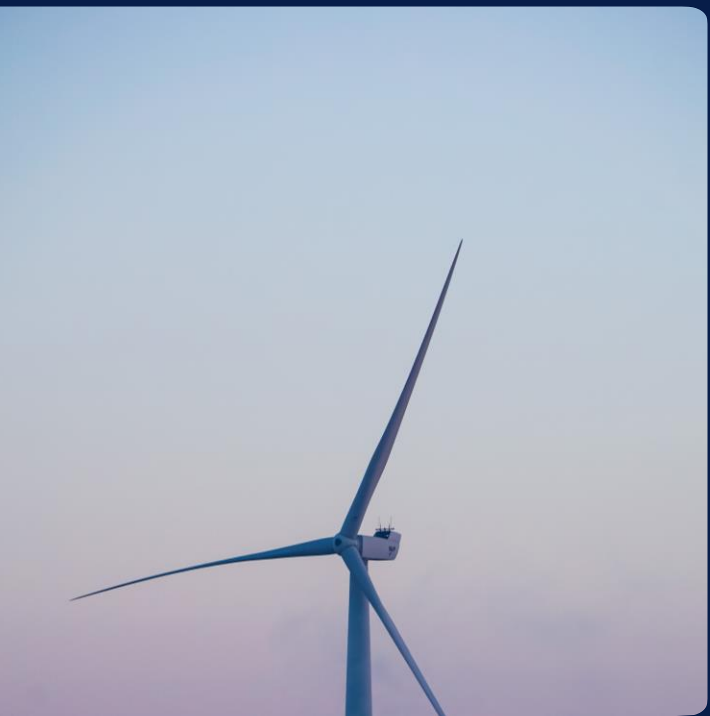
verdane

Whitepaper

Carbon emission avoidance

Developing a best-practice measurement methodology for investors



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Introduction

At our core, Verdane is a structural growth chaser. We invest in companies positioned to significantly faster than the overall economy. These market opportunities are almost enabled by technology. Crucially, we will only invest in companies aligned with the sustainable economy. The world is moving towards a sustainable future and ideally the invest in benefit from this transition, but at minimum they should not be negatively Verdane aims to be the preferred growth partner to sustainable, tech-enabled European industries supported by two mutually reinforcing structural megatrends: digitalisation and decarbonisation.

A challenge for fund managers such as Verdane is how to adequately measure and recognize the impact of our investments. This is particularly difficult for avoided emissions, which we define as reductions in greenhouse gas emissions due to the company's activities. Currently, there is no industry-wide standard for measuring avoided emissions. Instead, the market is presented with a range of approaches, each of which provides a slightly different lens on how to gauge avoidance. This presents investors with tricky choices in deciding how they should assess what they invest in.

In this paper, we publish the output of our work to develop a CO_2e avoidance methodology to support investment decisions. Since the launch of our EU Article 9 fund, Idun I, several years ago, we have gained valuable insights and experience in best practices for measuring impact. We have refined this approach into a robust, best-in-class methodology which is currently in use for underwriting impact investments across all Verdane funds. Now, we are delighted to share our new and revised framework for CO_2 avoidance that fulfills the need for an objective approach that applies across investments and funds.

By sharing, our goal is to foster broader adoption of best practices for measuring CO_2 avoidance and accelerate the transition to a decarbonised economy. We hope that sharing this methodology will help other investors measure and track their impact during (and beyond) their holding periods. We also hope to accelerate towards a common consensus or standard for measurement methods, ultimately enabling more investment into the sector. We invite collaboration and recognise that global issues simply cannot be solved in isolation.

