, more carbon-intensive activities²⁴.

Exhibit 9: Estimated Avoided Emissions for 19 identified carbon-avoiding activities

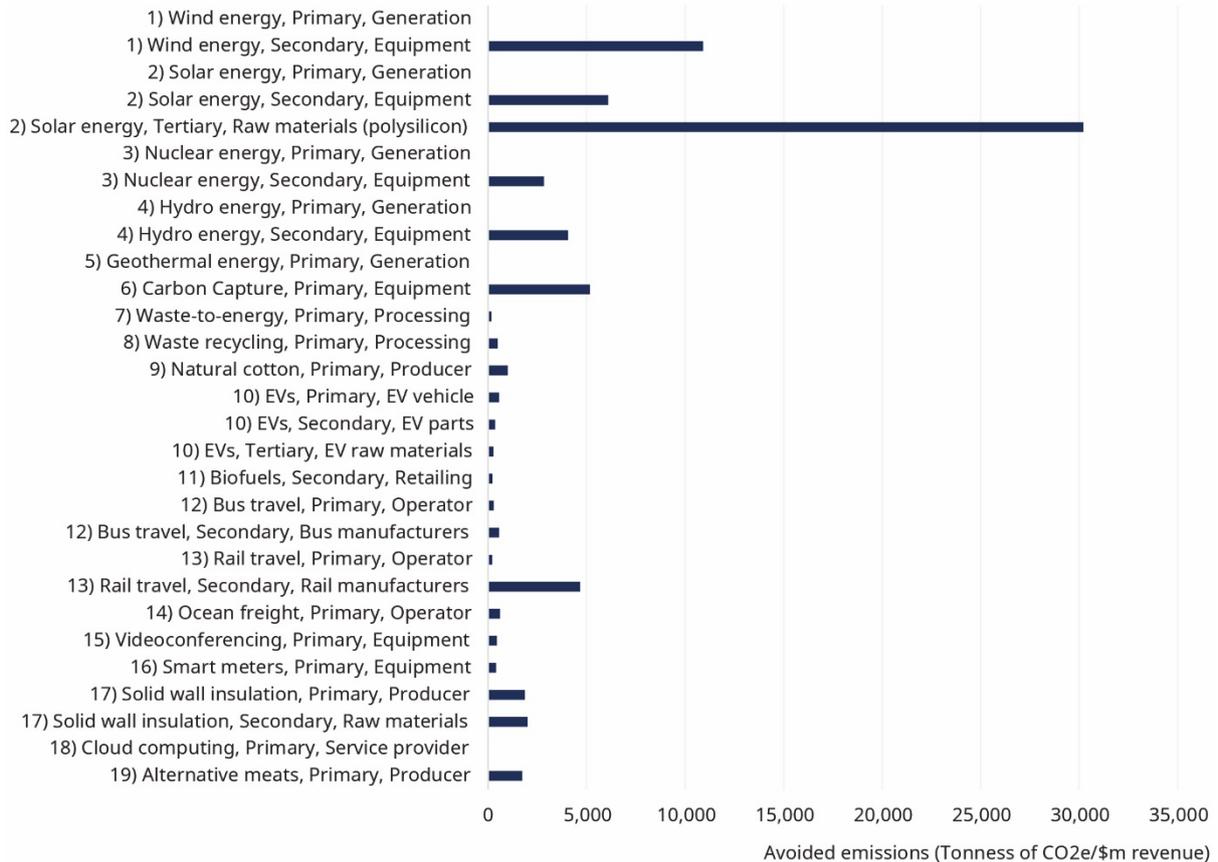
Activity	Alternative	Emissions sector	Unit	Savings per unit
1) Wind energy	Gas energy	Energy use	tCO2e per GWh	473
2) Solar energy	Gas energy	Energy use	tCO2e per GWh	414
3) Nuclear energy	Gas energy	Energy use	tCO2e per GWh	470
4) Hydro energy	Gas energy	Energy use	tCO2e per GWh	473
5) Geothermal energy	Gas energy	Energy use	tCO2e per GWh	550
6) Carbon Capture	No carbon capture	Energy use	tCO2e per GWh	1
7) Waste-to-energy	Landfill	Energy use in transport (passenger vehicles)	kgCO2e per tonne of waste processed	37
8) Waste recycling	Landfill	Energy use in transport	tCO2e per tonne of waste recycled	0.6
9) Natural cotton	Polyester	Energy use in transport	tCO2e per tonne produced	2.95
10) EVs	ICE vehicles	Energy use in transport (passenger vehicles)	tCO2e per vehicle lifetime	33
11) Biofuels	Gasoline	Energy use in transport (passenger vehicles)	tCO2e per GWh	108
12) Bus travel	Car travel	Energy use in transport (passenger vehicles)	tCO2e per million passenger km	63
13) Rail travel	Car travel	Energy use in transport (passenger vehicles)	tCO2e per million passenger km	117
14) Ocean freight	Air freight	Energy use in transport (aviation)	kgCO2e per tonne-km	0.4
15) Videoconferencing	In-person meetings	Energy use in transport (aviation)	tCO2e per teleconference room per year	114
16) Smart meters	No smart meters	Energy use in buildings	kgCO2e per meter lifetime	60
17) Solid wall insulation	No insulation	Energy use in buildings	tCO2e per installation lifetime	52
18) Cloud computing	Individual hardware storage	Energy use in buildings	kgCO2e per user per year	21
19) Alternative meats	Meat	Livestock and manure	tCO2e per tonne produced	26

²⁴ We use global average savings for simplicity but recognise that regional considerations could significantly affect estimates. The existing power generation mix in APAC is considerably more carbon-intensive, and added capacity is more likely to replace a fossil fuel source. This will also reduce the savings from EVs and other methods of electrification, given the emissions from energy generation itself. There is scope to refine future iterations of the model to capture these regional considerations.

Appendix 3: Avoided Emissions intensity by industry

Exhibit 10 lists the Avoided Emissions intensity for each industry we have identified to be part of the value chain of carbon-avoiding activities. The highest intensity is typically related to low carbon energy production, given these activities contribute most to emissions reduction overall.

Exhibit 10: Avoided Emissions intensity by industry



* Low carbon generation activity is not included as generation intensity is used instead of revenue intensity.

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