Measuring climate impact
impact

With hundreds of billions of dollars being channelled into climate finance, private capital has a significant role to play in transitioning the global economy to net-zero emissions. However, a major task for investors is to understand the impact of funding over time, both on an individual company basis and across their portfolios. Over the past two years, we are among several organisations to have developed a methodology that can both support our own investment process and inform others as they consider their potential approaches. Along the way we have made exciting advancements and faced significant hurdles, reflecting both the complexity of the task and the relative immaturity of the topic. Here, we gather some of the key challenges that arose during the process:

Lack of a global methodology
methodology

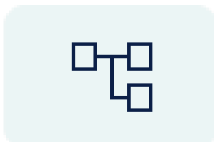
In the absence of a common approach, the assessment process is characterised by a variety of assumptions, metrics and methodologies. This inhibits comparison across companies and geographies. Still, guidance such as those proposed by Project Frame and WBCSD are gaining attention, and there are excellent contributions from entities including TPG Rise Climate, Nysnø Climate Investments, Energy Impact Partners, GA BeyondNetZero, Ara Partners, Vidia, the World Fund, and others.

Uncertain system boundaries
boundaries

System boundaries enable investors to clearly define the scope of their emissions avoidance calculations. Boundaries may be considered in terms of supply chains contexts, geography, or the function of a particular product or process. Once established, boundaries help investors define emissions factors, reflecting emissions per functional unit. For example, when considering solutions impacting the power grid, investors must set boundaries around the country's or region's grid emissions intensity. They must also decide whether to calculate on an average (e.g., the annual grid mix) or marginal (when new load is added) basis. These factors can have significant impacts on the calculation output - almost 2x for one of our portfolio companies in the renewable energy space, depending on which approach we used.

supply chain

geography



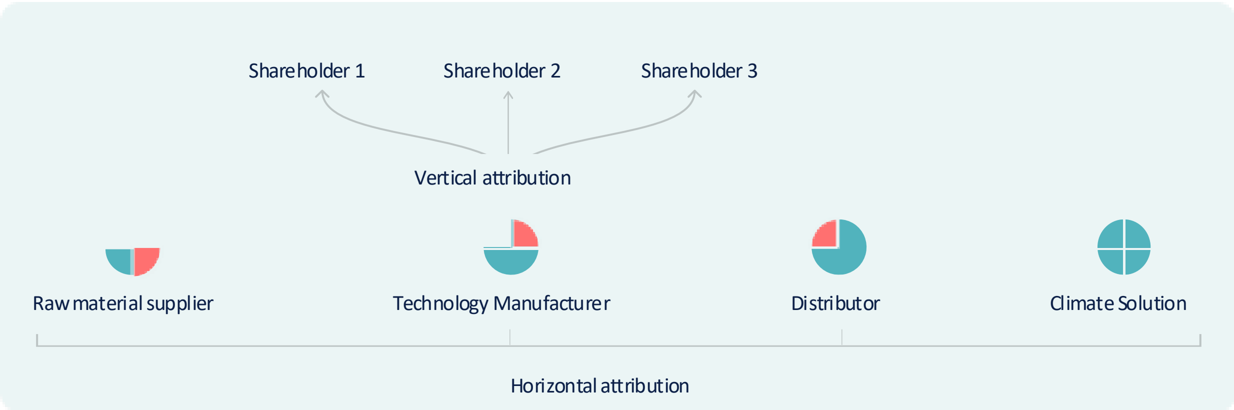
function of a product or process
process

Defining a counterfactual/reference scenario scenario and future baseline

The impact of any investment is contingent on the counterfactual: what would have happened if the if the investment had not been made, both now and in the future? For example, future grid emissions could emissions could develop in line with a pathway to net-zero by 2050 or in line with some other more more conservative pathway. From an investment perspective, a slower change scenario would lead to the lead to the potential for higher emissions avoidance, and vice versa. However, modelling potential outcomes potential outcomes is complex and data-intensive, especially in niche applications. In addition, there are there are challenges in ensuring comparability between outcomes, for example by opting for middle-ground middle-ground scenarios rather than the most optimistic or conservative scenarios.

Allocating emissions across the value chain chain

In a global economy, many products and components are the result of activities across extended value chains. For example, in the solar industry, value chain participants include manufacturers of photovoltaic panels, inverters, installers, grid infrastructure, financiers and software providers. As well as the issue of avoiding double counting, allocating emissions to these stakeholders on a fair basis is challenging.



Investment avoidance intensity intensity

Vertical attribution refers to the amount of avoidance that can be reasonably claimed by individual shareholders. A common metric is share of equity ownership. Still there are questions around how to treat debt and contingent holdings such as warrants or options, and whether a majority shareholder should consolidate all emissions, as is the case with revenues in financial accounting.

Impact timelines

Solar panels may produce renewable electricity and avoid emissions for up to 30 years, while newly built newly built factories can operate for even longer, and well beyond the average investment holding period of holding period of firms like Verdane. Thus, assumed investment timelines have a significant impact on impact on avoidance quantification. Should you calculate impact for each specific year, the period of the period of the investment, or some other timespan? Financial accounting leverages the concept of net present of net present value. Would this also work for carbon accounting?

Company data

Many companies still do not undertake lifecycle assessments (LCAs) and therefore lack solid data on their emissions profiles. Also, for some companies emissions avoidance is more about telling a story than undertaking a rigorous analytical and scientific process. For investors, this raises questions over how best to gauge emissions intensity over time.

Avoided emissions calculations calculations

Projected emissions are often calculated as a function of the company's growth outlook. Investors can reference either a business plan, an internal investment model, or some other scenario. They then need to tie the growth assessment to avoidance outcomes, both for the portfolio company and through the supply chain.

Our approach and priorities

In developing our approach to measuring avoided emissions, we took time to carefully consider the tools and consider the tools and potential data resources available, as well as our investment priorities. Our objective Our objective was to create a model that would balance the need for realistic boundaries with the ambition to the ambition to be as accurate as possible.

Our first priority was to produce an objective methodology. That meant working with independently verifiable data and reducing or eliminating the need for subjective opinion. Further, we needed to be a pragmatic methodology that could be implemented across a variety of investment scenarios, leveraging robust benchmarks and data resources.

An important condition was that our model should enable comparability. To support effective decision making, the tool needed to produce results that could be indexed to other methodologies and between investments, to the extent possible. We wanted to ensure our approach was aligned with existing reporting frameworks and principles, helping us share ideas and innovations with our peers.

We aim to work with our partners and industry colleagues towards standardisation over time, so that comparable tools can be used by industry participants to determine which investments to prioritise – akin to how the carbon abatement cost curve has supported evaluation of the cost effectiveness of different climate interventions.

Given the nascent state of avoided emissions calculation, we aimed a conservative approach, which would also mitigate the challenge of uncertain data quality. We understand that carbon abatement is tougher in some industries than others, and we wanted to reflect this in our assessments. Moreover, there is an exceptionally wide range of carbon abatement solutions and use cases, from renewable energy to recycling and waste-based animal feed. Our methodology was designed to consider as many of these as possible.

Effective and accurate measurements of investment impact must reflect changes in emissions and technologies over time. As long-term investors, we needed to ensure that the efforts of our investee companies would be reflected in our calculations, both during and after the period of our holding (for which we help them prepare as growth investors). At the same time, we wanted to be able to report progress on at least an annual basis but ideally even more frequently.

Finally, one of our core principles is transparency. As the investment world moves towards systematic support for greener technologies, we want all our stakeholders to be able to monitor our progress and help us understand where we can enhance our process.

We learned many things in the process of developing our approach. For example, we found that company that company data is sometimes limited, creating hurdles in producing accurate results. Moreover, choosing Moreover, choosing the best reference scenarios or counterfactuals can be challenging as there is no globally there is no globally aligned view of how the future is most likely to develop. We favour widely recognised recognised scenarios, such as those produced by the International Energy Association (IEA) and emissions and emissions factors from organisations such as the National Renewable Energy Laboratory (NREL). These (NREL). These have helped us develop a more objective framework that can be adopted by climate investors climate investors globally regardless of the companies they invest in.

The new methodology in practice

Through standardised modelling, market participants can obtain an objective estimate of avoided emissions. Our framework reflects the need for a pragmatic approach that can be applied across markets. Our aim is to apply a methodology that offers analytical robustness and confidence in achieving the reductions targeted, based on four key steps:

1. First, to ensure a common unit of measurement, we convert the entity or technology into a standardised functional unit, which is aligned with the financial model. For example, for a company that is a Renewable Energy developer, this would be a MWh of energy produced.

2. We calculate emissions per functional unit, based on the chosen reference scenario and and corresponding emissions factors.

3. We estimate the emissions savings the relevant portfolio company realises over the holding period and for a period afterwards, based on the growth trajectory set out in our underwriting case. Additionally, we (horizontally) attribute a share of estimated emissions based on the attribution category (see below) of the business.

4. Finally, we scale the emissions to ourselves (vertical attribution) proportional to our equity stake in line with most other methodologies.

When it comes to horizonal attribution, the specific approach to modelling of avoidance potential will depend on the type of business in question. There are two distinct groups. The first comprises direct avoiders, which either produce, install or operate climate solutions, such as solar panels or heat pumps, that directly limit greenhouse gas emissions or offer products/services, such as batteries or key components of wind turbines, that are critical to achieving the same end. The second type is enabling solutions, referring to products or services that do not directly reduce emissions but play a significant role in the process.

Beyond these basic design choices, five key parameters dictate model configuration. Here we outline our rationales and key benefits:

Conditions and system boundaries	Reference scenarios	Portfolio company	The avoided emissions calculation	Investment avoidance intensity intensity

Selected methodology

Selected (highlighted in bold)

Options: More pragmatic → More rigorous

Category	Design parameter					
Conditions and and system boundaries 1	Global Warming Potential standard	**GWP100**	GWP20			
	Timeframe for avoided emissions	10 yrs	15 yrs	20 yrs	**Holding period +5 yrs**	
	Geographic boundaries	Single country	EU	Global	**Regional split based on business plan**	
	LCA[1] system boundaries	**Attributional (focus on the direct environmental impacts of a product or process)**	Consequential (takes into account the indirect impacts that result from changes in demand or market conditions)			
	Value chain boundaries	Scope 1-2 only	Scope 1-2 and Scope 3 upstream	Scope 1-2 and Scope 3 downstream	**Scope 1-3 full inclusion**	
	CO2e emissions over time	**Constant value**	Discounting rate			
Reference scenarios 2	Reference/alternative solution logic (incumbent/status quo)	Closest possible comparable unit (e.g., other battery in case of BEV3 battery)	**Final product substituted (e.g., ICE4 vehicle in case of BEV3 battery)**	Case by case		
	Reference CO2e intensity metric at present	Industry average	Industry margin	**Case by case**		
	Reference CO2e variability	Static	**Dynamic (changing over time)**			
	Reference CO2e intensity forecast logic / sources	Top-down linear decline or exponential reduction rate	**Based on established future scenarios (e.g., IEA, where available)**	Bottom-up modeling case by case		
	Reference CO2e value	Verdane analysis leveraging peer benchmarks	**Leveraging external LCA[1] inventory databases, complement with Verdane analysis as needed**	Conduct Verdane bottom-up modelling based on external emission intensity metrics on sub-component level		
The portfolio company 3	CO2e intensity metric at present	Peer benchmark	**Bottom-up modeling based on emission intensity data**			
	CO2e intensity variability	Static	**Dynamic (changing over time)**			
	CO2e intensity forecast logic / sources	Linear decline in line with SBTi1 commitment (-4.1 p.a.)	Linear decrease in line with Verdane 60% emission/SEK revenue by 2030 target	**Based on external future projections (where available)**	Bottom-up modeling case by case	
Avoided emissions calculation 4	Accounting for some products being additional (e.g., tablet additional to/substituting laptop)	Assume 100% substitution and use as best-case scenario	Apply blanket statement substitution share for all cases	**Assume 0-100% substitution case by case**		
	Horizontal attribution of avoided emissions (% of total avoided emissions allocated to given solution in value chain)	**100% (accept double counting)**	Blanket split	TCO / CAPEX split	Expert consensus split	Case by case
	Functional unit scale-up method	Scale by revenue	**Scale by 'average units sold' (if discrete product exists)**			
	Company growth projection used	Global/regional average GDP growth	Business plan growth projection applied2	**Investment underwrite case growth projection applied**		
	Accounting for stored CO2e over time	**Count once regardless of timeframe for capture**	Apply logic of multiple capture counting linear to timeframe of storage			
Investment avoidance intensity 5	Vertical attribution of avoided emissions (% of total avoided emissions allocated to given shareholder of company)	100% (accept double counting)	**Allocate by equity share based on equity stake incl. non-expired call options**	Split by total funding share including debt		
	Assumed development of future avoided emissions at point of exit	Assume no future avoided emissions	Assume future yearly avoided emissions remain the same as that of exit year	**Assume future yearly avoided emissions in line with investment underwrite case**		

1. Life Cycle Assessment; 2. World Business Council for Sustainable Development; 3. Battery Electric Vehicles; 4. Internal Combustion Internal Combustion Engine 5. Science Based Targets initiative; 6. Supplemented with proxy data from external reference scenarios reference scenarios (e.g., EU PV capacity projection) where needed

Source: Avoided emissions framework/guidance developers (e.g., Project Frame, Schroders, WBCSD, WRI); Expert interviews; Team interviews; Team analysis

1. Conditions and system boundaries

Greenhouse gases are generally measured by global warming potential (GWP), which represents how much represents how much thermal radiation the emissions of one ton of gas will absorb during a given period, given period, relative to the emissions of one ton of carbon dioxide. CO2e, by definition, has a GWP of 1 GWP of 1 regardless of the time period used, because it is the reference[7].

GWP is calculated for a specific time span, most commonly 100 years, which is around the period CO2e will period CO2e will persist in the atmosphere. The choice between GWP20 or GWP100 often doesn't make a doesn't make a significant difference as CO2 (the most common GHG) is 1 in either frame. However, it can However, it can make a significant difference when looking at cases focused on methane: while methane is methane is shorter-lived in the atmosphere, it has significantly higher potency (84-87 x CO2 in GWP20). GWP20). Consequently, some cases may be significantly impacted by this choice, such as those in the in the agricultural and waste handling sectors. For most cases we will use GWP100, but we may consider consider GWP20 in certain exceptional circumstances (or if there is increased momentum towards its use). towards its use).

A critical consideration when determining avoided emissions for a company or portfolio is how to estimate the relevant timeframe. We will use our holding period plus five years, because it strikes a pragmatic balance between near-term impact and decarbonisation beyond the investment period (where uncertainty increases). There are several reasons for this decision. We want to ensure that we identify companies that have significant short term impact, particularly within our holding period, given the urgency with which emissions need to be reduced. However, we also want to account for companies with 'blue sky' potential, where we see opportunity for outsize returns and hold the investment for a longer term. If we didn't account for any impact beyond our initial holding period, then we could disincentivise significant capital expenditures late in the holding period with companies that have yet more growth potential. Finally, accounting for some impact beyond our holding period has some parallels to accounting approaches to financial valuation on exit. For example, a discounted NPV converts future revenue and profits into a valuation today.

We expect the science around timeframes will continue to evolve as insights around impact of technologies and processes develop. Therefore, we look at both the lifetime impact of installations and "in-year" emissions avoidance. For example, a solar deployment would be viewed from the perspective of lifetime emissions avoidance in the year of deployment during holding period, while processes such as fish waste recycling would be viewed as a function of in-year emissions avoidance from processed materials and lifetime emissions from the factories built during the holding period.

7. Understanding Global Warming Potentials, The United States Environmental Protection Agency, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

A key area of consideration relates to the boundaries the model should incorporate. The most obvious is obvious is geographic boundaries, which could be based on a company's country, regional or
or
global operations, or a regional split indexed to our underwriting case. We chose the latter, which we believe provides the most accurate and relevant perspective. The reason for this is that the counterfactual may be significantly different depending on the region.

For example, grid emissions are significantly lower in Northern Europe than in China – or consider how in the US astroturf is often landfilled, while in Europe it is more frequently incinerated. Accounting for these local differences is crucial for a more accurate estimate.

Another type of boundary relates to which carbon emissions to include in estimations. Should we only include direct scope 1 emissions (of both the solution and the counterfactual), or also look at scopes 2 and 3? This set of criteria determines which unit processes (such as manufacturing or transportation), inputs, outputs, end-of-life and impacts are considered in an LCA. Here we choose the most exhaustive, which are Scope 1, 2 and 3 emissions both upstream and downstream. We must also choose whether to consider the LCA in an attributional approach, focusing on direct environmental impacts, or consequential approach, taking into account the indirect effects of market conditions. For example, the land use change effects that may occur in other regions due to shifting agricultural practices in one region. We focus on the former, which is in line with World Business Council for Sustainable Development (WBCSD) standards.

2. Reference scenarios

One of the challenges of modelling the impacts of greenhouse gas emissions is the high number of climate models available, their inherent complexity, and the lack of alignment on which scenario is 'right'.

In choosing reference scenarios, a key element is the solution logic. This refers to the basis on which the solution is judged to avoid emissions. Here we might consider either an alternative abatement technology, for example comparing one lithium-ion battery with another, or the status quo product (representing the average product across the industry) that is substituted. We opt for the latter; for example, the emissions that would have been produced by an internal combustion engine if a battery electric vehicle did not exist. This is in line with standard industry approaches, such as those recommended by WBCSD and Project Frame. While we acknowledge that there often may be a few competing abatement technologies or competitors offering the same technology, what is most important is that the solution replaces existing technologies. For example, even if there are different manufacturers of heat pumps, they will likely replace gas boilers and it is this impact we want to identify.

Carbon intensity metrics refer to the amount of greenhouse gas emissions per unit of some activity or output. To gauge intensity for specific companies, we may apply an industry average, or industry margin, depending on which most closely resembles reality. For example, when looking at renewable energy generation, we will most likely choose the marginal grid emission intensity. The reason is that renewable energy such as wind or solar often has very low marginal cost, so they will be one of the first sources of electricity to be called upon, meaning it shifts out the most expensive generation capacity (i,e., the capacity at the margin), which often also is more polluting than the average. We also assume that reference CO2e metrics are dynamic rather than static, where possible basing our forecasting logic on established scenarios such as those published by the IEA.

When it comes to reference emissions intensity data, we leverage LCA inventory databases such as ecoinvent, which we compliment with our own analysis, optimising our use of external resources and internal expertise. In addition, as we conduct more avoided emissions estimates we are building up our database of internal scenarios, reference cases, and high-quality research that we can leverage for future cases.

3. The portfolio company

Individual companies will present unique emissions trajectories based on their business models and models and circumstances. Consequently, when modelling CO2e intensity over time, it is vital to tailor to tailor estimates to the company . We try to avoid peer or industry benchmarks if possible (e.g., average LCA (e.g., average LCA emissions of rooftop solar) and instead model the company's situation based on its own based on its own data and targets, where available. We prefer dynamic over static assumptions. When it assumptions. When it comes to forecasts, we prefer to use a company's own climate reduction plans, if they reduction plans, if they exist. Where they do not exist, we apply conservative external projections. projections.

4. The avoided emissions calculation: a horizonal lens

We recognise that the path to zero emissions is not easy; there are many actors across the value chain that contribute to realising avoided emissions. However, exactly determining what share of 'final emissions avoided' should be assigned to each step of the value chain is challenging and subjective. It also does not take into account, for example, the binary effects of different technologies. No electric vehicles would exist without batteries or chargers, even if both are only a part of the solution. This would speak to accounting for full avoided emissions for the final product, for individual parts of the value chain, which to some extent is how scope 3 emissions functions today.

However, not every part of the value chain is 'equal' in its contribution, for example the nuts and bolts used in an EV are not unique, differentiated or as critical to the solution as the batteries used. We have spent significant time trying to identify best practice or potential methodologies to address this problem, spanning full accounting of impact, share of value add, and set allocation percentages. In the end, we have identified distinct categories of 'direct avoiders' and 'enablers', helping us balance and take into account different situations and business models.

Direct avoiders either directly avoid emissions through their operations (e.g., a solar PV farm generating clean electricity or a technology increasing the uptime of wind turbines) or are essential to realising these emissions (e.g., an EV battery manufacturer).

For these direct avoiders we attribute 100 percent of the CO2e emissions avoided. For enablers we take a different approach. Here we take a cost perspective, evaluating the share of the total cost of the final carbon avoiding product/service the company in question represents. We acknowledge that there is double counting here, and we will continue to evaluate and push for better standards.

5. Investment avoidance intensity: a vertical lens

We believe the most comprehensive framework will include vertical attribution of avoided emissions, which is the proportion allocated to individual shareholders. We allocate by equity stake, adjusted over time to include future options or funding rounds for additional equity. This is in line with industry standards. As we invest for long-term impact, we assume continuing and rising impact beyond our period of ownership in line with our underwriting. This is estimated on entry and updated on exit. The calculation is based on growth forecasts in our underwriting investment case.

Looking ahead: collaboration will be key

We are proud of our efforts to build a methodology to calculate avoided emissions. Through the efforts of our colleagues and collaboration with our peers, we believe we have created a blueprint that contributes to global best-in-class practice. We also recognize that we all have a long way to go. Methodologies will evolve as we see improvements in data collection, scenario analysis and common standards. As we continue to invest in companies that propel us toward a better future, we will monitor developments, improve our models and share our learnings. We also hope to see higher levels of cooperation across the market, and encourage all fund managers to connect, discuss and collaborate. Through partnership, we believe the industry can build the businesses of the sustainable future and help the world win the battle against climate change.

Reach out to our Sustainability and Decarbonisation Decarbonisation team

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Case study | Solar-as-a-Service solution: Our four-step modelling approach in action

UrbanVolt is a climate tech company that helps business customers make a cost-effective transition to clean energy with their unique 'Solar-as-a-Service' business model. UrbanVolt's model involves financing, installing, and maintaining solar panels for customers, enabling the customer to buy solar-generated power at a discount to grid-based electricity providers' rates.

1. In the first step of our four-step approach we converted the power managed to the functional unit for GWh produced. We posited growth beyond the investment period based on an IEA estimate of photovoltaic (PV) growth combined with our own knowledge of the company.
2. We then calculated the avoided emissions per functional unit and compared it to a projected grid emissions counterfactual based on the marginal grid emission factor in the European Union, given the interconnectedness of the grid in Europe (rather than local emission factors for e.g. Ireland). We assumed that PV lifecycle emissions start at 43 gCO2e/kWh and fall by ~3 percent per year, based on IEA forecasts.
3. In the third step, we attributed 100 percent of the emissions avoided, as this is a "direct avoider". We estimated lifetime emissions avoided for the installations deployed during the holding period and for the five years following given the fact that PV installations are long lived and the majority of the cost is represented by up front CAPEX and development.
4. Finally, in the fourth step, we calculated our own attribution, based on an assumption that our credit is proportional to our equity stake in any given year.

Note: This case study is simplified for illustrative purposes.